The Identification *of* Jewish Patterns *of* Food Preparation *and* Consumption: *a* Zooarchaeological Approach *to the* Medieval *and* Early Modern Evidence *from* Central-Eastern Europe

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To my beloved mum, who waited for this thesis

Ewa Lisowska
1947–2014

of blessed memory

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Abstract

The thesis addresses the question of detecting traces of Jewish presence in the zooarchaeological record. It discusses the cultural aspects of meat provisioning adopted by the medieval and early modern Jewish communities in Polish and Czech lands. Two indicators of Jewish presence in zooarchaeology are discussed: the presence/absence of the bones of non-kosher animals (especially pig) and the hindlimbs of cattle and caprines. The evidence suggests that both indicators can successfully contribute to detecting the Jewish footprint in animal bone assemblages. However, they are not as straightforward as previously thought, and need to be supplemented with other lines of evidence, as well as interpreted in their broader archaeological and historical contexts. Most crucial is a thorough analysis of the religious, historical, and ethnographic aspects of porging practice — a butchery activity essential for producing kosher meat — and its detection on bones. The study presented here reveals the occurrence of porging on bones from the Middle Ages and early modern period, and discusses their possible uses, including a particular culinary tradition of a Sabbath stew, called tsholnt. Further zooarchaeological analyses show regional and temporal differences in Jewish meat provisioning and consumption connected to wealth and possibly local traditions. Comparisons with Christian assemblages indicate that some of the Jewish patterns of meat provisioning were, in fact, common to the broader society. Nevertheless, the Jews appear to have been provisioned with animals of lesser quality, probably as a consequence of the inferior role placed upon them by the Christians. The thesis also discusses the issue of observance and transgression of the dietary rules in the Middle Ages and early modern period and their impact on Jewish identity, as demonstrated through zooarchaeological analysis.

Key words: *zooarchaeology, taphonomy, butchery studies, ethnozooarchaeology, Jews, religion, Judaism, Poland, Silesia, Czech Republic, Bohemia, Middle Ages, early modern age.*

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Glossary

aron kodesh a receptacle in a synagogue used to store the scroll of Torah. 73

bedikah the process of inspection of the carcass in order to find lung lesions which would prevent the meat from kosher consumption. 225, 226, 296

chanukiah the candelabrum lighted during the holiday of Hanukkah. It has nine branches.. 75

chelev some fats of the domestic cattle, sheep and goats forbidden for consumption. Located mostly in the hindquarters . 226, 230

dreidel a small four-sided top used to play during the holiday of Hanukkah . 40

gid hachitzon one of the nerves in the hindlimb of an animal forbidden to be consumed in some traditions. 219, 221, 226, 236

gid hanasheh one of the nerves in the hindlimb of an animal forbidden to be consumed . 219, 220, 225, 226, 228, 230, 236

Golem in Jewish folklore a clay effigy brought to life by a rabbi to protect the community. 69

Kalisz Privilege a privilege granted by King Bolesław V to the Polish Jews providing some forms of autonomy and personal freedom. 54

kareth a severe and ritual punishment in Judaism. 301

kashrut a set of religious dietary laws. 265

Khmelnytsky Uprising a Cossack rebellion against the Polish–Lithuanian Commonwealth in 1648–1657. It resulted in countless deaths of the local Jewish populace. 34, 36

Magdeburg law a form of city law granting a it a set of privileges. 34, 52, 53, 61

menakker see *porger*. 224, 264

Passover (Heb. פֶּסַח, Pesah) a spring festival, lasting seven days in Israel and eight in the Diaspora. It commemorates the Exodus from Egypt. On the first night, a ritual feast called Seder is held (Kanof, 2007). xxx, 224, 236, 237, 258, 309

pogrom a mob attack against the local Jewish population of their properties. 36, 55, 68

porger a religious butcher trained in the process of *porging*. 304

porging a butchery process necessary to making meat kosher during which forbidden fats, nerves, and veins from the hindquarter are removed. 188, 190, 191, 194, 197, 200, 202, 203, 205, 207, 214, 216, 218, 220, 276, 295, 297, 304, 309

qahal a largely self governing Jewish community. 31, 35, 36, 54, 56, 62, 63, 264

Seder (Heb. סֵדֶר) ritual feast marking the begenning of the holiday of Passover. It includes a special Seder plate containing six symbolic foods, including Zeroa (Kanof, 2007). xxx, 236, 309

shechita a set of rules governing the religious slaughter. 224, 268, 296, 297, 304

shoychet a religious butcher responsible for the slaughter. 63, 224, 304

shtetl a small town in Eastern Europe with a large Jewish community. 32, 35, 262

treyf meat which is not kosher. 11, 12, 25, 300, 303, 305, 306

tzadik a Judaic "righteous man" and a sage. 63

yeshiva a religious academy for Talmudic learning. 54, 303, 307

Zeroa (Heb. זרוֹע) a roasted bone, often lamb shank bone, included in the Seder plate as a reminder of the paschal lamb and the festival offering in Temple times (Kanof, 2007). xxx, 236, 237, 258, 309

Acronyms

Chapter 1

Introduction

This thesis is a product of my long-lasting interests in Jewish culture and zooarchaeology. The moment when I, a prehistoric zooarchaeologist, realised that I can merge those two seemingly different fields was truly life-changing. I can just hope that the reader will have at least half as much pleasure in reading this book, as I had writing it.

1.1 Research aims and objectives

The main aim of this thesis is to explore the under-researched topic of Jewish presence as reflected in the archaeological animal bone record. Firstly, the research will propose an approach to the detection of faunal assemblages originating from Jewish settlements. Secondly, it will apply such an approach to investigate aspects of Jewish life in medieval and early modern Central/Eastern European towns, and integrate it with historical evidence. Specifically, several research questions are explored:

- Can patterns of Jewish food consumption be identified in the zooarchaeological record? In other words, can assemblages from Jewish sites be distinguished from contemporary ones deriving from the activities of other ethnic or religious groups? To provide the method for recognising this in the bone record, religious rules of butchery will be compared to data provided by actualistic studies of modern Jewish butchery. The research will take into consideration taxonomic and body part representations, and patterns of butchery marks.

- Did the religious practice of food preparation and consumption of the Jewish people differ geographically, and how did it change over time until the present day? Is it possible to investigate this through the integration of zooarchaeological data and historical texts? Does the zooarchaeological record provide evidence that is not documented in the texts? The study will analyse animal bones from several sites across Poland and the Czech Republic, and compare the results to contemporary and geographically relevant historic texts.

- Will the zooarchaeological record provide insights into differences in livestock management, meat consumption, culinary preferences, and social and economic status of Jewish versus Christian communities? Will it provide information on inter-communal meat trade and hence Jewish–Christian relations in different cities?

1.2 Summary of chapters

Chapter 2 is aimed to familiarise the reader with the Jewish religion and to help them understand the dietary restrictions governing the life of an observant Jew.

Chapter 3 presents the body of zooarchaeological research previously done on Jewish archaeological sites. It starts with summarising the zooarchaeological indicators previously used to identify Jewish presence at those sites. Then, it presents the research done on sites in Ancient Israel, and European and American Jewish Diaspora.

Chapter 4 introduces five archaeological sites in four cities which are the subject of the current research. Each part begins with the summary of the local history of the city and its Jewish residents. Then, it presents the results of the archaeological excavations and research on the sites.

Chapter 5 discusses the zooarchaeological methods and techniques used during the analysis.

Chapter 6 demonstrates the main body of data and the analyses of animal bones from the sites.

Chapter 7 focuses on the butchery process of porging. It presents the detailed descriptions of the relevant animal anatomy and the religious rules. It discusses the ethnographic research done to determine the patterns of porging on bones and shows the zooarchaeological evidence corresponding to it.

Chapter 8 contextualises the gathered data in a wider geographical and historical context.

Chapter 9 proposes the expanded indicators to be used in zooarchaeological research of Jewish sites. It also discusses the role of pork abstinence and consumption for the identity of the medieval and early modern Jews, the trade relationships with Christians, and some local culinary traditions.

Chapter 10 shows directions for the future research.

Chapter 2

Judaic laws of slaughter, butchery, and consumption of meat

Judaism is one of the oldest religions; it derives from the Bible and was enriched by many subsequent writings. The very core of Judaism is Torah (תורה), 'the Teaching', comprised of Written Torah and Oral Torah. The term Written Torah refers to the *Tanakh* (תנייך), the Hebrew Bible, by Christians known as the Old Testament, which was written over the course of a millennium, from approximately the twelfth century BCE to the second century BCE (Brettler, 2005). The *Tanakh* has three parts: the *Torah* (another meaning of this name, this time with the definite article), widely known by its Greek name Pentateuch or the Five Books of Moses; *Nevi'im* (נביאם), the Prophets; and *Ketuvim* (כתובים), Writings. The Oral Torah is the exegesis of the *Tanakh*, believed to be passed orally by God to Moses on Mount Sinai and is unique to Judaism. It is believed to be passed by generations, unchanged, until being written down as the Talmud (תלמוד), books of written oral tradition of Judaism. The foundation and core text of the Talmud is *Mishnah* (משנה), authored by a dynasty of scholars known as *Tannaim* (תנאים) in the Ancient Israel between first and the beginning of third century CE (Johnson, 1987). The second part of the Talmud is *Gemara* (גמרא), commentary to the *Mishnah*, which was written in subsequent centuries (3rd till 5th century CE) in two centres: Palestine and Babylonia; by scholars called *Amoraim* (אמוראים). Over the course of subsequent centuries, the Talmud was widely discussed by Jewish scholars in the Middle East and Europe, with notable examples of Rambam alias Maimonides (Rabbi Moshe ben Maimon, 1135-1204 CE) and Rashi (Rabbi Shlomo Yitzchaki, 1040-1105 CE)

(Johnson, 1987). They both left important and significant commentaries which were included in subsequent published versions of the Talmud.

The Talmud widely discusses the writings of the *Tanakh*. Guidelines and rules of pious life are scattered through the *Tanakh*; the Talmud puts them in order and covers them with extended discussions on reasoning behind them. These rules form the religious law of Judaism, *Halakha* (הלכה). The Talmud is, however, exceptionally vast, and the rulings of the *Halakha* are not easily accessible. The practical areas of the Jewish law were later summarised in legal code books. One of the most important ones was the early fourteenth century *Arba'ah Turim* (also known as the *Tur*) by Jacob ben Asher, which was expanded with comprehensive commentary in 1550s by Joseph Caro in his *Beit Yosef*. The latter book was a basis of the most influential code of the Jewish law written by the same author: the famous *Shulhan Arukh* published in 1565 (Rabinowitz, 2007). Caro was a Sephardi Jew, and the laws and customs summarised in the *Shulhan Arukh* are native to the Sephardi culture. The adjustment of those rules for the Polish and German Ashkenazi culture was published in *HaMapah* written by Rema (Moses Isserles) in the 1570s in Cracow, Poland. The published versions of the *Shulhan Arukh* include comments by both these scholars.

2.1 The *Halakhical* regulations of meat consumption

> "Separate thyself from the nations, and eat not with them"
>
> *Jubilees 22:16*

Judaism has one of the strictest set of food regulations amongst all religions. Although reasons for the emergence of such strict rules are under dispute (see discussion in Hesse, 1990; Kolska-Horwitz et al., 2017), it is clear that one of the reasons of their existence is to separate the religious Jews from other groups to maintain the cultural identity of the Jewish people. Food is one of the things bringing people together. Commensal dining is a powerful tool which can overcome differences and blur the boundaries between people. Whereas commensal dining shears walls, exclusion from it erects them (see Dietler, 2001). This is hardly a new discovery, but rather common knowledge. Restricting Jews from dining with non-Jews was an important component of a larger set of regulations intended to prevent mingling and intermixing with non-Jews, and blurring out the tradition, the religion, and the culture (see Cooper, 1993, p.30–31).

The dietary regulations of the Judaism are divided to a few components. *Kashrut* (כשרות) is a set of regulations that specifies which food, and in case of animals, which species and parts thereof are kosher (כשר), which means permitted (literally 'fit') to consume. To be kosher, animals should be slaughtered and prepared according to a set of rules called *Shechita* (שחיתה). The highly detailed rules of *Kashrut* and *Shechita* have been summarised for English speakers in various research publications related to food technology, often by religious authorities (e.g. Berman, 1941; Grunfeld, 1972; Levinger et al., 1976; Regenstein and Regenstein, 1979; Cohn, 1981; Blech, 2004; Rosen, 2004). Also, the very roots of those rules, the Bible and *tractate Chullin* from the Babylonian Talmud, as well as the codes of the Jewish law, such as *Shulhan Aruch*, are available for the Anglophone readers as open source on various easily accessible websites, and in print (e.g. Lach, 2011). Here, I will describe only the rules that are relevant to the undertaken zooarchaeological investigation.

2.1.1 *Kashrut* — the permitted and the banned

"Thou shalt not eat any detestable thing"

Deuteronomy 14:3

God is believed to restrict his choice of the nations to Israel, and Israelites are told to restrict their choice of consumed animals only to those permitted by him (Milgrom, 1990). The importance of dietary laws in Judaism is believed to be essential, and abolishing them is believed to abolish the distinction between Jew and non-Jew (Milgrom, 1990).

2.1.1.1 Mammals

The original prescriptions providing the rules in regard to species permitted for consumption can be found in the Bible, in books of Leviticus, chapter 11 and Deuteronomy, chapter 14. Amongst the land mammals, any animal which has cloven hooves (that is an artiodactyl) and chews its cud (that is a ruminant) is allowed to be consumed (Leviticus 11:3-8, Deuteronomy 14:4-8). These rules are the reason for the well-known abstinence from pork consumption amongst the

Jewish people. Pigs, and the wild boars for that matter, although possessing cloven hooves (being artiodactyls), do not chew their cud (are not ruminants), hence are deemed unclean (Leviticus 11:7, Deuteronomy 14:8). These prescriptions make species that do not possess both of these traits not kosher. This is for instance the case for rabbit, hare, and hyrax which do not have cloven hooves, although, were thought to chew their cud (Cohn, 1981). In addition, camels and llamas are deemed not to be kosher, though they are ruminants and even-toed (artiodactyl), but their feet have a broad skin pad, fused at the back of the sole, which makes their hoof appear undivided. It is worth pointing out, that the horse, consumed in many European countries, is also not kosher, because it does not have any of the traits of the kosher species. Leviticus (11:27) additionally bans species which possess paws instead of hooves, like carnivores. The Babylonian Talmud also states that if one finds a stray animal, and is not certain about its hooves — for example, because they are not visible to him — the absence of the upper front teeth will indicate that it is kosher, because ruminants generally lack upper incisors (tractate Chullin 59a).

The names of kosher mammals are listed in Deuteronomy (14:4-5) (see Amar et al., 2009). Ten species are named, three of which are cattle, sheep, and goat, but the identification of the remaining seven is ambiguous, as different translations and versions of the Bible list different species of bovids - gazelle, antelope, oryx, ibex - and cervids, generically referred to as 'deer'.

Zooarchaeological research on ancient Levantine sites has made an important contribution to the precise taxonomical identification of these species (Amar et al., 2009). Based on the occurrence of specific species in the archaeological data, the authors suggested that the remaining seven names of kosher animals can include actual eleven taxa: fallow deer (*Dama mesopotamica*), roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*), mountain gazelle and dorcas gazelle (*Gazella* sp.), hartebeest (*Alcelaphus buselaphus*), Nubian ibex (*Capra ibex nubiana*), Arabian oryx (*Oryx leucoryx*), aurochs (*Bos primigenius*), mouflon (*Ovis aries*) and wild goat (*Capra aegagrus*) (Amar et al., 2009). This list is not complete, and any species which does meet the previously stated criteria can be considered as kosher, like the giraffe, which has recently been confirmed as being permitted (Zivotofsky et al., 2003).

2.1.1.2 Birds

Unlike mammals, the consumption of bird species in the Bible was not governed by a general rule. Instead, the Bible (Leviticus 11:13-19 and Deuteronomy 14:11-18) list 24 'species' (term not used in the biological meaning) which are not permitted for consumption, and states that any "clean bird" is allowed (Deuteronomy 14:11), which is usually interpreted that basically any other bird species can be kosher (Zivotofsky and Amar, 2003). In later oral tradition (Mishnah, Chullin 3:6), the rabbis defined four features, helpful in identifying kosher species: (1) predators (birds of prey and scavengers) are not kosher, and birds with an (2) 'extra toe', (3) crop, and (4) gizzard that can be peeled, are kosher (Zivotofsky, 1998). These features were often debated in the rabbinical literature, especially the first trait, where the definition of a 'predator bird' was discussed (Zivotofsky, 1998).The ambiguity of those rules is partly the reason that local traditions are important when determining whether a bird species is kosher. According to Rabbi Shlomo Yitzchaki, the twelfth century commentator of the Talmud: "no bird should be eaten unless there is a mesorah that it is a kosher species" (tractate Chullin 63b; Zivotofsky and Amar, 2003). The oral tradition, mesorah (מסורה), is in fact the key factor that allows consumption of specific bird species, which can vary between different Jewish communities, based on their geographic, ethnic and religious backgrounds. If a bird was consumed by this community in the past, it is kosher; if not, perhaps because the species is newly introduced to the particular community, it is not considered to be kosher. This means that one species can be forbidden to be consumed by observant members of one community and permitted by another. Commonly permitted species include chicken, goose, dove, duck, pigeon, and their close relatives (Greenfield and Bouchnick, 2010). It is worth noting that the first Jewish settlers to reach the American continent, were introduced to several new species, for example turkey, and consuming them was not yet a mesorah, but it became one, making them kosher (Zivotofsky, 1998; Zivotofsky and Amar, 2003).

2.1.1.3 Fish

There are very specific rules that indicate which fish species can be considered kosher (Cohn, 1981, p.55). A kosher fish has at least one fin and one scale (Leviticus 11:9-12 and Deuteronomy 14:9-10). Rabbinical literature states that scales have to be visible to the naked eye and easy to remove, excluding all but cycloid and ctenoid scales (Cohn, 1981). Other marine animals, such as molluscs, crustaceans or sea mammals cannot be eaten. Amongst the most commonly consumed fish in Europe, those permitted are bass, carp, cod, perch, salmon, trout, pike, most tuna species, herring, tilapia, and mackerel. The Talmud (tractate Chullin 63b) lists over 700 species of fish not considered to be kosher, including catfish and eel. It is worth noting that the classification of sturgeon as kosher is debatable. It possesses enlarged scales which form scutes, but they are not easily removable. This feature makes the sturgeon, as considered by the contemporary followers of Orthodox Judaism, not kosher, whereas some others permit it (Cohn, 1981).

2.1.1.4 Other species

The Torah prohibits the consumption of "all winged swarming creatures that go on all fours" (Leviticus 11:20) and "small creatures that swarm on the ground" (Leviticus 11:29), which includes small mammals, reptiles, amphibians, insects (Leviticus 11:29-30), and, in general, everything which is not permitted by previous rules. Amongst insects, however, four species of grasshoppers are kosher, and listed by their name in Leviticus 11:21-22 (Greenfield and Bouchnick, 2010).

2.1.2 *Shechita* — the rules of slaughter

Shechita is a set of rules governing the slaughter and preparation of meat of kosher mammals and birds. The biblical origin of shechita is found in Deuteronomy 12, 21: "thou shalt kill of thy herd and of thy flock, which Hashem[1] hath given thee, as I have commanded thee" (Orthodox Jewish Bible). The last part of the verse implies the existence of prescriptions of the act of killing animals given by the God, but they are not specified anywhere in the five books of the Torah. Instead, these prescriptions were kept in the Oral Law, and described in the Talmudic tractate Chullin (3rd-5th century CE) with the extensive commentary by Rashi (late 11th-early 12th c.), later summarised in codes of Jewish law, the twelfth century Sefer Yad ha-Chazaka by Maimonides, and the sixteenth century Shulhan Aruch (Asz, 1936; Berman, 1941; Cohn, 1981, p.57).

These rules were made to ascertain the application of the laws of Kashrut, as presented in the Torah, and must be applied to every animal slaughter (Cohn, 1981, p.57). The rules of shechita tend to be very precise and alterations and

[1] title used to refer to God

minor mistakes can cause the whole animal carcass deemed unclean, also referred to as treyf. One of the reasons for their strict observance is the well-being of the animals, because Torah commands the slaughter of animals with a humane and least painful death, which is believed to be shechita (Asz, 1936; Berman, 1941; Levinger et al., 1976). The other reason is that the consumption of the forbidden parts of the animal is believed to be a serious sin — possibly more serious than eating pork — punished with 'the extermination of the soul': kareth (כרת), a punishment as serious as Hell (Cohn, 1981, p.75). The forbidden parts include blood, mentioned in the books of Leviticus (3:17, 17:13) and Deuteronomy (12:16, 12:23, 15:23), some fats called chelev (חלב), and some nerves.

The butcher who performs shechita is called a shochet or shoychet (שוחט). It is often required that it needs to be a male. He must be an observant Jew, with good knowledge of the halakhical rules of kashrut, and highly trained in anatomy and practical butchery (Berman, 1941, p.83; Cohn, 1981, p.58; Rabinowitz, 2007, p.434). Moreover, he must not be visually impaired, affected with mental disorder or learning disability or be a minor (tractate Chullin 2a). Until the Middle Ages, the shoychet was not a fixed occupation; any adult who fit the halakhical description could perform the slaughter (Rabinowitz, 2007, p.434). This had changed around 1220 CE, when a synod of rabbis convened in Germany ordered that no one is allowed to slaughter without a license (called kabbalah) issued by a rabbi and obtained after an examination (Berman, 1941, p.85; Rabinowitz, 2007, p.434).

The main part of shechita is the slaughter (tractate Chullin 9a). This needs to be done in a very precise fashion (see Asz, 1936; Berman, 1941; Levinger et al., 1976). The animal must not be stunned, hurt, or unconscious before the slaughter which is important because this is believed to ensure rapid death and facilitate the successful removal of the blood (see Asz, 1936; Berman, 1941; Levinger et al., 1976). This requirement consequently makes animals killed during hunting not kosher, but consumption of meat of wild animals such as deer is permitted when the animal was slaughtered during shechita. The slaughter needs to be carried out using a long, extremely sharp knife called challaf (Cohn, 1981, p.60). This knife is only used only to kill the animal, and it needs to have a blunt end, to prevent accidental stabbing. An animal can stand, or lie on its back (the latter seemed to be preferable in pre-holocaust Poland; see Asz, 1936), and while its neck is being tightened, the shoychet makes a single cut with the challaf, back and forth, transversely on the ventral side of the neck. This cut needs to be very precise; hesitation is strictly forbidden, as well as pausing during the cut, pressing the knife against the neck, the accidental slipping of the blade, the tearing of the flesh with a nicked knife, and burying the blade too deeply. The cut can be made on any part of the neck until the rostral border of the thyroid cartilage (Lach, 2011), preferably between the first and the second ring of the trachea (Cohn, 1981, p.60; Greenfield and Bouchnick, 2010). The cut is meant to rapidly severe skin, muscles, common carotid arteries, jugular veins, nerves and, most importantly, trachea and oesophagus (tractate Chullin 9a; Asz 1936). In modern shechita, touching the bone during this cut makes the carcass treyf (Greenfield and Bouchnick, 2010). It is not touching of the bone per se which is forbidden, but rather nicking the knife as the result of it[2].

After the slaughter, the carcass is inspected. Diseases, pathological changes, and injuries are generally not allowed on a kosher carcass. The inspection, called bedikah (בדיכה), aims to find abnormalities or pathologies, especially on the internal organs of the carcass (Levinger et al., 1976). The examination is made only for the most common defects, mainly the adhesions on lungs; other kinds of pathological changes are generally not sought for, but may be noticed incidentally, during the later stages of preparation (Cohn, 1981, p.63). The latter also applies to the changes on bones, which are not regularly under the scrutiny during bedikah, but may disqualify the animal when found on its carcass. These include: a large fracture of the skull, fractures on more than half of the ribs, a dislocation of a vertebra, a fracture of an upper joints of limbs (but not the lower joints), a compound fracture of the middle long bones, and more (Levinger et al., 1976, p.39; Cohn, 1981, p.66–67). Abnormalities found during bedikah, depending on their seriousness, can be cut off from the carcass or cause the whole carcass to be deemed forbidden to be sold to observant Jews; however, it is still possible to sell it to non-Jews, as long as the abnormalities are not a consequence of a contagious disease.

2.1.3 *Nikur* — porging of the carcass

Porging or deveining (Hebrew: nikur ניקור; Yiddish: treybern; Polish: trybowanie or wyłażwianie) is the final and a very important part of the kosher butchery (Levinger et al., 1976; Zivotofsky, 2006). It is a butchery process which entails removing of some parts of the carcass due to religious prohibitions. These include the major blood vessels, forbidden fat tissues called chelev (חלב) and

[2] Rabbi Ari Zivotofsky, Bar Ilan University, personal comment

some blood vessels that pass this fat, and most importantly, the prohibited nerves, including gid hanasheh (גיד הנשה) and the fat which surrounds them (see Hirsch, 1903; Eisenstein, 1905; Cohn, 1981, p.73–74). Skilled craftsman who is trained in porging is called menakker or treyber, and in English 'porger'.

2.1.3.1 The reasons for porging

The need for porging is rooted in the Torah. Leviticus 7:23-25 explicitly prohibits consumption of some fats, called chelev. These are the fats covering the inner organs of the domesticated animals, the kidneys and the liver, loins, including suet, caul fat, and tail fat (Hirsch, 1903; Cohn, 1981, p.73–74). In the Ashkenazi tradition almost all fat of the hindlimb is prohibited. Chelev is mostly located on soft tissues, such as muscles or internal organs. The forbidden fat may be found near the bone on the pelvis or sacrum too (tractate Chullin 93b). Additionally, the blood vessels which pass the forbidden fats are believed in the Ashkenazi tradition to carry the residues of thereof and need to be removed with the fat.

The prohibition of the nerve, gid hanasheh, is a mitzvah (religious duty) rooted in Jacob's (Ya'akov) story told in Genesis 32:22-32. In this passage, Jacob, son of Isaac (Yitskhak), was engaged in the fight against a man, who is believed to be an angel or even God himself. The fight lasted the whole night and the Jacob's opponent was not able to defeat him; thus he decided to strike Jacob's hip socket (called kaf), dislocating it and ending the fight. After the fight, the opponent told Jacob that he will be henceforth known as Israel (Yisra'el); often translated as *one who fights with God*. The final verse of the story (Genesis 32:32) states: "This is why, to this day, the people of Yisra'el do not eat the thigh muscle that passes along the hip socket — because the man struck Ya'akov's hip at its socket" (Complete Jewish Bible). Hence, a particular food restriction was established (tractate Chullin 91a): the prohibition of the consumption of gid hanasheh, the 'displaced tendon'. The prohibition only applies to mammals, both domestic and wild; the birds are excluded because their hip looks different: they "have no spoon-shaped hip", or a hollow in the thigh (tractate Chullin 89b).

2.1.3.2 The procedure of porging

It is important for the further zooarchaeological investigation to explore in detail how the porging is performed and what is the exact meaning of the term gid hanasheh. The book of Genesis (32:32) does not provide the specifics for locating gid hanasheh in the carcass; only the prohibition is set. The detailed location of thereof was provided later in the Talmud: in Gemara written by the Amoraim sages in third till fifth century of the Common Era. Gid hanasheh is described there as "the nerve that spreads throughout the entire leg" (tractate Chullin 91a). The word gid in Hebrew refers to a fibrous animal tissue, too tough to be chewed, such as ligaments, tendons, or nerves (Kaganoff, 2014). The present-day consensus amongst the Judaic scholars states that gid hanasheh refers to the sciatic nerve, the largest nerve of the body located in the thigh (Lach, 2011, p.194). This meaning may be wider than the actual anatomical term and depends on the regional Jewish tradition. In the Middle Eastern Yemenite Jewish tradition, gid hanasheh refers only to the actual sciatic nerve. What is more relevant to this thesis, in the European Ashkenazi tradition gid hanasheh encompasses also the branches of the sciatic nerve: the tibial nerve and common fibular (peroneal) nerve and their offshoots (Lach, 2011, p.89–90).

The Talmud (tractate Chullin 91a) sets a restriction additional to the one introduced in the Torah. Besides the above-mentioned gid hanasheh, which is referred to as the 'inner nerve, next to the bone', another nerve is prohibited in the rabbinic ordinance: the 'outer nerve, next to the flesh' (gid hachitzon גיד החיצון) (tractate Chullin 91a). The 'outer nerve' may refer to the femoral and saphenous nerves (in the Ashkenazi tradition), or to the common fibular (peroneal) nerve (in some Yemenite and Tunisian Jewish traditions) (Cohn, 1981, 74; Lach, 2011, p.196–197). Despite defining the 'outer nerve' as being 'next to the flesh', the Talmud (Chullin 93b) does acknowledge that it passes also near the bone in the place where the 'butcher cuts it open' to perform porging — possibly referring to the stifle joint.

The rabbinical ordinance (tractate Chullin 91a, 92b) states that the above-mentioned prohibited nerves with all their branches and, what is very important, the surrounding fat and blood vessels running along them must be removed. This process includes cutting and scraping them off (Cohn, 1981, p.74). In the Ashkenazi tradition, this practice involves a very meticulous and painstaking, so-called, 'digging' to remove every branch of the nerves, even the thinnest one, as far as they go (Lach, 2011, p.99 and 197).

Despite the seeming present-day consensus on the nature of gid hanasheh and the way it is removed, the procedure of porging was debatable through the history. The very first disagreement about the removal of the nerve comes from the Talmudic sages themselves. In the Mishnah part of the tractate Chullin (92b and 96a), written in the third century CE, Judah the Prince argues with his opponent; he claims that only a part of gid hanasheh needs to be removed — 'merely cut away from the cap of the bone' (Chullin 92b) — whereas his opponent states that the nerve must be removed in its entirety. In the end, this depends on the local tradition, as discussed above, the Ashkenazim remove the nerve in its full, and extend this to other nerves as well. Another debatable issue is the precise identification of the 'inner' and 'outer' nerves. Rashi, a French medieval rabbi from the eleventh–twelfth century, famous for his important commentaries to the Talmud, presumably had a different understanding of this matter. He provides descriptions of the nerves which do not correspond with their anatomical location, assuming the aforementioned identifications of the 'inner' (sciatic) and 'outer' (femoral) nerves (Lach, 2011, p.196–197). It seems that in his understanding both 'inner' and 'outer' nerves are branches of the femoral nerve, which suggests that the process of porging according to him was different. Rashi's comments were so important that his point of view was discussed for hundreds of years by rabbis and porgers; also in the sixteenth century Poland (Lach, 2011, p.196–197). Another controversy took place in the eighteenth century Prague. An expert porger spread the declaration that gid hanasheh is in fact not the sciatic nerve but a different nerve, found only in male animals, and the porging needs to be performed differently (Leiman, 2004). This notion lived until one of the rabbis, Rabbi Jonathan Eybeschutz, finally disproved his claims, and documented this dispute.

These kinds of historical evidence are important, because they suggest that the understanding of porging and the method it was performed were different depending on the cultural and chronological context; sometimes being influenced by the interpretation of the religious laws by some influential local individuals. The importance of the local tradition is emphasised by the Code of the Jewish law, Shulhan Arukh, itself. In the Ashkenazi adaptation of thereof, written in the sixteenth century Poland, Rabbi Moses Isserles stresses twice (Yoreh Deah 64:7 and 65:8) that porging cannot be learnt from the text, only through the apprenticeship (Zivotofsky, 2006). The reason for this is not only the difficulty of the process, but the local tradition, or minhag, which strongly influences the practice. It seems that in the past even different cites could have local porging customs important to their communities, and distinguishing them from the other communities.

2.1.3.3 Treatment of bones in porging

Some of the earliest literary sources about porging which include detailed descriptions of treatment of bones come from the Middle Ages. The sixteenth century scholar Joseph Caro mentions in his legal code Beit Yosef (Yoreh De'ah, Siman 65:24) that breaking of the bones of the hindlimb was discussed and required earlier, in the early fourteenth century haGaos Ashrei, glosses to the code Piskei haRosh by Asher ben Jehiel. The mentioned rule states that parts of gid hanasheh terminate on bone, and the 'tops' of the thigh bones (presumably meaning femur and tibia) need to be broken and removed with all the 'tendrils of the tendon', even ones as thin as a hair, and the surrounding fat. The same rules are repeated by Moses Isserles, a sixteenth century Polish scholar, in his Ashkenazi commentaries to Shulhan Arukh, Yoreh De'ah, as well as in other contemporary works.

Additionally to the general codes of Jewish law mentioned above, the details of porging are the main focus of several books of rules of porging, called Sefrai Nikur. One of the oldest comprehensive works of this kind was published in Cracow in Poland in 1580 CE. It was called Seder haNikur (סדר הנקור הלכות נקור) written by an authority in porging, Tzvi Hirsch Buchtener. It describes the rules and how their execution should be carried out by the porgers. It discusses removing of the ends, as the above-mentioned sources, but it includes even more rules. One of the most useful sections depicts porging of the femur: patella needs to be removed due to its proximity to a forbidden nerve, tendons should be cut off from the ends of femur and tibia, and the shaft of femur needs to be cleaned, or 'peeled', because of the contact with gid hanasheh. The original text of this passage is shown on fig. 2.1.

The abundance of these rules makes the process of porging on bones very painstaking. Consequently, its execution may only be restricted to the femur and the tibia since it may be economically viable to obtain them due to their high marrow content[3]. The removed ends of the bone, along with those prohibited tissues attached, would be discarded as not kosher. Other bones of the upper parts of the hindquarter — notably the pelvis — are difficult to clean

[3] Rav Yair Bloch, porger, personal comment

due to their awkward shape, and may be neglected and discarded altogether as not kosher.

The aforementioned religious literary sources draw a picture very useful for the current study. The religious practice of porging would involve epiphyses of the femur and tibia removed, presumably chopped with a cleaver. The tendons, even the smallest ones, would be scooped off the bone, and the remnants of the soft tissues would be 'peeled', presumably scraped, off the shafts of those long bones. This will further be investigated on ethnographic and archaeological bones in chapter 7.

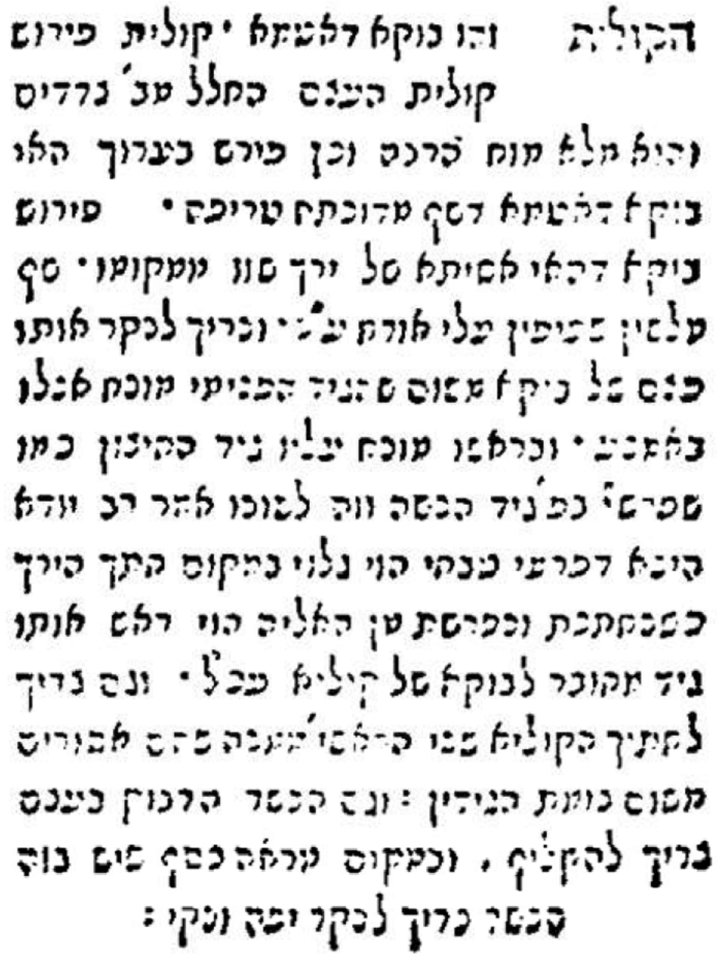
הקולית וזו נוקא דאטמא · קולית פירוש
קולית השוק כמלל שנ׳ גרדים
והיא מלא׳ מוח הרכה וכן פירש בערוך הלז
נוקא דאטמא דסף מדוכתה טריפה · פירוש
נוקא דהאי אטיתא של ירך שנו ממקומו · סף
עלבין בשיפין עלי אורח עב״י · וצריך לנקר אותו
כנס כל נוקא משום שהגיד הפנימי מונח אצלו
באמצע · ונראה מונח עליו גיד החיצון כמו
שפירש׳ בפ׳ גיד הנשה וזה לשונו אמר רב יודא
היכא דפרעי שבתי הוי גלוי במקום התך הירך
כשמסתבת ונפרשת מן האליה הוי דלש אותו
גיד מחובר לנוקא של קוליא שבל׳ · וגם צריך
לחתוך הקולית שני הראשי׳ שגנה שהם אבורים
משום כוונת הגידין : וגם הבשר הדבוק בשנס
צריך להקליף · ובמקום מראה כסף שיש בזה
הבשר צריך לנקר יפה ונקי :

Fig. 2.1 Porging of femur (Heb. kulit קולית) described in a passage from the book of laws of porging (Heb. Sefer haNikur סדר הנקור הלכות נקור) by Tzvi Hirsch Buchtener published in 1580 in Cracow (Interpretation supported by Yair Bloch and Ram Bouchnick; the book is available online at Chabad–Lubavitch library at http://hebrewbooks.org/11807.

2.1.3.4 The practice of *not* porging in the past

Most of porging is performed on the hindquarters. That is because of the presence of the prohibited nerve, and the forbidden fat chelev, which is abundant and more difficult to remove than in the front part of the carcass (Zivotofsky, 2006). The process of porging is extremely time consuming, complicated, and it requires a highly trained specialist called *porger*. In the past, the porger was forbidden to serve as butcher due to conflict of the interest: fear that the self-interest of the butcher may hinder the proper performance of porging (Eisenstein, 1905).

Many Jewish communities throughout history saw it practical to consume only the kosher forequarters. It was more practical due to the difficulty of porging and sometimes it was necessary because of the lack of skilled porger. The hindquarters, not kosher without porging, were sold to their non-Jewish neighbours. In the Ashkenazi tradition this happened to the part of the carcass behind the twelfth rib, but this depends on the local tradition (Zivotofsky, 2006; Marks, 2010; Kaganoff, 2014). This practice is allowed in Talmud, but only whole, uncut animal thighs are allowed then to be sold to the non-Jews (tractate Chullin 93b).

One of the earliest notes on the practice of not consuming the hindquarters comes from a sixteenth century Sephardic rabbi in Egypt, David Ibn Zimra, who mentions the habit of selling the hindquarters to Muslims (Zivotofsky, 2006). In the sixteenth century Poland, the quality of porging varied in different cities. Rabbi Mosses Isserles of Cracow believed that most porgers were experts (Berman, 1941, p.210). Rabbi Solomon Luria from the eastern part of Poland was of a very different opinion, claiming that the porgers in his day were sloppy and did not do an adequate job in porging; hence, he would refrain from consuming the hindquarters if they were not double-checked by another porger (Zivotofsky, 2006). It seems that the trust in the quality of porging declined with time, and it was not performed in many cities in the seventeenth century Moravia, Germany, Italy (Berman, 1941; Zivotofsky, 2006). These are the signs of a wider process of disappearing of this practice in Europe, especially in the eastern part, since the seventeenth century onwards (Eisenstein, 1905). It was still performed in some cities, especially the large ones, in the eighteenth century; including Prague, Lvov, Brodt, Cracow, Lissa (Zivotofsky, 2006). In the nineteenth century porging was still practised occasionally in Eastern Europe only in several cities. It is worth mentioning that in some cases, such as in Jerusalem in the nineteenth century, porging was only done on cattle, whereas it was considered to problematic to be performed on much smaller sheep and goats, which hindquarters were sold to non-Jews (Zivotofsky, 2006).

With time, not porging started to be associated with the Ashkenazi Jews. This is the case in the United States, where it became a custom not to porge due to the lack of porgers. The first porgers in America appeared in the late 1800's, but the lack of porging was already a set tradition by then (Greenfield and Bouchnick, 2010; Lach, 2011).

Chapter 3

Zooarchaeology of Judaism

It is possible to detect Jewish presence in zooarchaeology through two main indicators:

- presence of kosher species and the absence of non-kosher species
- absence of bones from hindquarters, when porging was not being performed, or the presence of specific butchery marks on those bones, when porging was being performed.

These two indicators constitute the basis of investigation of this thesis and will be discussed in detail.

The first indicator should be straightforward and simple to detect merely looking at the species composition of an assemblage. The most obvious and easiest to detect is the presence or absence of pig bones. This species is represented at most sites from all historical periods across the globe, and its absence may therefore be significant. It is, however, important not to be over-reliant on it, as the taboo on pork consumption is also shared with the Islamic world. Pig bones can also be missing from assemblages associated with industrial or craft activities - such as horn or hide working. In some cases, taphonomy can be the reason for the underrepresentation of pig bones. Pigs tend to be slaughtered at younger ages than cattle or caprines, as their sole breeding purpose is meat production. Long bones from younger individuals are more porous, and their epiphyses have not yet fused to the shafts. These features make them more vulnerable and more susceptible to taphonomic destruction (Binford, 1981; Brain, 1983). Also, mandibles of young individuals tend to preserve much worse than those of older animals, which results in underrepresentation of the former (Munson and Garniewicz, 2003) Potentially, in some assemblages, bones of pigs culled at a young age may be destroyed more frequently than those from cattle and caprines, which may result in the complete lack of pig bones in small assemblages (Lyman, 1994).

In addition to pig, other animals, such as rabbit, hare, horse, camel, catfish, eel, and sea food in general, which are commonly consumed in many cultures, are not kosher and their consistent absence may also be an indicator of Jewish food waste. However, despite the ban on consumption of non-kosher animals, other kinds of uses of them are not forbidden. Non-kosher species can be exploited for traction (e.g. horse and camel), or be kept as pets (e.g. such as dog and cat), and parts of their bodies (e.g. fur or bones) can be used to make clothes and utensils. On this account bones of non-kosher animals can be found in assemblages from Jewish sites, therefore the context of each find should be individually investigated. Remains of pets and traction animals should generally be found as articulated skeletons or parts thereof, unless the sediment has been mixed. Butchery marks will be absent, with the possible exception of those resulting from skinning. Some animals can be kept or caught for the sole purpose of acquiring their skins for fur and leather production. Rabbits, hares, foxes, sables, pine martens, even cats, can be exploited this way and their skinless carcasses can possibly be dumped together with kosher kitchen waste. A few non-kosher species, such as pine martens, sables, and foxes were important for Chassidic communities in the last few centuries, since their fur was used to make traditional fur head wear — shtreimel, kolpik, and spodik (Arnon, 1995). The bones of the animals slaughtered for this purpose will be far less fragmented, with no butchery marks, except of skinning marks, and therefore it may be possible to distinguish them from food waste.

The lack of bones of some kosher species, such as species of cervids, can also be the archaeological indicator of Jewish presence. Red deer, roe deer and fallow deer are kosher species, but they will rarely be eaten by Jews. Meat, if kosher, must originate from an animal slaughtered by a shoychet, in the way described previously. Wild animals, such as cervids, will not be kosher if killed during the hunt, instead, they would need to be caught, and slaughtered according to shechita, which is rarely possible (Berman, 1941). It is reasonable to assume that most assemblages deriving from kosher activities will lack bones of wild species in the kitchen waste.

Porging is a tradition indigenous to Judaism, and there are no reasons for non-Jews to perform it, which means that it makes it a good indicator of Jewish practice. The possibility of detecting porging in zooarchaeology is twofold — it can be identified due to its absence or its presence.

In many Jewish communities across time and land, porging was not performed, and hindquarters of carcasses were being sold to local non-Jewish neighbours, while the Jews dined only on forequarters. In the case of a well preserved and non-contaminated archaeological context associated with kitchen waste, this practice should result in a significant bias in body part representation in the animal bone assemblage. Bones from hindquarters — mainly pelves, femora, and tibiae — will be underrepresented, or absent from the record.

The presence of porging in zooarchaeology is much more elusive. Despite a few studies aiming to find butchery marks on bones which would be caused by porging, no butchery pattern has been evidenced (e.g. Cope, 2004; Bar-Oz et al., 2007). Filling this gap is one of the aims of this thesis, and will be discussed in the following chapters. The reader curious about the results may move forward to the description of my research on this topic in chapter 7 or to the summary in section 9.1.

In the next sections I'll present previous studies which have utilised those indicators to investigate the Jewish presence in the past.

3.1 Ancient Israel and the emergence of dietary restrictions

The largest body of data on faunal remains as an indicator of Judaism derives from ancient sites in Levant. Zooarchaeology widely contributed to the discussion on the emergence of Judaic dietary restrictions, which certainly can be interpreted as an emergence of the Judaism itself. Not surprisingly, most studies were focused on the most obvious and prominent feature of Judaic diet: the prohibition of pork.

The origins of pork taboo are widely debatable (see discussion in Harris, 1985; Griegson, 1987; Zeder, 1996, 1998; Hesse, 1990; Kolska-Horwitz et al., 2017), but it is possible to track down the period in which it emerged. In Southern Levant, the number of pig bones significantly decrease after the Bronze Age, and in the Iron Age I (12th–10th c. BCE), the pig remains are very scarce in highland sites of this region (Sapir-Hen et al., 2013). It was argued that the absence of pig bones can be a cultural indicator, and the increased number of pig bones at the Iron

Age lowland sites indicates the presence of Philistines, in opposition to the low number of pig bones in Israelite highland sites (Hesse, 1990; Greenfield and Bouchnick, 2010). Other studies postulated that the absence of pig bones itself is not a conclusive indicator of ethnic groups in that region (Hesse and Wapnish, 1997) and have questioned this concept of an ethnic dichotomy (Sapir-Hen et al., 2013). A recent study, complemented with data from new sites, argues that after the noted decrease in the frequency of pig bones at the Iron Age I highland sites, in the subsequent period, Iron Age II, the pattern changes (Sapir-Hen et al., 2013). Since the Iron Age II, pig bones are found only in lowlands and highlands of the southern lands of the Hebrews — the Kingdom of Judah — while the northern sites connected to the kingdom of Israel witness another increase of number of pig bones (Sapir-Hen et al., 2013). This is the time of the biblical authors, and the authors of the study suggest the written rules could have served to promote the pig taboo amongst all of the Hebrew people as a 'Judahite cultural trait' and to unite people of northern kingdom of Israel and southern kingdom of Judah (Sapir-Hen et al., 2013).

As stated previously, detecting the emergence of Shechita in the zooarchaeological record is difficult. Butchery practices in Levant were subjected to a major change in the early/middle Bronze Age transition, with the introduction of metal tools (Greenfield and Bouchnick, 2010). In the middle Bronze Age at Jericho butchery practices are more standardised, and the frequency of cut marks on bone significantly increases (Greenfield and Bouchnick, 2010), but linking it to Shechita is impossible. It is not until the classical period that studies are trying to link butchery patterns to the existence of Shechita (Cope, 2004; Bar-Oz et al., 2007; Bouchnick et al., 2007). The highly standardised butchery pattern was found on bones from excavations of the city dump of Jerusalem, dated to the first century CE (Bar-Oz et al., 2007; Bouchnick et al., 2007). The pattern of standardised distribution of body parts and repetitive cut marks was interpreted as caused by specialised butchers, and the absence of non-kosher species indicates Jewish presence (Bar-Oz et al., 2007). However, the efforts to find the evidence of porging on bones of hindlimbs were unsuccessful, presumably due to a small sample size (Bouchnick et al., 2007). The butchery pattern of porging is argued to be present on bones from two Israelite sites from similar periods, Gamla and Yodefat (Cope, 2004). Frequent cut marks were found on cattle and caprine bones in distinct locations, such as the ischial spine, or the greater trochanter of the femur, and were previously interpreted as caused by the removal of gid hanasheh, the sciatic nerve (Cope, 2004). Unfortunately, this study shows it is difficult to discriminate between cut marks resulting from regular butchery and those left during the porging, therefore the porging pattern cannot be successfully investigated. What is interesting and worth noting, at Gamla and Yodefat (Cope, 2004), as well as previously discussed Iron Age sites such as Jericho (Greenfield and Bouchnick, 2010), cut marks resulting from slaughter were regularly found on the ventral sides of cervical vertebrae. Cutting through bone during slaughter is not allowed in modern shechita (Greenfield and Bouchnick, 2010), and makes the whole carcass treyf. Cut marks on the cervicals could be the shoychets error, as interpreted by the authors (Greenfield and Bouchnick, 2010). As it was mentioned before, the cutting of the bone is not forbidden per se; it is not done because it may nick the knife. Therefore, the cut marks on cervicals do not necessarily constitute the evidence that the slaughter was not kosher.

3.2 European Diaspora

Jewish presence is not commonly evidenced in the archaeological faunal assemblages in Europe. No comprehensive study of this topic has been published, and Jewish presence was only recognised in those few cases when the studied assemblage showed absence of pig bones or originated from an area of a former Jewish district. Few case studies used this opportunity to discuss the possibilities of detecting ethnicity and religion from the bone assemblage and to address the issue of Jewish dietary restrictions as indicators of Jewish presence in the faunal record. The studies rarely tackle the characteristics of the meat consumed, wealth and status, and other zooarchaeological inquiries concerning differences between Jews and their non-Hebrew neighbours.

In Poland and the Czech Republic, focal areas of this thesis, there are few papers reporting the absence of pig bones and connecting them with Jewish presence, particularly in view of the abundant presence of Jewish people in those areas in the past. Probably the most widely recognised example in Poland comes from the city of Wrocław. This city, one of the largest and most important in Western Poland, was home for a Jewish community since the Middle Ages (Ziątkowski, 2000). Excavations in two places in the historic Jewish district of Wrocław presented interesting results. The assemblage from excavations at Plac Uniwersytecki (Kaźmierczyk, 1959) showed as little as 2% of pig bones, but no precise data was presented by the researchers and it is not possible to trace other indicators of Jewish presence, such as the porging pattern. A few hundred meters away from this site, at Więzienna Street 11, well-documented excavations have uncovered a substantial assemblage of bones from the thirteenth–fifteenth century. The analysis showed that in few habitation phases of the site pig bones were underrepresented, but other possible indicators of Jewish presence were not investigated (Socha et al., 1999). For instance, the bulk anatomical representation indicated a slight underrepresentation of hindquarters of caprine carcass, the possible indication of lack of porging, but this was not discussed in the paper. Due to the absence of a thorough analysis of the Jewish footprint in the assemblage in the previous report and the importance of the site, I decided to re-examine this assemblage as part of this thesis. This is also the case with assemblages from a few sites in the town of Chełm. This town in Eastern Poland, next to the present day border with Ukraine, used to be a thriving *shtetl* — a small town predominately inhabited by Jews. The history of Jewish people in Chełm starts in the thirteenth century and continues until the Holocaust (Zimmer, 1974). The memory of Chełm still remains vivid in Jewish folklore and humour, it is known as a town of 'foolish' people. In several places of the historic Jewish district, commercial excavations uncovered remains of early modern Jewish houses. A few bone assemblages have been studied as parts of Bachelors and Masters theses (Dąbrowska, 1999; Bratkowska, 2002). These, however, have only discussed the underrepresentation of pig bones in a few contexts.

In the capital of the Czech Republic, Prague, excavations in one of the oldest synagogues in Europe, Staronová Synagogue (Dragoun, 2000, 2003a,b), yielded an interesting assemblage from the Middle Ages. The faunal record from this site shows the underrepresentation of pig. Again, other indicators of Jewish presence were not researched.

Further to the west, in Amsterdam, Netherlands, the most widely known research of this topic has been carried out. The study represents a preliminary analysis done of a huge animal bone assemblage (100 thousand bones) from seventeenth–nineteenth century cess pits from the Waterlooplein and Oostenburgermiddenstadt quarters (Ijzereef, 1988, 1989). The author uses the scarcity of pig bones as the main criterion to identify Jewish households. He assumes that kosher Jewish houses are those with less than 1% of pig bones in the assemblage (Ijzereef, 1988, 1989). Other criteria that were used for recognising Jewish households are as follows: absence of hindlimbs of kosher animals; absence of calf bones — because, as he states, the Jews 'bought only adult oxen'; a high percentage of chicken bones in comparison to the predominance of duck bones in non-Jewish households; the absence of eel; and finally a lower percentage of fish and mollusc than in the non-Jewish assemblages (Ijzereef, 1988, 1989). It is clear that the underrepresentation of hindlimb bones was caused by the selling of hindquarters to non-Jews, rather than porging. Also, the absence of eel and low percentage of molluscs, which are both not kosher, will be good indicators of the Jewish presence. However, the underrepresentation of calves, ducks, and fish does not derive from Judaism. IJzereef's study (1988; 1989) shows that Jewish houses were present in both researched quarters, and were mostly grouped into a few clusters, and the gentiles living in the Jewish parts slightly adopting the Jewish flavour in food. One of the assemblages discussed is believed to represent a very wealthy Jewish household. The assemblage consisted predominately of cattle bones with a lack of hindquarters. Another common species was the chicken. A few of hundreds of sesamoids of this species had lead seals, known as plumba, indicating that the carcass was kosher and on what day of the week it was killed. It is also interesting to see turkey bones, suggesting that this species was already consumed by the Jewish residents of that household. This animal had no tradition of being consumed by the European Jews, as its presence on the kosher tables appeared in America. Eating turkey might been a status indicator for the residents, or they had connection to some American Jews. Certainly it was somehow important in this house to keep kosher. On the other hand it seems that some rules were transgressed, because the assemblage is also rich in mollusc shells — including exotic species — and rabbit bones, animals strictly non-kosher. It may be possible, that the rich Jewish family ate high status food, regardless of its religious prohibition. IJzereef's (1988; 1989) papers, since publication, has become the main reference for subsequent studies of Jewish presence in zooarchaeology, though the final report of this study was never published. Much later, a study on fish remains from Amsterdam and Cologne (Bakker, 2014) showed the usefulness of this analysis in detecting the Jewish presence.

Another important contribution to detecting the Jewish presence in zooarchaeology was provided by Daróczi-Szabó (2004). He traces the Jewish presence to an assemblage of the fourteenth century, Teleki Palace, next to the historical Jewish quarter of Buda, in the capital of Hungary. He found a substantial difference between the composition of the species in the upper and lower parts of a deep, 148 metre, section of a well. While the upper part of the stratigraphic section had some presence of pig bones (less than 5%), the lower part had almost no pig bones. Additionally, the lower part shows a clear bias against bones of the hindquarters, and the lack of non-kosher fish species. Two artefacts of Jewish origin were also recovered: a wooden plate with a Star of David and a glass shard with a Hebrew inscription. The data clearly suggest Jewish presence, though the context is unclear as the well was a rubbish dump for years or decades, and the assemblage was mixed. The underrepresentation of hindquarters indicates that in late medieval times the Jews of Buda would generally not porge, and hindquarters were being sold to non-Jews. The study does not provide data on butchery patterns, and it is therefore not possible to look for the porging pattern of cut marks on bones. Daróczi-Szabó (2004) makes an important contribution to the topic of detecting Jewish presence in zooarchaeology, but he leaves plenty of room for further zooarchaeological inquiries; such as meat trade, consumption, and social status.

The first evidence of documented butchery traces of Jewish presence in Central Europe comes from Austria. A doctoral thesis on the assemblage from Vienna (Czeika, 2008) documents the presence of a well of a presumably Jewish house dating to the fifteenth century. Besides the underrepresentation of pig bones, the study records a specific butchery pattern on femora. Long scoop marks on the diaphyses and chopped off epiphyses noted in all layers of the well suggest a consistent method of butchery across decades of accumulation. However, the author of the thesis (Czeika, 2008) does not link this pattern to porging. I compare this pattern to my findings in chapter 7.

Another important contribution comes from Berlin, Germany. In the Eastern Berlin area of Großer Jüdenhof, excavations uncovered households associated with the Jewish presence (Morgenstern, 2015). In the several phases of habitation lasting from the thirteenth to mid-fifteenth century representation of pig drops from around 15% to less than 5. The assemblage also displays a pattern of pelvis and femur underrepresentation for cattle and caprines but not for pig.

An interesting case-study presents an analysis of the assemblage from a rural estate "Blauwhof" in Antwerp in Belgium (Aluwé et al., 2015). The estate was inhabited in the sixteenth—seventeenth century by Ximenez family of merchants of Portuguese Jewish roots, who converted to Christianity. The faunal assemblage reveals that despite their wealth they were consuming no exotic foods and modest numbers of shellfish. They based much of their consumption on mutton and beef, mostly young, with only some pork. The authors suggest that the Ximenezes have fully embraced their new Christian identity, but some parts of their diet, like an unusually high number of caprines hint their foreign Portuguese Jewish roots.

Although Western and Southern Europe is not covered by this research, one study from that area is notable and should be mentioned here. That is the study of bone assemblages from two medieval towns in Catalonia, Tàrrega and Puigcerdà (Valenzuela-Lamas and Valenzuela-Suau, 2012; Valenzuela-Lamas et al., 2014). The study shows that the Jewish presence in zooarchaeology can be distinguished not only from Christian presence through the absence of pig bones but can also from Muslim presence through porging. In this case, the underrepresentation of bones from hindquarters suggest that local Jews were selling out those parts due to lack of porgers, and this is confirmed in medieval and early modern literary sources (Berman, 1941).

3.3 North-American diaspora

The history of Jewish migration to the New World dates back to the sixteenth century and it is partly documented archaeologically. Zooarchaeology has shed some light on how keeping kosher was connected to preserving Jewish identity. Two case studies from the nineteenth century in the United States show how useful zooarchaeology can be in distinguishing religion and identity, and how useful historical records are in archaeological and zooarchaeological research.

Abraham Block, a prosperous Jewish merchant, and his family lived in Washington, Arkansas, in the 1830s (Stewart-Abernathy and Ruff, 1989; Markus, 2011, 2015). Their household was one of the earliest Jewish households in that area, isolated from their brothers in faith. According to sources, the elders of the family, and perhaps other family members too, were religiously observant, and defined themselves as Jews (Markus, 2011, 2015). The excavations of a small pit at the back of their house, revealed an assemblage deriving from domestic refuse, including numerous animal bones (Stewart-Abernathy and Ruff, 1989). The results are significantly different from what was expected. In the assemblage, pig bones dominated, being more abundant than cattle, and remains of white-tailed deer were present in great numbers. There was no bias against the hindquarters. Among fish remains, catfish was identified in many cases. This is certainly an assemblage which does not indicate the observance of Jewish dietary laws. Presumably, the Blocks, as an isolated Jewish family amongst non-Jews, found themselves in a position where the observance of the laws of Kashrut was very difficult, or impossible. They adopted the food customs of their neighbours, transgressing this part of the Jewish tradition, but without forsaking the whole of their Jewish identity. This case study shows one of the ways in which the process of secularisation and blending in of the American Jewry proceeded.

Interestingly, transgressing of the Jewish diet was not only limited to isolated families as the Blocks, but also occurred in larger Jewish communities, even amongst religious figures. In the 1830's, in the middle of Manhattan, at the infamous Five Points, a tailor and a rabbi of Polish Jewish ancestry, Harris Goldberg, lived with several of his students. They had as neighbours a non-Jewish carpenter and a group of prostitutes (Milne and Crabtree, 2001). Although they lived in an area where it was possible to acquire kosher food, the faunal record shows that not all the food Goldberg and his students consumed was kosher. The assemblage comprises of bones from cheap cuts of meat, and cheap fish, which suggests that Goldberg was not a wealthy man. Although he tried to keep kosher, which is indicated by the predominance of forequarters of cattle carcasses, and the presence of kosher lead seals, *plumbas*, attached to legs of kosher poultry, this choice was not consistent. Kosher meat was certainly more expensive, and buying cheaper meat might have been a necessity for him. The evidence suggests, that from time to time, he used to buy pork and some cuts from hindquarters of cattle, which were certainly not kosher[1], but presumably cheaper.

[1] Porging was not performed at that time in the States; see Greenfield and Bouchnick, 2010

Chapter 4

Historical and archaeological context of analysed sites

Since the times of the Babylonian Exile, the majority of the Hebrew people lived in diaspora (Johnson, 1987). Despite being scattered, the Hebrews kept their sense of identity through their customs, languages, and religion. The diaspora played a major role in the survival of the Jewry, the development of Judaism and Jewish culture. After the Hellenistic and Roman conquers of the Middle East, the Jewish diaspora spread into the Mediterranean Basin and then to the rest of Western and Southern Europe. The first Jews arrived to the Slavic parts of Central and Eastern Europe in the early Middle Ages. They were among the merchants from far Mediterranean and Oriental lands using long distance trade routes to reach Poland and Russia (Demetz, 1997, p.14 and 40). One of those routes led from Kiev through Cherven Cities, such as Chełm, through Kraków, and then Prague to Italy and France (Demetz, 1997; Zaremska, 2005, p.24). The merchants arrived with spices, silk, and luxury produce to sell to Slavic nobles. On the way back they acquired Baltic amber, textiles, weapons, beeswax, leather, fur, and Slavic slaves — hence the word 'slave', adapted from 'Slav' (Evans, 1985). Exports from the Slavic lands reached Byzantine Empire and Muslim Spain.

The earliest Jewish communities in Polish and Czech lands appeared around the tenth and eleventh centuries in important cities located along trade routes. The peak of Jewish immigration, however, started much later. Many Jews were expelled from their home countries in Western Europe in late Middle Ages and early modern period and they had to flee east, mostly to Poland. In the fifteenth century the number of Jewish *qahals* in Poland rose from 12 to over

100 (Zaremska, 2005, p.35–36). Jews inhabiting the Czech lands were subject to religious prosecution in the late Middle Ages, but in the sixteenth century the number of communities also steeply rose.

The immigration of the Jewry to Polish lands flourished in the sixteenth and seventeenth century. This period is often called 'the Golden Age of Polish Jews' (Pogonowski, 1998, p.66). The Polish–Lithuanian Commonwealth was considered the safest country for the Jews, due to its religious tolerance granted by kings and local rulers; it was even deemed *Paradisus Iudaeorum*, 'the Jewish paradise' (Johnson, 1987; Hundert, 2004, p.7). Many believed that Poland was the place where God wanted the Jews to live, because the Hebrew name for Poland: *Polin*, can be also translated to 'dwell here', or 'here dwells the Lord' (Hundert, 2004, p.7). Hence, Poland became home for the majority of the world's Jewish population for centuries. Jewish–Polish diaspora had its distinctive traditions and culture and the Commonwealth was one of the birthplaces of the *shtetls*, little villages predominately inhabited by Jews (Kassow, 2004, p.27).

Fig. 4.1 Map of present-day Poland and Czech Republic with location of the sites analysed in the thesis

4.1 Chełm

Chełm (pronunciation: *kh-eh-wm*) is a town in the eastern part of Poland, near the present-day border of Ukraine (fig. 4.1). The town stands on the river Uherka, a small tributary of one of the main waterways of Eastern Poland, the river Bug. The beginning of the existence of Chełm is dated to the twelfth or possibly eleventh century (Zimmer, 1974, p.16). Its importance became apparent in 1235, when Daniel Romanovich Halytskyi, the ruler of the Rus' state of Galicia–Volhynia, fortified the Chełm hillfort and made it the capital of his state (Zimmer, 1974, p.17–18). Prince Daniel's hillfort was placed on a strategic location; surrounded by bogs and on the top of the hill (fig. 4.2), which gave Chełm its name; *kholm* is an old Slavic word for a hill (Warchoł, 1995).

The thirteenth century hillfort appeared to be a highly developed settlement. This contained an inner ward with a court, Christian temples, barracks and a stronghold placed on the highest point of the hill, and an outer ward (Pol. *podgrodzie*) with artisans' and merchants' houses, and churches (Zimmer, 1974, p.19). The Ruses and the Polish constituted the core of the town's population. In the thirteenth and the first part of the fourteenth centuries Chełm's development and profits were driven by far-reaching trade between Black and Baltic Seas and its rich agrarian-based economy (Frydman, 1954; Zimmer, 1974, p.23).

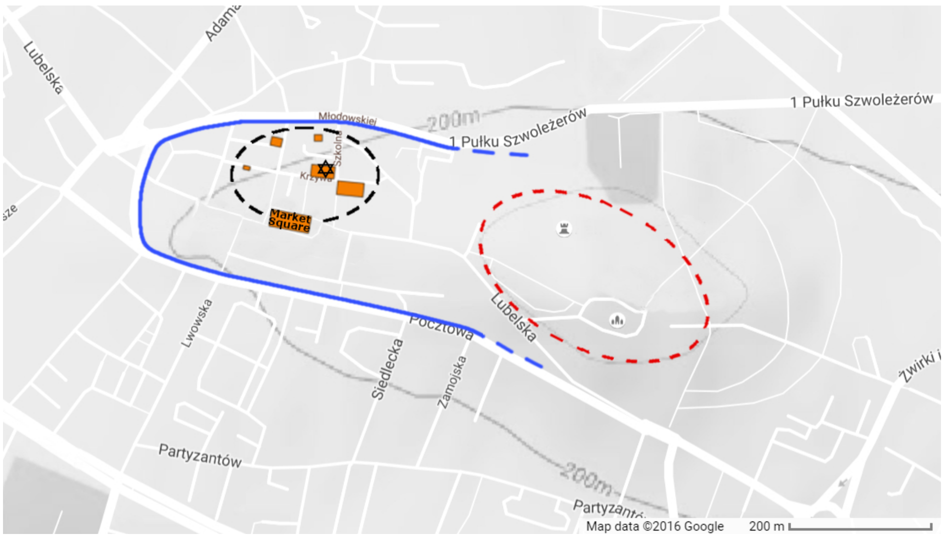

Fig. 4.2 Chełm. Isoline map of the town (AMSL). The red area marks the approximate location of the medieval and early modern hillfort's/town's inner ward with the castle and the church; the blue area marks the approximate location of the outer ward with the historic placement of fortifications (blue line, cf. Zimmer, 1974, p.43); the black dash line marks the approximate location of the early modern (15th/16th centuries onwards) Jewish district; the orange areas represent archaeological sites; ✡ — the Great Synagogue.

In 1387, after many decades of local wars between Poland, Hungary and Lithuania, Chełm was incorporated in the Kingdom of Poland (Zimmer, 1974; Subtelny, 2000, p.73). A few years later, in 1392, the King Władysław II Jagiełło granted Magdeburg law in the city charter. Contemporary Chełm occupied the whole extent of the Chełm hill, extending to the west. A new fortified castle, a cathedral, and a monastery were built on the spot of the old Chełm hillfort, on the top of the hill (Zimmer, 1974, p.41).

Numerous wars in the fourteenth century left Chełm riddled with many problems. Many trade routes had been terminated, its profits from trade largely decreased and its economic base had been weakened (Zimmer, 1974, p.22–23). A Polish chronicler from the fifteenth century, Jan Długosz, described Chełm as a "petty and wretched town" (Zimmer, 1974, p.27). From the end of the fifteenth and in the sixteenth centuries the town was given a few royal privileges, granting new rights to merchants and releasing its inhabitants from paying some of the duties (Zimmer, 1974, p.27–28). In the sixteenth century trade routes returned, the town importance and wealth began to increase again and Chełm was flourishing (Zimmer, 1974, p.28 and 50). The local population started mining and exporting its famous chalk and the town became an important trade point in salt trade (Zimmer, 1974, p.28). In the seventeenth century Chełm witnessed a series of conflagrations, epidemics and subsequently repeated sacking due to many conflicts, most notably the Cossack's Khmelnytsky Uprising (Zimmer, 1974, p.29). The town began to deteriorate, its trade ceased and workshops fell in disuse (Zimmer, 1974, p.50). The majority of the inhabitants perished following those events. In the eighteenth century, Chełm was rebuilt and began to slowly improve its economic situation (Zimmer, 1974, p.67). In the unsettled times of the Partitions of Poland in the late 1700s the town was sacked by Russian troops, incorporated into the Austrian Empire, and finally into the Russian Empire.

Since the fifteenth century the town was surrounded by earthworks, a palisade, and a moat (Dzieńkowski, 2012). In the seventeenth century the defensive wall of the outer ward was situated along the present day streets of Pocztowa, Reformacka, Podwale, and Młodowskiej. In the east it enclosed the inner ward at the castle's hill (fig. 4.2) (Zimmer, 1974, p.43). A longitudinal market square was founded in the centre of the outer ward (the present day Łuczkowskiego square) and the town hall as well as one of the main city wells were built there (Dzieńkowski, 2012). The majority of residential buildings in Chełm were still predominately wooden, even in the eighteenth century (Zimmer, 1974, p.84).

4.1.1 Jewish presence in Chełm — a brief history

Chełm, or Khelem in Yiddish (כעלעם), was an important *shtetl* and a cultural and religious scholarly centre for Polish Jews from the sixteenth to the eighteenth century (Frydman, 1954, p.33). Khelemer Jewish merchants were involved in trade with distant lands, whilst its famous rabbis published well-known religious commentaries and served communities throughout Europe. Chełm was a remarkable place for the Jews. It became embedded in Jewish collective memory through many legends, tales, and also famous Chełm jokes (Gotfarsztajn, 1954; Janasowicz, 1954).

There is limited evidence to document the first presence of Jews in Chełm. A book from around 1200 CE, called "זרוע אור" (Hebr. "Original Seed") is believed to make reference to the community of Khelemer Jews, but the reliability of this information is questionable (Frydman, 1954, p.13). The first reliable historical sources mentioning the presence of Jews in Chełm are dated to the fifteenth century (Mart and Lubaszewski, 2010, p.7).

The Khelemer *qahal* was growing quickly. In the sixteenth century it was the most substantial and influential Jewish community in Poland (Frydman, 1954, p.15). Its greatness was partly caused by privileges granted by the King Sigismund II Augustus; the bill from 1566 allowed more Jews to settle in Chełm, and another one from 1567 improved their economic situation by allowing unregulated trade of comestibles (Mart and Lubaszewski, 2010, p.7). At that time Chełm was inhabited by around two thousand inhabitants, of which 250 (Zimmer, 1974, p.44) or 371 (Frydman, 1954, p.15) were Jews, who owned 40 out of the 265 houses in Chełm.

In the second half of sixteenth century Chełm was flourishing and its trade routes reached Baltic Sea through Gdańsk and Toruń (Zimmer, 1974, p.29). Khelemer Jewish merchants had an important part of trade in Chełm and the whole region (Mart and Lubaszewski, 2010, p.7). At the famous market in Lublin they provided large part of trade goods, they "traded in leather, flour, oxen, textiles, wool, and merchandise from the Black Sea" (Frydman, 1954, p.14). The wealthiest of Jewish merchants and artisans were amongst the wealthiest people of Chełm (Zimmer, 1974, p.56–58). In the middle of the sixteenth century, 26 Jewish shops (Zimmer, 1974, p.28), and 46 Christian and 26 Jewish artisans operated in Chełm, and this number increased to 145 at the end of the century (Rybarski, 1958, p.225). The majority of Jewish townsfolk lived, however, in a harsh economic situation. Salaries of simple workers were rather small and would not support a family (Zimmer, 1974, p.30 and 56–58).

In the seventeenth century, 400 Jewish residents of Chełm constituted ca. 30% of the town's population and owned 51 out of 300 houses (Mart and Lubaszewski, 2010, p.8–10). These unsettled times, especially the Khmelnitsky Uprising, left few of the Khelemer Jews alive. The number of artisans decreased to only 26 in 1628–29 (Zimmer, 1974, p.31 and 52). The town was rebuilt and after the wars Chełm was home to ca. 700 people, including 240–270 Jews, who owned 30 houses and 13 out of the 20 existing shops. Also Jewish artisans formed a number larger than their Christian counterparts (Zimmer, 1974, p.56). Even through these hard times, some Khelemer Jewish merchants were still trading with distant cities, such as Poznań and Wrocław, playing an important role in leather export to these places (Frydman, 1954; Zimmer, 1974, p.52).

In the eighteenth century the number of Jewish residents rose up to 1418, and in the whole Chełm region up to 10,000 (Frydman, 1954; Mart and Lubaszewski, 2010, p.9). Most of the 37 shops, taverns, and workshops and the majority of houses, including most of the ones in the centre of the town, were owned by the Jews (Zimmer, 1974, p.56 and 65). The economic situation of Jewish townsmen rapidly improved; merchants were engaged in horse trade, many owned houses or shops (Frydman, 1954; Zimmer, 1974, p.105). After Poland as a state ceased to exist in the late 1700s, the situation of the Khelemer Jews worsened. Many trade routes were terminated because of the new borders (Frydman, 1954, p.24).

Relationships with Christian neighbours were difficult throughout the history of the Khelemer *qahal*. In the sixteenth and seventeenth centuries, attacks were carried out by local Christian students and townsfolk, but the most serious *pogroms* occurred during the Khmelnytsky Uprising in 1648 and the subsequent invasion of the Russian army in 1655, during which the vast majority of the Khelemer Jews perished (Frydman, 1954; Zimmer, 1974, p.49).

4.1.2 The Jewish quarter

The Jewish quarter of Chełm came into existence approximately in the sixteenth–seventeenth century, to the north of the Market Square. It centred on the area of Krzywa and Szkolna streets. Here the Great Synagogue was located, extending to Młodowskiej street northwards and to the northern part of Market Square southwards (Mart and Lubaszewski, 2010, p.9–12). The area is placed on the northern slope of the chalk stone hill (over 200 m a.s.l.) which extends to most of the town centre and peaks eastwards (fig. 4.2). Since the thirteenth century this area was enclosed to the outer ward of the hillfort and densely inhabited (Dzieńkowski, 2008).

The existence of a synagogue and Jewish residential buildings is documented in texts and by archaeological data to the second part of sixteenth century (Rudnik, 1996; Dzieńkowski and Gołub, 1999; Dzieńkowski, 2012). The earliest records mentioning the existence of a synagogue come from 1580. The first temple was a wooden building located on the northern side of the market square (Mart and Lubaszewski, 2010, p.7–8). After the governmental permission was issued in 1583, another temple was built of brick, at the corner of Krzywa and Szkolna (fig. 4.2) (Mart and Lubaszewski, 2010, p.7–8). The historians thought that the new Great Synagogue was built on the foundations of a destroyed Christian monastery (Zimmer, 1974, p.44), but excavations carried out in that area has not yet confirmed this (Dzieńkowski and Gołub, 1999, 2000). The synagogue, rebuilt after its destruction in the seventeenth century, survived until the Second World War (Mart and Lubaszewski, 2010, p.9).

Some of the most important streets of the Jewish quarter include:

Krzywa Street existed already in the late medieval period. It became later a key place for the Khelemer Jewry when the Great Synagogue was built here (Mart and Lubaszewski, 2010, p.68). In the early modern age the surroundings of the temple were mostly inhabited by the Jews and consisted of shops, workshops and stalls occupying rather small wooden houses built on narrow streets (Mart and Lubaszewski, 2010, p.68). In the nineteenth century, large brick residential houses replaced the small wooden buildings.

Kopernika Street begins in the Market Square, intersects Krzywa and descends north, down the slope of the chalk hill. The foundation of the street is fairly recent; a map of Chełm from 1823 does not show its existence, instead, a neighbourhood of small houses remained on the spot. The street was founded later and is present on a map from 1852 (Gołub et al., 1997).

Młodowskiej Street marks the location of Chełm's northern line of fortifications (Zimmer, 1974, p.48 and 64). The street was founded on the outer base of earthworks, which are today largely absent (Mart and Lubaszewski, 2010, p.75).

The Old Market Square, present-day Łuczkowskiego Square was in use since the Middle Ages as a part of Lubelska street which was a trade route from Lublin to Ukraine (Mart and Lubaszewski, 2010, p.47). Later on, it became the hub of the city, where the city hall and one of the main city wells were built. Houses and shops in the northern part of the square were mostly owned by Khelemer Jewry, whilst the main Jewish district extended northwards of the square. The historic settlement in Chełm, because of its location on a chalkstone hill, had problems with fresh-water distribution. Chalk bedrock of the hill made digging wells an arduous task and the majority of townsfolk could not afford to have private wells. Well digging had to be undertaken by most of the community and the finished well belonged to the community (Balcerzak, 1978). One of the first communal wells was located at the market square. Private wells first appeared in Chełm presumably around the seventeenth century for the use of breweries and distilleries (Gołub, 1997a).

4.1.3 Chalk mining in Chełm

Much of Chełm's town historic centre is located on a hill formed of the local chalk stone bedrock (Zimmer, 1974). Chełm chalk was considered to be especially pure, was sought after throughout Poland, and became a very important source of the townsfolk income in the early modern age (Zimmer, 1974, p.65). It was used to make ornamented coving in numerous palaces, white dye, and building material. Chalk mining presumably started as a very primitive process of collecting pieces found on the ground or digging shallow pits to extract chalk. Later, it became an industry practised by inhabitants of houses in the town centre, often Khelemer Jews (Zimmer, 1974, p.65). The industry was far from organised. Historical texts do not mention the existence of the occupation of a chalk miner nor a miners' guild (Gołub, 1997d). Shafts and tunnels were mined by individuals and their families, entrances were located in basements of townsfolk, initially mostly Jewish, homes (Zimmer, 1974, p.65). Most residential houses included such basements and cellars craved in chalk (Zimmer, 1974, p.65). The Chełm chalk miners seemed to have mastered the technique of chalk mining well (Gołub, 1997c). Many tunnels were supported with arched and polished ceilings. Niches were gouged in side walls to help in even distribution

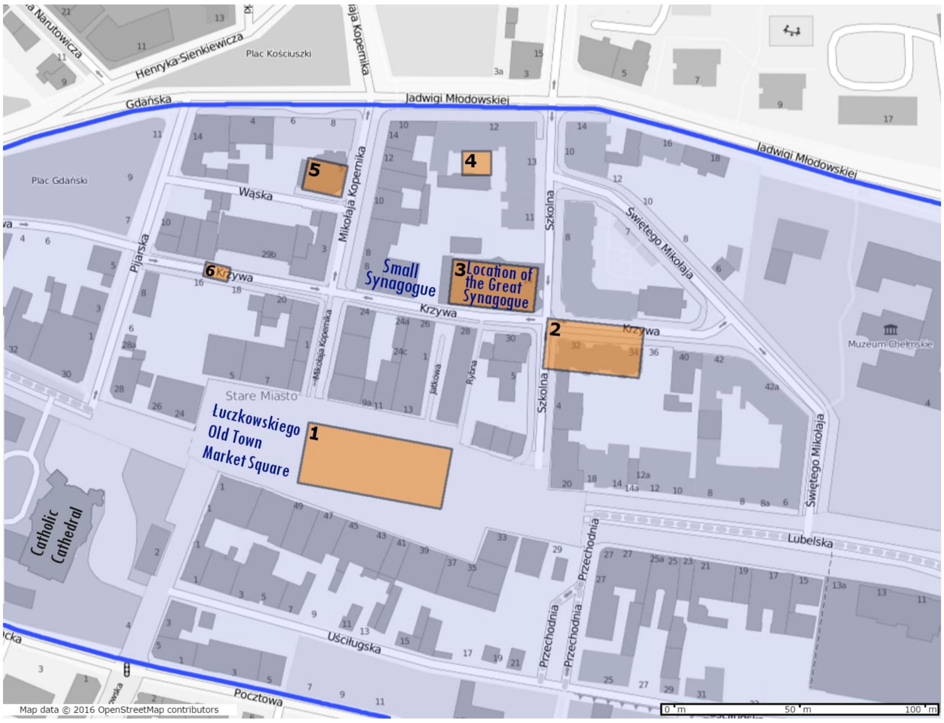

Fig. 4.3 Chełm. Location of the archaeological sites within town centre (orange areas: 1 — Łuczkowskiego square; 2 — Krzywa 32–34; 3 — Krzywa 37; 4 — Młodowskiej 12A; 5 — Kopernika 5/7; 6 — Krzywa 16) and the approximate extent of the outer ward (blue area) with the location of city fortifications from the early modern age based on historical texts (blue line)

of the force. The unused tunnels were filled with chalk debris to protect them from collapsing.

As the time passed, cellars became connecting tunnels, establishing a few dozen kilometre long network of chalk mines (Zimmer, 1974, p.65). The network was not planned and badly supported tunnels collapsed many times. The process of creating of the network was long, but the mining industry was an important part of Chełm townsfolk livelihood for centuries, maybe as early as the thirteenth century until the end of the nineteenth century, with its peak in the sixteenth and seventeenth centuries (Gołub, 1997d).

4.1.4 Archaeological sites in Chełm's old Jewish quarter

Archaeological sites I have chosen to include in this thesis are all located in the historical area of the Jewish district, on Krzywa, Kopernika, Młodowskiej, and Łuczkowskiego (the former Market Square) streets (fig. 4.3). All those sites were excavated separately in different years and often by different teams. A description of the excavations can be found below.

The features taken into account are the remnants of urban household activities and possibly some production/manufacture activities. They include:

- parts of households, such as basements, flooring and walls
- residential rubbish pits
- chalk tunnels connected to households
- a tile kiln
- two wells, re-filled with rubbish

For the purpose of this analysis they were divided into two phases (table 4.1). **Phase 1** consists of features dated from the fifteenth century up to the seventeenth century, with some residual material coming from the fourteenth century layers inside features CKR13 and CKR56. **Phase 2** includes features dated to the late seventeenth century and eighteenth century. Feature 20 from Łuczkowskiego Square, part of a ditch from the fifteenth/sixteenth century, possibly with remnants of a timber house, has a distinct and substantial faunal assemblage and will be analysed as a separate entity labelled as **Structure 20**.

4.1.4.1 Młodowskiej 12A

Site at Młodowskiej 12A is situated inside the historic outer ward, around 50 meters north of the former Great Synagogue (Dzieńkowski, 2008). Excavations uncovered a house or workshop (Structure 1), with surrounding pits dated to the second half of the seventeenth–first half of the eighteenth centuries. The building covered approximately 23 square metres, and was divided into two rooms. It comprised of associated features 2, 4, 11, and 12 (fig. 4.4) (Dzieńkowski, 2008). Feature 2 constitutes of remnants of a stone wall; feature 11 was a foundation of a hearth or part of a stone wall; feature 4 consisted of burnt remnants of wooden walls and flooring with a habitation layer and presumably a hearth; and feature 12 is believed to be a storage barrel embedded in a pit. Structure 1 was rich in finds: several hundreds of pot sherds (including fine maiolica-like pots), dozens of fragments of tiles, glassware, numerous animal bones, over 30 coins of various provenience, and bronze and copper items including a ring, most of which were found in feature 4. One uncovered Judaic artefact, a *dreidel*,

Table 4.1 Chełm. List of archaeological features used in the thesis with their description

Street	Feature	Code	Description	Context
Kopernika 5/7 (site 148)	3	CKO3	**Chalk cellar**	Phase 1
	5	CKO5	A **tile kiln or a production feature**	
	8	CKO8	**Chalk cellar**	
	9	CKO9	**Chalk tunnel**	
Krzywa 16	9	CKR9	An **entrance to a chalk shaft filled with rubbish**	
Krzywa 32-34 (site 19A)	20	CKR20	A **rubbish pit**	
	21	CKR21	Unfinished **well**	
Krzywa 32-34 (site 99)	13	CKR13	A basement of a **residential house**	
Krzywa37 (site 160)	56	CKR56	A **rubbish pit**, initially presumably dug for chalk mining	
Krzywa 32-34 (site 19A)	4 (4a,4b)	CKR4	Feature of **unknown** purpose	Phase 2
	5	CKR5	Feature of **unknown** purpose	
	6	CKR6	Feature of **unknown** purpose	
	7	CKR7	Feature of **unknown** purpose	
	18	CKR18	A chalk shaft re used as a **rubbish pit**	
Krzywa 32-34 (site 99)	8	CKR8	**Chalk tunnel**	
	10	CKR10	A two storey **chalk tunnel**	
Łuczkowskiego square		CCW	A refilled communal city **well**	
Młodowskiej 12A	4	CM4	Part of a **household or a workshop** (burnt remnants of walls and flooring with a habitation layer)	
	11	CM11	Part of a **household or a workshop** (foundation of a hearth or a part of a stone wall)	
Łuczkowskiego square (2009 excavations)	20	CL20	**A large ditch/moat or remnants of a timber house**. Multi-layered fill:	Structure 20
			Layer 3: an anthropogenic layer of dark grey rendzina accumulated next to a wall; superposing all other layers of feature 20	
			Layer 10: a layer of chalk rubble produced by erosion of a wall	
			Layer 11 (11a): remnants of timber construction, a layer of soil rich in decayed timber; beneath unit 3	

was presumably also associated with this structure (Dzieńkowski, 2008). Animal bones used for the analysis were found in features 4 and 11. Other relevant features lacked osteological finds.

4.1.4.2 Kopernika 5/7

Excavations at the lot at Kopernika 5/7 uncovered part of a network of mined chalk tunnels and cellars dated to the sixteenth–seventeenth centuries (Gołub et al., 1997). The tunnels are the evidence of intensive chalk mining, whilst the presence of cellars suggests that chalk structures were assigned to particular houses and re-used by their inhabitants for domestic purpose (Gołub

Fig. 4.4 Chełm, Młodowskiej 12A. Structure 1 with its stone wall (features 2), and foundation of the hearth or stone wall (Feature 11), both marked in grey; and the remnants of burnt timber walls and flooring (Feature 4) marked in brown (figure from Dzieńkowski, 2008, edited by author)

et al., 1997). Chalk cellars like these are structures unique to Chełm (Gołub and Jarszak, 1998). Mined in chalk stone bedrock, they usually were less than 2 metre wide, and 3 to 8 metres long, the ceiling was 1.6–1.8 metre high. On both long walls, they had gouged out niches used for shelving (see fig. 4.5). The entrances to chalk cellars were placed in brick basements of residential houses, and steps were craved in chalk (Gołub and Jarszak, 1998). The fill of chalk tunnels and cellars was comprised mostly of presumably domestic rubbish dumped there by inhabitants of above houses, and chalk rumble (see fig. 4.6).

Due to the large size of the tunnels, only samples of fills were excavated and yielded archaeological material (Gołub et al., 1997). Animal bone assemblages appropriate for analysis were recorded in four features from the site: features 3, 5, 8, and 9. They were previously taken into consideration in a bachelor's dissertation (Bratkowska, 2002). Features analysed in this thesis are:

Feature 3 (fig. 4.5, 4.6), a chalk cellar, was about 7m long (Gołub et al., 1997). The longer walls had niches with 3 shelves on each side. The arched ceiling was mostly polished.

Fig. 4.5 Chełm, Kopernika 5/7. Feature 3, a chalk cellar after the excavation with exposed side niches (figure after Gołub et al., 1997)

Fig. 4.6 Chełm, Kopernika 5/7. Feature 3, a chalk cellar with chalk rubble before the excavation (figure after Gołub et al., 1997)

Feature 9 was another chalk cellar. It was 5m long, with niches and polished ceiling as in feature 3. Chalk rumble with pottery, animal bones and tiles constituted the fill.

Feature 8 was a chalk tunnel; it was excavated only partially.

Feature 5 was a pit dug in chalk stone with abundant finds of charcoal and unused fired hearth tiles that suggest the pit was a kiln (Gołub and Jarszak, 1998).

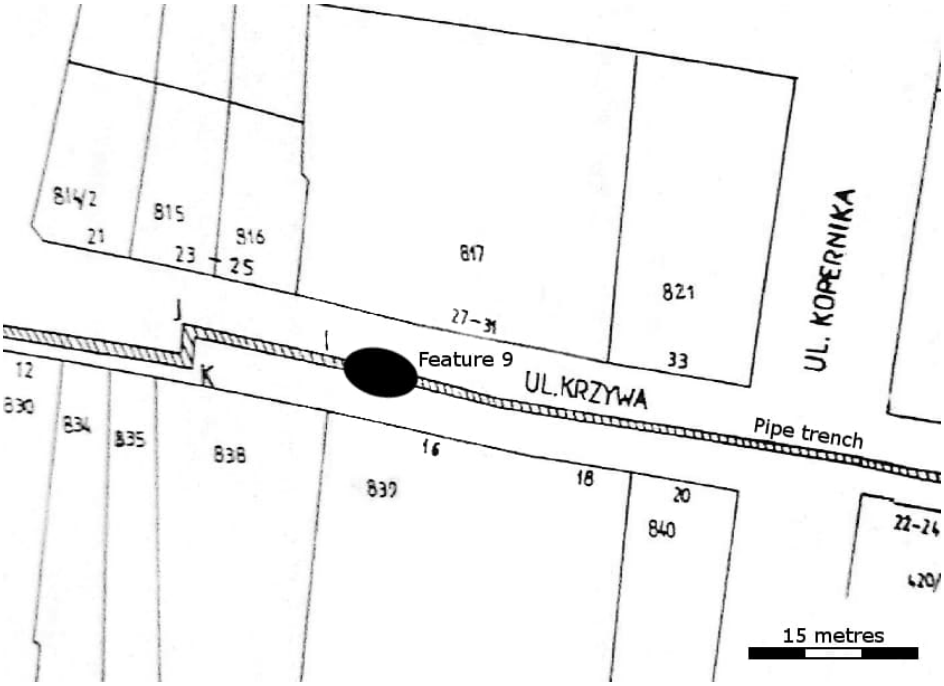

Fig. 4.7 Chełm, Krzywa 16. Location of feature 16 (figure after Mazurek et al., 1997, edited by author)

4.1.4.3 Krzywa 16

A solitary find of an entrance to a chalk shaft was found near the lot at Krzywa 16, about 100 metres west to the Great Synagogue (fig. 4.3) (Mazurek et al., 1997). Feature 9 (fig. 4.7) was dated to the late fifteenth or early sixteenth century based on the finding of a late medieval ceramic vessel in the top layer; however, it is possible that the finding was residual (Mazurek et al., 1994, 1997). The project did not allow for proper excavation, but a 30 cm wide trial trench uncovered the section of feature 9. The feature was approximately three metres deep, the fill was multi-layered, with an interesting layer of timber. Finds comprised of potsherds, fragments of tiles, pebbles, charcoal, and animal bones. The latter were mostly clustered in the deeper layers of the pit and included a deposit of a few dozens of goat horn cores.

Fig. 4.8 Chełm, Krzywa 32–34, site 99. Feature 8; section of the anthropogenic layer of the chalk tunnel (figure after Gołub, 1994)

4.1.4.4 Krzywa 32–34

Krzywa street lots 32 and 34 (site numbers 19A and 99) are located on an intersection of Krzywa and Szkolna, opposite to the remnants of the Great Synagogue (fig. 4.3) (Dzieńkowski et al., 1996; Gołub and Dzieńkowski, 1997b). The site yielded several early modern features: previously unknown chalk tunnels, three wells, remnants of houses and cellars. A part of the animal remains from the site were previously analysed: features 18, 20 and 21 (site 19A) in a masters dissertation (Dąbrowska, 1999); and features 8, 10, 13 (site 99) in a paper (Lasota-Moskalewska, 1997a). Features analysed in this thesis are:

Feature 8 (site 99), from seventeenth–eighteenth century, was a short chalk tunnel with an anthropogenic layer which accumulated during the utilisation of the tunnel (fig. 4.8) (Gołub et al., 1994). The tunnel was more than 5m. long, it had polished arched ceiling (fig. 4.9), niches gouged out in chalk on its sides, and was connected through a cellar with a residential building (feature 6 from site 99). (Gołub et al., 1994; Gołub, 1997d).

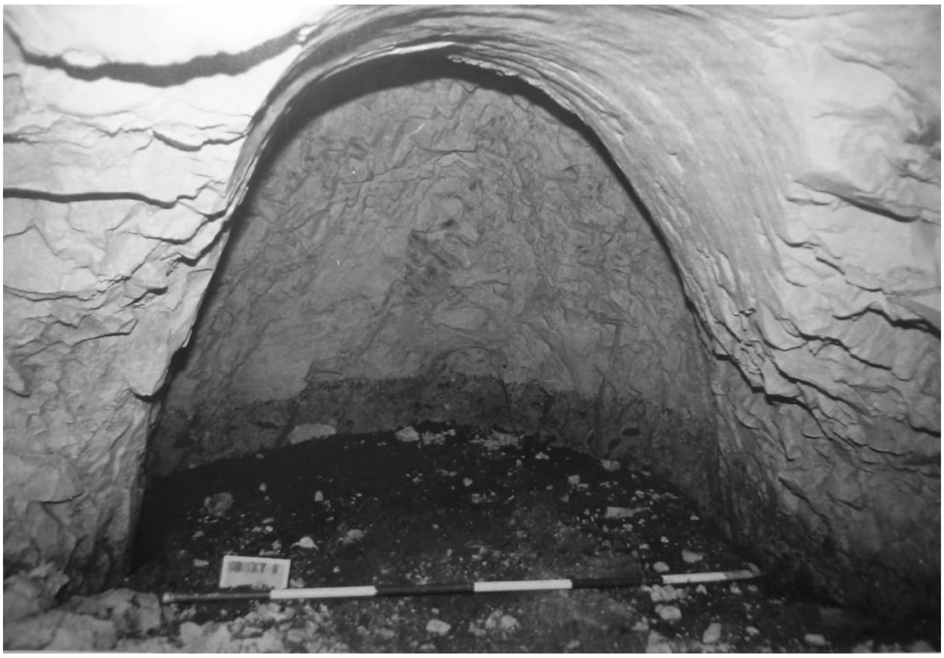

Fig. 4.9 Chełm, Krzywa 32–34, site 99. Chalk tunnel (feature 8) with the anthropogenic layer (figure after Gołub, 1994)

Feature 10 (site 99) was a two storey net of chalk tunnels. It was partly filled with chalk rubble (fig. 4.10). The upper storey was 30 metres long and the lower one 25 metres long. It is one of the most notable passages in the town's entire chalk mining network because of the discovery of the relief of the eagle carved to one of its walls (fig. 4.11) (Gołub et al., 1994). The feature yielded, however, other notable finds: small niches used for holding torches gouged in walls, steps gouged in chalk and supported with stones, and a well preserved habitation layer (Gołub, 1997d). Excavations of an anthropogenic layer located near the entrance uncovered bones and many potsherds dated to the sixteenth century onwards (Gołub, 1997d).

Feature 13 (site 99) presumably was a basement of a residential house (Gołub et al., 1994). Its walls were timbered and the basement was founded on a buried entrance to a chalk tunnel or was constructed as an antechamber to the tunnels and buried later. The feature layers can be assigned to two main horizons, the first dated to the fourteenth–fifteenth centuries and the second to the sixteenth–seventeenth centuries. Abundant artefacts were found in the feature. The presence of many shapes and types of pottery, including fine majolica-like plates and goblets, as well as orna-

Fig. 4.10 Chełm, Krzywa 32–34, site 99. Feature 10. The upper storey of the chalk tunnel filled with chalk rubble before the clearing (figure after Dzieńkowski et al., 1996)

Fig. 4.11 Chełm, Krzywa 32–34, site 99. Feature 10. The relief of the eagle carved to one of the walls of the chalk tunnel (figure after Gołub, 1994)

mented glassware suggests that the residents of the household were wealthy (Gołub et al., 1994).

Features 4, 5, 6, 7 (site 19A) were of unknown function. Their plans and descriptions were not published, but the majority of the pottery from those features was dated to the early modern period.

Feature 18 (site 19A), dated to the sixteenth century onwards, was presumably a chalk shaft which was re-used as a rubbish pit (Dzieńkowski et al., 1996; Gołub, 1997b).

Feature 20 (19A) was a rubbish pit, dated to the seventeenth century.

Feature 21 (19A) was an unfinished well, square in plan and 2m x 2m wide (Gołub, 1997b). The feature was gouged in the chalk stone, 8 metres deep and narrowing to its bottom. The fill comprised of chalk rubble with little dirt. The pit was presumably initially intended to be a well, but the early-modern well-diggers did not reach the underground water source, so they ceased their work and refilled the shaft in a single event (Gołub, 1997a,b). The rich assemblage from the fill comprised of knives, belt buckles, numerous glassware, over 400 fragments of animal bones and almost a thousand potsherds and several complete vessels (Gołub, 1997a). Some finds, including a ceramic plate with fish ornaments and some small ritual vessels, suggest a connection with the Jewish community and also the wealth of the local residents (Gołub, 1998). The fill can be dated to the second half of the sixteenth century or the first half of the seventeenth century.

4.1.4.5 Krzywa 37

Excavations at Krzywa 37 (site 160) uncovered remnants of the Great Synagogue (Dzieńkowski, 1998; Dzieńkowski and Gołub, 1999). A part of animal bones from the site was previously analysed in a master's dissertation (Stacewicz, 2005), but was unavailable for re-analysis. Here I will only focus on previously unanalysed feature 56, which was a deep rubbish pit (fig. 4.12). The deepest layers of the pit can be dated to the fourteenth–fifteenth century, while the upper layers are presumably from the sixteenth century. The feature was likely to be initially established for chalk mining in fourteenth–fifteenth century and became a waste pit later.

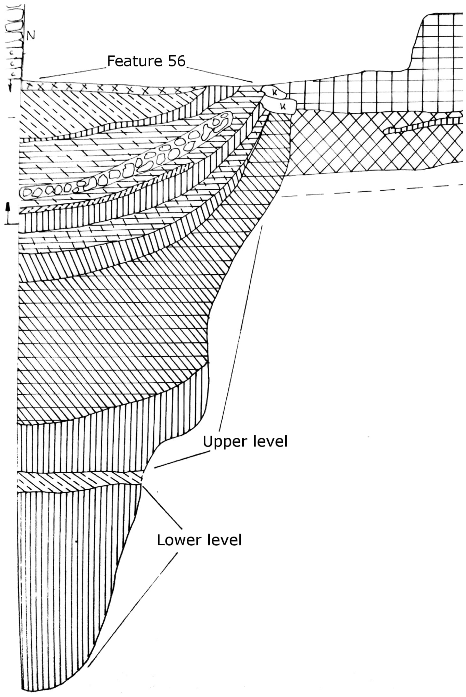

Fig. 4.12 Chełm, Krzywa 37, site 160. Section of feature 56, eastern aspect (figure after Dzieńkowski and Gołub, 1999)

4.1.4.6 Łuczkowskiego market square

The sample from Łuczkowskiego comes from feature 20, excavated as a part of the excavations of the remnants of the seventeenth–nineteenth century city hall (fig. 4.13) (Gołub and Dzieńkowski, 1997a; Rejniewicz, 2002; Dzieńkowski and Gołub, 2009). Feature 20 (fig. 4.14) was a two metre deep anthropogenic depression dug in chalk bedrock, adjacent in its southern part to the northern wall of the city hall. Osteoarchaeological finds analysed in this thesis derive from three out of several layers of feature 20, mainly from the topmost layer 3, which was rich in coins, mostly from the sixteenth century. The feature is either a ditch/moat or remnants of a timber house from the fifteenth–sixteenth century.

4.1.4.7 City well

The most notable well in Chełm was discovered in the middle of the Łuczkowskiego square, eastwards to the remnants of the city hall. It was first noted in the 1960s by modern miners who were excavating a new passage to connect historic chalk tunnels, and explored archaeologically in the 1980s (Bronicki

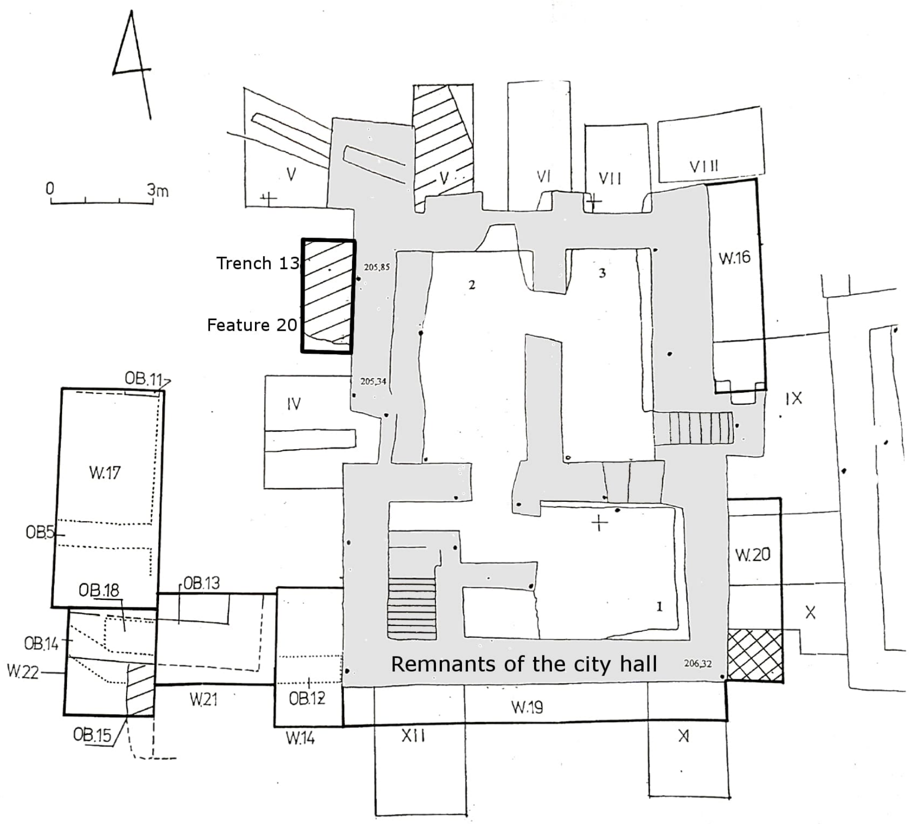

Fig. 4.13 Chełm, Łuczkowskiego square. Remnants of the city hall and location of the archaeological trenches (figure after Dzieńkowski and Gołub, 2009)

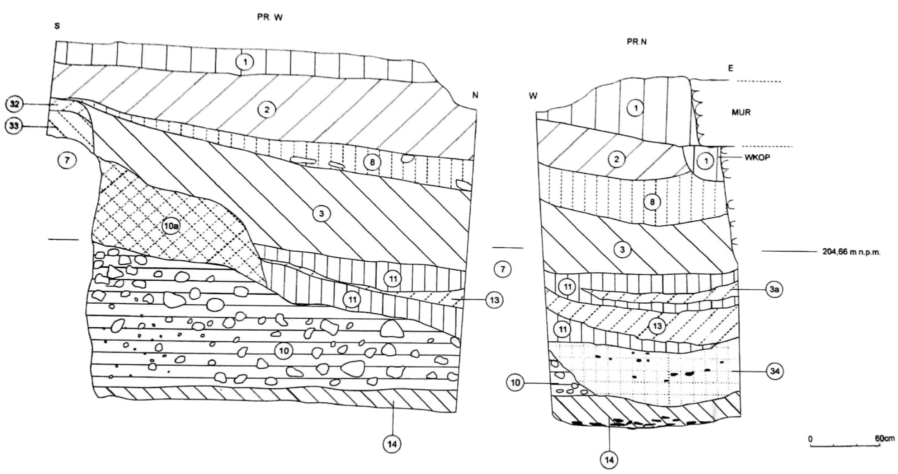

Fig. 4.14 Chełm, Łuczkowskiego square. Section of feature 18, western and northern and aspects. Digits in circles represent numbers of layers (figure after Dzieńkowski and Gołub, 2009)

et al., 1991). Today, the well is an important symbol of Chełm and is accessible for viewing from chalk tunnels. It was 24.5 metres deep, rectangular in shape (fig. 4.15 and 4.16). The overground construction of the well was made of wood and brick. The well ceased to serve the community after one of the large conflagrations that affected the town in the late eighteenth century, and was subsequently refilled (Bronicki et al., 1991). The uniformity of the fill across the whole section suggests that the well was refilled in a single, rapid event. Soil and rubble used for refilling was collected from strict proximity and may represent the rubbish left by local residents. Animal bones were previously analysed by A. Lasota-Moskalewska (Bronicki et al., 1991; Bronicki, 1997)

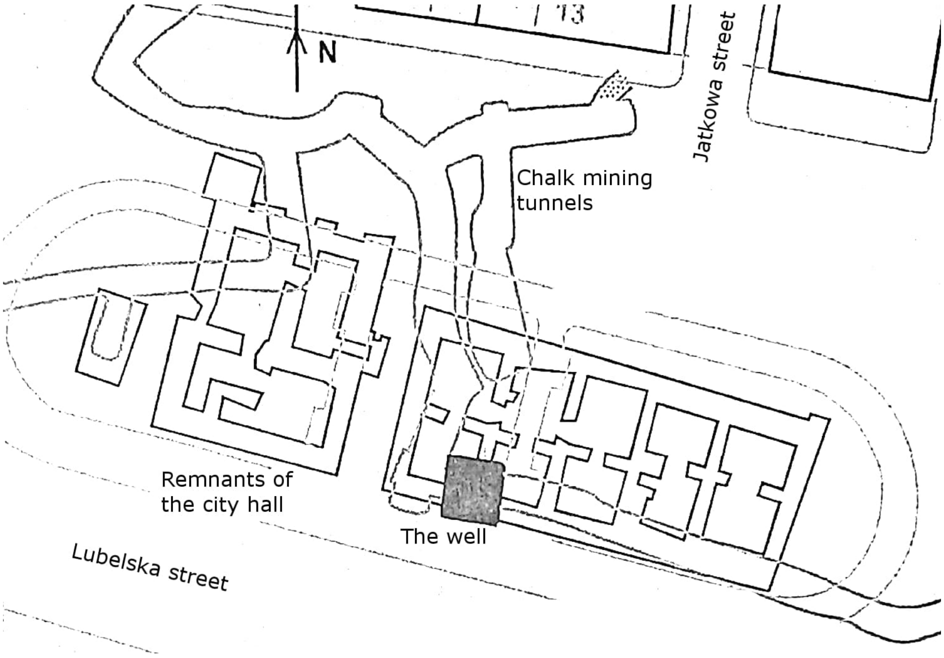

Fig. 4.15 Chełm, Łuczkowskiego square. Location of the well, remnants of the city hall and chalk tunnels (figure after Bronicki and Tworek, 2003)

4.2 Wrocław

Wrocław (pronunciation: *vrotz-waff*) is one of the major cities in present-day Poland and a historic capital of the Silesia region, in Western Poland (fig. 4.1). Throughout history, national borders around Wrocław have changed many times, leaving the city under the rule of different countries; this has resulted in a multicultural melting pot of many ethnicities.

The city originates from a Bohemian settlement, a hillfort, located on the bank of the Odra River in the tenth century and was most likely named after a Bo-

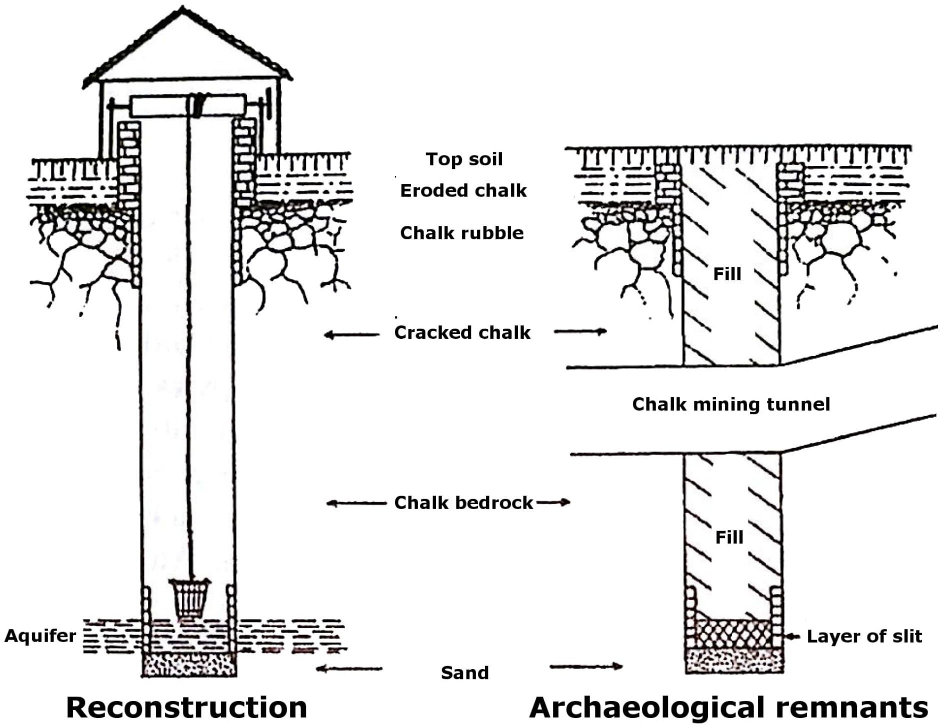

Fig. 4.16 Chełm, Łuczkowskiego square. Simplified section of the well: archaeological remnants and reconstructed well (figure after Bronicki and Tworek, 2003)

hemian duke, Vratislav I (Davies and Moorhouse, 2002, p.55). Soon, it fell under Poland's rule, and in the aftermath of the Congress of Gniezno, 1000 CE, the German Emperor put the city under the ecclesiastical See of the Polish royal city of Gniezno. This was an important argument in Poland's claims to the city in later times. In the next few centuries three forces competed for the rule of Silesia; the Polish, the Czech, and the German rulers (Davies and Moorhouse, 2002, p.61). Wrocław, called *Wrotzila* then, was predominately under Poland's reign from the tenth to the twelfth century. The city grew rapidly, quickly exceeding its initial territory of the hillfort built on Ostrów Tumski Island and became more dependent on auxiliary settlements in its proximity (Buśko et al., 2002, p.67 and 76). The twelfth–thirteenth centuries were periods of change. Silesia became a semi-independent duchy under the reign of Silesian Piasts and Wrocław became one city with the central hillfort with auxiliary villages (fig. 4.17).

The Duke's law was replaced by Magdeburg law Due to a substantial influx of German-speaking settlers, much of the townsfolk became culturally Germanised (Buśko et al., 2002, p.88; Davies and Moorhouse, 2002, p.88–90). The city counted several thousand people at the time. Its trade and culture flourished

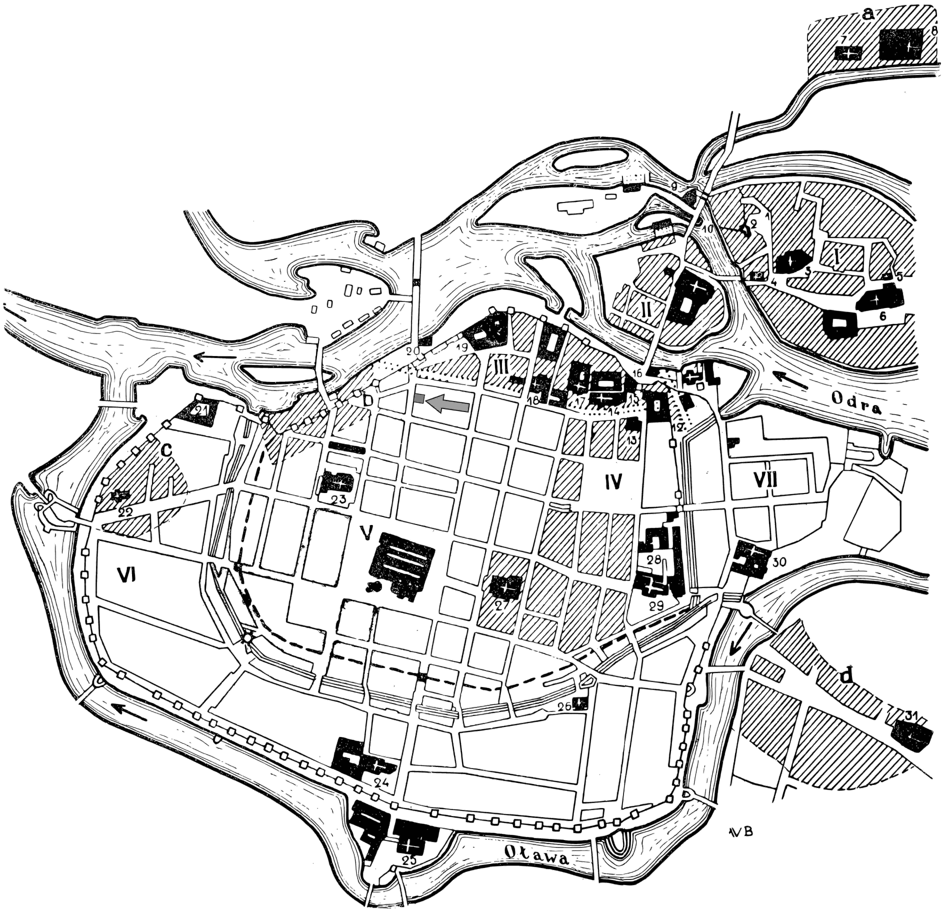

Fig. 4.17 Location of the site at Więzienna 11 (marked by a grey arrow) on the map of medieval Wrocław (figure after Münch and Maleczyński, 1948). Parts of the city are marked in Roman numerals: I. Ostrów Tumski (Cathedral Island); II. Piasek Island; III. Duke's City (enclosed by defensive earthworks); IV. Area planned for habitation in 1226–9 CE; V. 'Old Town' founded after Magdeburg law was granted; VI. Area incorporated to the city in the 13th century; VII. 'New Town' founded in 1263 CE. (Scale 1:6000; the north upwards)

due to its convenient location on the crossroad of important North–South and East–West trade routes (Buśko et al., 2002, p.76). When Silesia was incorporated into the Kingdom of Bohemia in 1335, Wrocław, called *Vretslav* then, was in its golden age of trade and prosperity but had also seen many conflicts. In the fifteenth century it was engaged in a 'trading war' with Poland that targeted Wrocław's merchants, and violent religious wars between Catholics and Hussites erupted (Davies and Moorhouse, 2002, p.112). The city was then one of the largest in Central Europe, reaching somewhere between 13,000 and 22,000 inhabitants (Buśko et al., 2002, p.202). Most of the townsfolk were German or Czech, with only a few thousand Poles and 3,000 to 5,000 Jews (Davies and Moorhouse, 2002, p.134–135). Wrocław was still in its prime when it was incorporated into the Habsburg Empire in the sixteenth century, reaching the population of 30,000–36,000 of people (Buśko et al., 2002, p.239). The Thirty Years War and other conflicts of the seventeenth century undermined trade in the region and put the 'golden age' of the city to an end.

4.2.1 Jewish presence in Wrocław, a brief history of the medieval *qahal*

The permanent presence of Jews in Bresloy (Yiddish: ברעסלוי), as the city was called in Yiddish (hence 'Bresle Jews'), can be traced to the late twelfth century (Ziątkowski, 2000, p.9–10; Buśko et al., 2002, p.71–72). Since the beginning, they were involved in craft and occasionally farming. Although, literary sources predominately mention money lending and their contribution to the trading importance of the city (Ziątkowski, 2000, p.10; Buśko et al., 2002, p.72). Bresle Jews were given fixed rights in a so-called 'Protection Privilege' in 1267 (Davies and Moorhouse, 2002, p.92). The charter was similar to the famous Kalisz Privilege, which granted the Jews some basic rights, including personal freedom and certain legal autonomy. The city quickly became the Jewish centre of Silesia; the *qahal* owned a few synagogues, a *yeshiva*, and a cemetery. Despite that, the situation of the Bresle Jews was far from ideal. The same year the 'Protection Privilege' was implemented, the Church's diocesan synod called for personal, spatial, and professional isolation of the Jews (Ziątkowski, 2000, p.9). Since they were not admitted to the city's guilds, Jewish craftsmen practised independently.

A prominent example of Bresle Jewish craftsmen were the butchers. In the early fourteenth century Jewish butchers were so numerous that they owned at least 12 out of the 92 slaughterhouses of the city (Ziątkowski, 2000, p.11; Davies and Moorhouse, 2002, p.91–92). This is a high number when compared to the Jewish proportion of the city population, and suggests that Jews supplied meat to Christians. This practice was frowned upon by the Church, which considered unacceptable that Christians would buy cuts previously deemed 'unclean' by the Jews (Ziątkowski, 2000, p.10). This very information presumably refers to the hind quarters of carcasses that had not been porged. Under the Church's influence the city set laws in 1315 forbidding meat trade between Christian and Jewish communities.

In the fourteenth century actions against the Bresle Jews turned violent. The community was heavily taxed by the rulers, and suffered due to various accu-

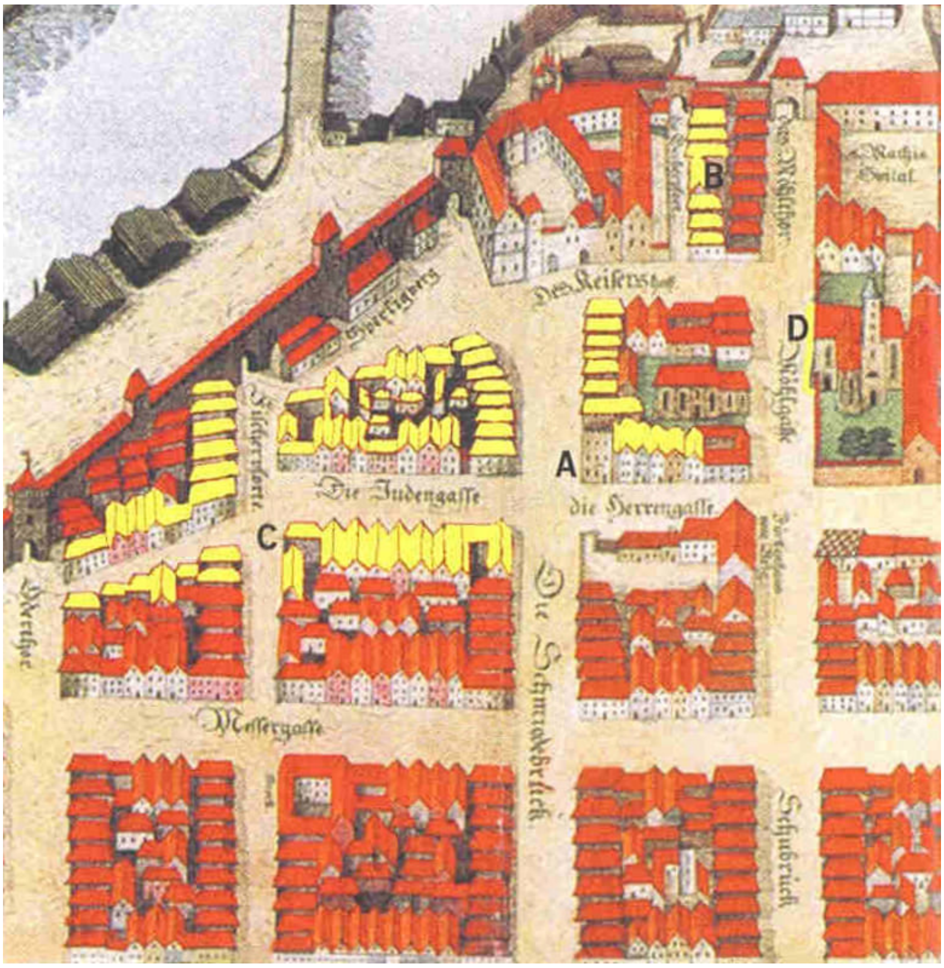

Fig. 4.18 The extent of the Jewish district of Wrocław on the city map from 1562 CE, according to A. Grotte (1937, after Ziątkowski, 2000, p.12). Yellow houses were owned by the Jews, letters mark the location of synagogues. The site at Więzienna 11 is located southward to the letter C, on the right-hand side of the street

sations made by the local Church. This in turn caused numerous anti-Semitic events, including *pogroms* and a few attempts of expelling the Jews (Buśko et al., 2002, p.139–140 and 156; Davies and Moorhouse, 2002, p.137–138). The anti-Jewish atmosphere caused many Jews to flee the city, which ceased to be the major Jewish centre of Silesia (Buśko et al., 2002, p.156). In 1423, the local Church proposed another set of rules aimed to cause the total isolation of the Jews from the Christians (Buśko et al., 2002, p.188). The final blow struck the community in 1453. The Church, led by its inquisitor, John of Capistrano, accused Bresle Jews of sacrilege and brutally murdered and burnt many of them, while forcing others into conversion or expulsion (Ziątkowski, 2000, p.16; Davies and Moorhouse, 2002, p.138). After this event, in 1455, the Bohemian king banned the Jews from living in *Vretislav* in the charter *Ius Iudaeos non tolerandis*, marking the end of the medieval community of Bresle Jewry. For the next 200 years the Bresle *qahal* ceased to exist, and visiting Jews mostly had a limited access the city during market days (Ziątkowski, 2000, p.17). Permanent Jewish inhabitants re-appeared in 1657.

4.2.2 The Jewish quarter

The Bresle Jews presumably settled in the Ostrów Tumski hillfort, but in the twelfth century they were moved to duke's premises on the left bank of the river that was close to the market. In the thirteenth century the left bank was a prominent centre for merchants and artisans. It had a regular and planned urban layout with a market square, main streets paved with logs, and wooden and sporadically brick and stone houses (Buśko et al., 2002, p.87–93). In the Middle Ages the Jews inhabited houses amidst their Christian neighbours, around the present day streets of Uniwersytecka (known a Judengasse, "the Jewish Street", in the medieval times), św. Barbary, Nożownicza (medieval Messergasse), pl. Uniwersytecki, Kuźnicza, and Więzienna (medieval Stockgasse) (fig. 4.18) (Piekalski, 1999, p.7; Ziątkowski, 2000, p.11). In the Middle Ages the Jewish district was relatively close to the city defensive wall.

4.2.3 The archaeological site at Więzienna street

The assemblage of animal bones from Wroclaw was recovered from a site on Więzienna Street number 11. The lot 11 was excavated along the neighbouring lot 10, but materials from the latter were unavailable for my analysis.

The site is located in the periphery of the medieval Jewish district, in the eastern part of Więzienna Street (fig. 4.17, 4.18) Excavations were carried out from 1989 to 1991 by researchers of the University of Wrocław (Piekalski, 1999, p.14). The results were initially published separately for lot 10 (Buśko et al., 1992) and lot 11 (Borkowski et al., 1993) and then expanded and published again a few years later (Buśko and Piekalski, 1999). A total area of 330 square metres was excavated; the trench, in its largest dimensions, was 23 meters long, 18 meters wide, and 3 meters deep (Piekalski, 1999, p.14). Archaeological layers and features were documented as 'stratigraphic units' (Polish *jednostki stratygraficzne*; often abbreviated as 'j.s.') within the Harris matrix of the site (Harris, 2014). The state of preservation of most archaeological contexts was rather good (Piekalski, 1999, p.14).

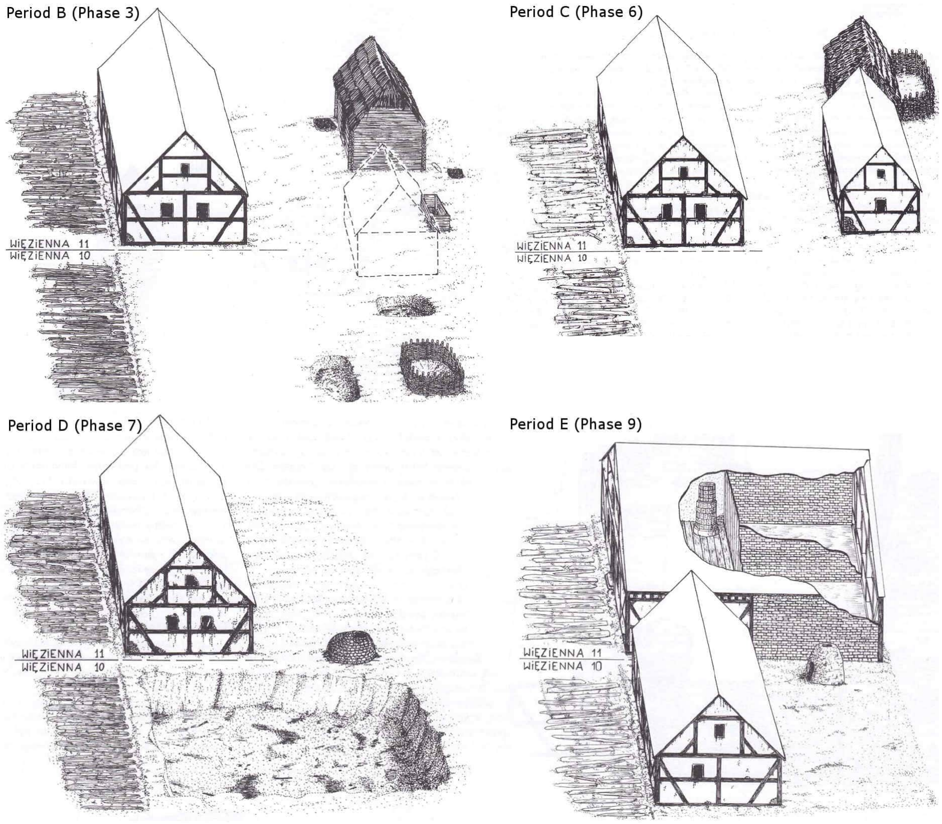

Fig. 4.19 Wrocław, Więzienna 11. The reconstruction of buildings at lot Więzienna 11 in periods B, C ,D, and E. The main residential building (referred to as functional zone 1) is present on the left-hand side of the lot, bordering with the street. Other functional zones are present further right into the plot: production buildings, hinterhäusen, and sanitation constructions (figure after Buśko, 1999b)

The site at Więzienna 11 shows a distinct model of urban planning in the Middle Ages; the lot was divided into **four functional zones** (Buśko, 1999b, p.210):

The first zone was the main residential area located at the front of the lot, on the side of the street. This area encompassed the main building of heavy framed construction, which was modernised through the ages from a wooden house to a gothic brick residential building (Buśko, 1999b, p.210).

The second zone included structures used by the residents for production, manufacture, and storage. This includes remnants of activities such as comb production, cooperage, clay storage, as well as hearths (Buśko, 1999b, p.210).

The third zone encompasses so-called *hinterhäusen*; the buildings at the back of the lot. These could have had two functions; those of sturdier log or frame construction were residential houses of lower standard than the main house, presumably lent to tenants (Pudełko, 1971). Buildings of a lighter, wattle construction were presumable barns or animal sheds (Buśko, 1999b, p.210).

The fourth zone was so-called 'sanitary area', and it included water wells and latrines. It was located at the back of the lot and was being gradually moved even further back in the later phases (Buśko, 1999b, p.210).

Buśko (1999b, p.212–214) has differentiated eleven phases of architectural development at the site, which I grouped into **main five periods** (fig. 4.19):

- Occupation which precedes the urban planning of the lot includes a refuse pit (j.s.98) and a building of light construction (j.s.96) (Buśko, 1999b, p.212–214). I will refer to these features as **Period A**; lasting until 1250 CE. During this time, Wrocław was a part of the Kingdom of Poland and later the Silesian duchy.

- **Period B** encompasses four phases of architectural development of the lot (Phases I to IV) since it underwent urban planning from about 1250 CE until the early fourteenth century (Buśko, 1999b, p.212–214). In those 40–50 years, a heavy constructed main building with a basement at the front of the lot was built and subsequently slightly re-modelled. At the back of the lot, residents constructed smaller and lighter structures which they repeatedly replaced with new ones in a short span of time. The standard of living of residents of the lot presumably improved over those years, which can be seen in the evolution of the waste disposal from a simple soil pit to a timbered latrine. The finding of a number of pits with horn comb production refuse suggests that some of the residents of the lot were professionally involved in this activity. The presence of pits with wood shavings, or possibly cooperage refuse, may also be a result of the residents' occupation. This period is also connected to a number of finds of weapons, which led Wachowski (1996) to the suggestion that the frontal, main house was inhabited by a soldier who was also a landlord lending the back of the parcel to artisans (Buśko, 1999b, p.212–214). During this period, the city was the heart of a semi-independent Silesian duchy.

- **Period C** includes two phases of architectural development (Phase V and VI) and it spans the almost entire fourteenth century. In this period the main building was still in place at the front of the lot, whilst the hind-zone buildings were being replaced with a framed constructed one. The lot in this period underwent far fewer architectural changes than in the previous one. The lack of comb production refuse and weapons in this period suggests that both the comb making artisan and the soldier did not live there anymore (Buśko, 1999b, p.212–214). During this period, the city became a part of the Kingdom of Bohemia.

- **Period D** (enclosing Phase VII) is dated to the late fourteenth–early fifteenth centuries. The lot underwent a visible change in this period and presumably changed owner. The back of the lot was razed, covered with a thick layer of dirt, rubbish, and manure; sharply separating it from the subsequent habitation (Buśko, 1999b, p.212–214). The city in this period was a part of the Kingdom of Bohemia.

- **Period E** (including Phases VIII to X; fifteenth–seventeenth centuries). In the early fifteenth century the lot was divided into two, separate lots corresponding to the present day lots Więzienna 10 and Więzienna 11. Since then, all the buildings were gradually replaced with more permanent brick constructions. In the late fifteenth century a secondary building at the back of the lot was used for tannery (Buśko, 1999b, p.212–214). In this period, the borders around the city changed: initially it was in the Kingdom of Bohemia, then the Kingdom of Hungary, Bohemia again, and lastly, under the Habsburg Monarchy.

The above-mentioned periods did not initially have assigned names (i.e. letters 'A' to 'E'), but I have introduced them for the sake of clarity.

For the use of this thesis I have taken into consideration reasonably well dated stratigraphic units with substantial number of bones coming from Periods A, B, and C, where there is presumable Jewish presence. Additionally, I have included several contexts from Periods D and E, though these contexts seem to be less coherent archaeologically and may be subject to post-depositional disturbance; hence, I only sampled them to have a general comparative base for the earlier periods. The full list of stratigraphic units analysed is presented in table 4.2.

Table 4.2 Wrocław. List of stratigraphic units from Więzienna 11 site included in this thesis with their detailed description (figure after Buśko, 1999b)

Period	Stratigraphic units (j.s.)	Phase	Function	Dating
PerA	96	0	light wooden building	< 3rd quarter of 13th c.
PerA	98	0	refuse pit (mostly destroyed)	< 3rd quarter of 13th c.
PerB1	91	1	wooden, framed house with basement (70m^2), located in the front of the lot	3rd quarter of 13th c.
PerB1	99	2	wooden, framed house with basement, located in the front of the lot; remodelled house j.s.91 (50m2)	3rd quarter of 13th c.
PerB2	88	2	wood working place (possibly associated to cooperage)	3rd quarter of 13th c.
PerB2	93	2	clay storage pit	3rd quarter of 13th c.
PerB2	95	1	two connected pits, with raw material and waste of comb production adjacent to the house j.s. 95	3rd quarter of 13th c.
PerB2	100	1	a rubbish pit with raw material and waste of comb production; adjacent to the house j.s. 91	3rd quarter of 13th c.
PerB3	75	3	a layer accumulated during habitation of a log cabin at the back of the lot	3rd quarter of 13th c.
PerB3	79	2	a pit	3rd quarter of 13th c.
PerB3	81	3	a building (possibly a barn) built on the spot of demolished previous one (j.s. 84)	3rd quarter -early 4th quarter of 13th c.
PerB3	83	2	layer of sandy humus with charcoal, sawdust, and fragments of bricks which covered a yard between buildings of phase 2	3rd quarter of 13th c.
PerB3	84	2	heavy wattle structured annexe to the building j.s.92	3rd quarter of 13th c.
PerB3	89	2	layer of sandy humus with charcoal, sawdust, and fragments of bricks which covered a yard between buildings of phase 2	3rd quarter of 13th c.
PerB3	92	2	free-standing building at the back of the main house j.s. 99	3rd quarter of 13th c.
PerB3	101	1	a pit of unknown function; adjacent to the house j.s. 91	3rd quarter of 13th c.
PerB4	67	4	a large latrine	late 13th/early 14th c.
PerB4	69	4	wattle roofing of the latrine (j.s.67)	late 13th/early 14th c.
PerB4	80	3	a well, reused as a latrine which replaced the previous one (j.s. 86)	3rd/4th quarter of 13th c.
PerB4	86	2	pit with human waste, no supporting constructions	3rd quarter of 13th c.
PerC1	61	5	a frame constructed annexe built over the demolished cabin (j.s.71) and adjacent to the hind wall of the main house (j.s. 99)	14th c.
PerC1	42d	6	a building, possibly an annexe to the main building	14th c.
PerC2	42	6	a layer of humus with manure surrounding a fire place	14th c.
PerC2	60	5	heavy wattle building with a fireplace built on the spot of re-filled latrine (j.s. 67)	14th c.
PerC3	54	6	a fireplace adjacent to j.s.55	14th c.
PerC3	55	6	a wattle free-standing construction/ annexe to a building at the back of the lot	14th c.
PerC3	56	6	a layer of manure with clay accumulated during habitation at the back of the lot	14th c.
PerC3	58	6	free-standing building at the back of the main house j.s. 99, built over the demolished annexe (j.s.61)	14th c.
PerC3	65	5	a layer of manure with clay	14th c.
PerD	34	7	a hearth	late 14th/early 15th c.
PerD	37	7	a thick layer of humus with clay	late 14th/early 15th c.
PerD	51	7	a layer of clay with humus	late 14th/early 15th c.
PerE	6	10	a basement of a residential building	first half of 16th c.
PerE	9	10	a layer of unspecified function	first half of 16th c.
PerE	40	10	a foundation trench for a wall	first half of 16th c.
PerE	44	8	a foundation trench for a wall	15th c.
PerE	46	10	a layer of unspecified function	first half of 16th c.
PerE	49	8	a foundation trench for a wall	15th c.
PerE	64	8	a pit inside a basement, filled with sand	15th c.
PerE	94	9	a layer of humus with debris filling a basement	late 15th c.

4.3 Lelów

Lelów (pronunciation: *le-loof*) is a small town on the upland of Lesser Poland region in the southern part of the country (fig. 4.1). The earliest historical

Fig. 4.20 Lelów. Map of the town from 1823 CE. The grey ring enclosing the town centre marks the location of medieval defensive earthworks. The excavated area is marked in red (map from http://lelow.pl, last accessed October 2018).

record of Lelów comes from a papal document from 1193 CE which mentions the presence of a market and an inn near the present-day location of the town (Białowąs et al., 2005, p.38). In 1246 CE duke Konrad of Masovia conquered the lands and founded a wooden fortified hillfort on a hill over the Białka River (Białowąs and Nowak, 2012, p.9). The location of the defensive earthworks was still visible on the map of the town from 1823 (fig. 4.20).

Lelów gained importance in the thirteenth and fourteenth century, when it was an important Poland's stronghold during its wars against Bohemia. In 1340 the Polish king, Casimir III the Great, granted the town Magdeburg law, expanded its castle and encircled it with a defensive wall (Białowąs and Nowak, 2012, p.11–14). In the fourteenth, fifteenth, and sixteenth century Lelów prospered and became one of the most important settlements of Lesser Poland, reaching 1500 inhabitants. Lelów was a town of craftsmen and artisans. Cloth-making was an important branch of industry in Lelów due to the abundance of woolly sheep herds kept on local soils unsuitable for cultivation (Białowąs and Nowak, 2012, p.20–21). Long and short distance trade were also important to the town's economy, because it was located at the crossroad of important trade routes in the Middle Ages and early modern age (Białowąs and Nowak, 2012, p.6). One of them connected Russia with Kraków and farther to Silesia and Wrocław, while another passed through Lelów on the way from Moldavia to Germany via Wrocław, and others connected Kraków with Poznań, Warsaw, the Sieradz region, and the west part of the Sandomierz region (Zarubin, 2006; Białowąs and Nowak, 2012, p.6–7). The seventeenth century was a difficult time, as Lelów struggled with frequent fires and conflicts, such as the Great Northern War, which left the city mostly ravaged and with its defensive walls destroyed. From this time, Lelów importance started decreasing and the town deteriorated. By the eighteenth century it was a small town whose inhabitants mostly made their living from agriculture.

4.3.1 Jewish presence in Lelów — a brief history

The history of the Jews of Lelów (Yiddish: לעלוב), or the Lelover Jews, starts relatively late. There is very little evidence of Jewish communities in the Middle Ages. Even the medieval Jewish merchants did not settle in Lelów despite the fact the region was located on important trade routes (Spyra, 2016). The earliest records note the presence of several dozen Jewish families before the conflagration of the town in 1547, but the first Jews might have settled there in the late fifteenth century. Nonetheless, only six families remained in Lelów after yet another conflagration in 1564 (Małecki, 1964, p.43). Since the end of the sixteenth century, Lelów had an organised *qahal* with a rabbi, a synagogue and a cemetery located in the southern part of the town (Spyra, 2016). During that time, Lelover Jewish merchants played an important role in the regional economic development. They traded their goods, such as leather, at Kraków's markets. The Lelover Jews were granted rights equal to other townsfolk in a privilege bill from 1612. Those included the freedom of trade of alcoholic beverages and other goods (Goldberg, 1984, p.146). These privileges were confirmed and further exceeded in a royal bill from 1646 (Zarubin, 2006). The new rights also included the right to slaughter cattle and sell beef if it did not violate the town's law (Falniowska-Gradowska, 1991).

The town was severely affected by military conflicts which were frequent in the middle of the seventeenth century, resulting in the Jewish trade with Kraków ceasing. Lelover Jewish community seem to have comprised only 18 members in 1678, but these numbers are believed to be underestimated (Guldon, 1991; Zarubin, 2006).

Jewish and Christian townsfolk in Lelów were engaged in several quarrels and legal conflicts with each other during the seventeenth and eighteenth centuries

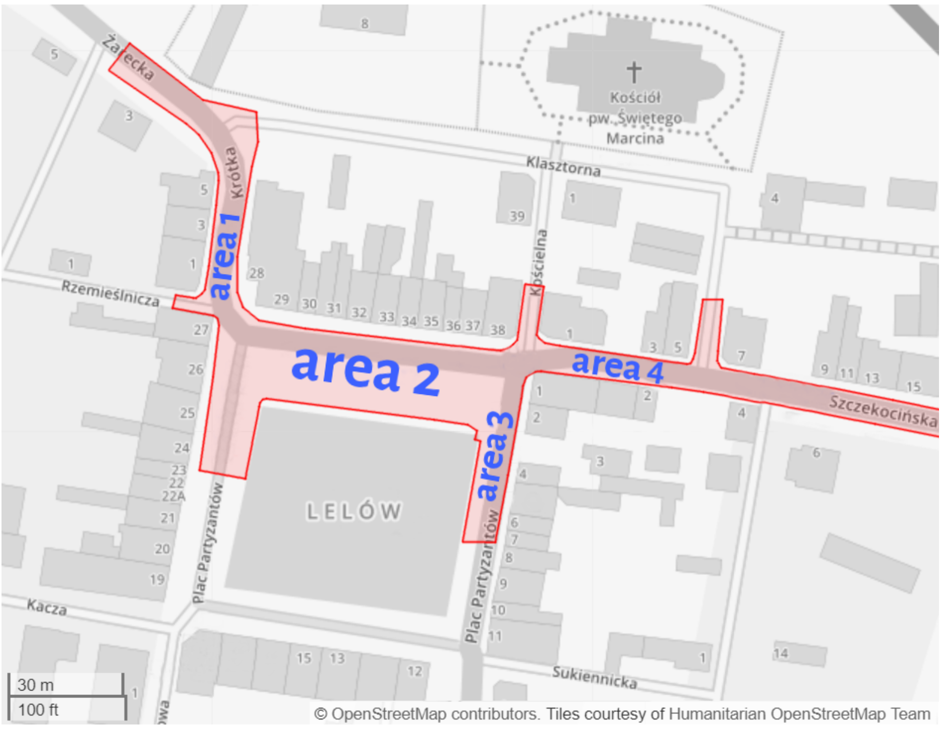

Fig. 4.21 Lelów. Map of the town with the extent of the 2011 excavation (in red) and the location of particular areas

(Zarubin, 2006; Spyra, 2016). This resulted in some restrictions imposed on the Jewish community in 1778. The Jews were allowed to produce comestibles only for their own use and could not trade them, the number of Jewish butchers had to be smaller than their Christian counterparts. Also, the Jews could own only 20 houses in Lelów, and they faced some limitations in lease (Zarubin, 2006; Spyra, 2016). Despite those limitations, the Jews owned 29 out of 129 houses in Lelów ten years later. The number of Lelover Jews in the late eighteenth century accounted approximately 200 inhabitants, who constituted about 20 percent of townsfolk (Zarubin, 2006). At the end of the eighteenth century the most common occupations of the Jewish inhabitants were tenant farmer, publican, and tailor (Białowąs and Nowak, 2012, p.29). There were also five Jewish butchers and one *shoychet*, who was presumably responsible for the killing. The Lelover *qahal* was one of the most important in the region in the eighteenth century, and was in charge of Jewish communities of neighbouring towns. Lelów became an important place for the Hassidic movement in the early nineteenth century, being home to famous *tzadik*, David Biderman and his Lelov Hassidic dynasty, whose members are still alive. The location of specific Jewish households in historic Lelów is not known. A Jewish cemetery was founded in the late sixteenth century near the present-day Ogrodowa street, on the southern side of the town. Next to it, a synagogue was erected.

4.3.2 Archaeological sites in Lelów

The archaeological excavation carried out in 2011 was the largest ever undertaken in Lelów. It preceded roadworks on road 46 and extended to several streets (fig. 4.21), covering a large portion (3600 square metres) of the town centre (Dobrakowski et al., 2013). The excavation was conducted by Mariusz Dobrakowski and Teresa Dobrakowska in 2011, and the results presented in a report submitted to the local heritage protection officer (in Dobrakowski et al., 2013), but it has remained unpublished. Animal bones from the site were recorded in a simple list of species and body parts in Boratyński (2013), included in Dobrakowski et al. (2013), but more elaborated zooarchaeological analysis was not undertaken.

The excavation yielded important findings; it revealed part of the town's defensive wall with a medieval gate, a medieval log-paved road with a wooden bridge, a moat, and a stone-paved part of the market square. Another important discovery was represented by the remnants of a kosher butchery shop on the market square, which were dated to the eighteenth century (Partyzantów square, area 2).

Animal bones analysed in this thesis come from habitation layers, rubbish pits, and butchery shop refuse layers. The assemblage derives from a large excavated area and was split into smaller parts for the sake of analysis. Based on location of analysed habitation layers I divided the area of excavation into four smaller areas, whose location can be seen in fig. 4.21. The dating of layers and features divides them into two general periods: those accumulated between the fourteenth and sixteenth century on the one hand and the seventeenth and eighteenth century on the other. Based on this spatial and chronological division, for the sake of analysis, I differentiated **seven groups**. The list of stratigraphic units (j.s.: 'jednostka stratygraficzna') and features which comprise each group can be found in table 4.3.

Table 4.3 Lelów. List of archaeological units and features used in the thesis for each period

Area (street)	Period A (14^{th}-16^{th} century)	Period B (17^{th}-18^{th} century)
Area 1 (Krótka street)	units: 9; features: 175, 201, 204, 224, 266	units: 6, 27, 29, 30, 39; features: 235, '*JATKI*' (butcher's shop)
Area 2 (Partyzantów str. numbers 25-38, Kościelna street number 25)	units: 8, 9, 24, 33, 41; features: 70	
Area 3 (Partyzantów street, numbers 2-5)	units: 9, 24, 33, 37	units: 27, 29
Area 4 (Szczękocińska str.numbers 1-15; Klasztorna street)	units: 7, 8, 9, 13, 15, 16, 22, 23; features: 11b, 64, 69	units: 6, 12, 46, 53, 57, 78; features: 2, 4, 39, 40

4.4 Prague

Prague, or Praha, is the historic capital of Bohemia and the capital of the present-day Czech Republic (fig. 4.1). For centuries, Prague was one of the most important cities of Central Europe, the seat of Czech kings and Holy Roman Emperors.

The history of the city began in the late 880s when the Czech duke Bořivoj of the Přemyslid dynasty decided to move his seat to the Hradčany plateau, where he built his hillfort on the western bank of the Vltava River (Demetz, 1997, p.13–14). In the tenth century, another hillfort was built on the eastern riverbank. It became known later as Vyšehrad. Both fortifications became the centres of new settlements, and hubs of trade and crafts. Early Prague was strategically located on astride an important international trade route connecting Germany and Western Europe with Poland and Russia (Demetz, 1997, p.14). In the tenth century the city was a very busy trade centre hosting merchants from all over Europe. In the following centuries Prague quickly grew and several churches, basilicas, and monasteries were erected (Demetz, 1997, p.30–31). In the twelfth century Bohemia became a kingdom and the hillfort on the left riverbank became the Prague Castle enclosed by stone walls.

Medieval Prague was more of a network of smaller towns and settlements than a homogeneous city (Demetz, 1997, p.32 and 81). Two of the most important ones, the Old and the Minor Towns were established in the thirteenth century. Later in the mid-fourteenth century, the settlement around the Prague Castle became the Castle District, or Hradčany. Minor Town, or Malá Strana, was established by the king on the location of an existing settlement below the

Prague Castle to settle merchants and artisans from Germany. The present-day heart of Prague, the Old Town (Staré Město) was founded a few decades earlier on the right riverbank, on the spot of a few merged smaller settlements. The Old Town had several Christian and Jewish temples, a market square, and later was enclosed by a defensive wall. The common folk mostly lived in wooden houses but the wealthy local merchants erected elaborate Romanesque stone buildings (Demetz, 1997, p.34).

In the late thirteenth and early fourteenth century, after the deaths of King Přemysl Otakar II and later his son, Prague underwent a very uneasy period of revolts, plunders, foreign occupation, hunger, and pestilence, during which many inhabitants perished (Demetz, 1997, p.67). The city entered the era of prosperity when Charles IV from the Luxembourgs took over the reigns as the Holy Roman Emperor in the mid-fourteenth century. Prague became the capital of the Holy Roman Empire and gained importance. Charles initiated the urbanistic and architectural development of the city, including the founding of the New Town southwards to the Old Town (Demetz, 1997, p.78). Charles' Prague, with all its districts, was one of the largest cities in Europe, with the population estimated to count somewhere between 30 and 100 thousand people (Demetz, 1997, p.81). Prague inhabitants of different nationalities tended to live in clusters, Czechs and Germans in separate places, and the Jews in the Jewish Town (Demetz, 1997, p.124).

In the late fourteenth century Prague started showing signs of the Bohemian Reformation (Demetz, 1997, p.106). The execution of Jan Hus in 1415 led to a bloody religious civil war between the Crown and the Hussites (Demetz, 1997, p.145–161). Prague was in the middle of the conflict. The Hussite Wars initiated a century of conflicts and shifts of rulers and ruling dynasties, which impeded the development of Prague. During that century the city also suffered conflagrations, with one of the most serious almost completely destroying the left riverbank in 1541 (Demetz, 1997, p.200).

The city regained its importance and prospered again in the late sixteenth century during the reign of the Emperor Rudolf II of Habsburgs. Rudolf's Prague was a splendorous European metropolis with religious freedom, a centre of art and science, and became the destination for a plethora of foreign immigrants of various faiths (Demetz, 1997, p.186 and 212). In the early seventeenth century religious tensions between Catholics and Protestants rekindled and again led to the Thirty Years War, and once again Prague suffered from battles, sieges and sackings (Demetz, 1997, p.220–225). The war was won by the Catholics, the Emperor's seat was moved to Vienna and Prague lost its importance and became impoverished and provincial (Demetz, 1997, p.241). The population of Prague declined from 50,000, before the war, to only 26,000 (Demetz, 1997, p.241). The Czechs lived in the New Town, the Old Town was half-German and some of the Czech and the foreign residents mostly lived in Minor town or the Castle District.

4.4.1 Jewish presence in Prague — a brief history

The first Jews to arrive at Prague were among the merchants from Mediterranean and Oriental lands using long distance trade routes to reach Poland and Russia through Prague (Demetz, 1997, p.14 and 40). One of the earliest named Jewish merchants was Ibrahim ibn Yaqub from Moorish Tortosa, who arrived in Prague probably in 965 CE. He was a traveller and a slave trader who wrote one of the earliest literal sources describing Bohemia and Poland.

The beginnings of the Jewish community of Prague can be dated to the late tenth century (Demetz, 1997, p.40–41). The Jews inhabited two or three neighbourhoods: one in the proximity to the trade routes and the ducal hillfort at Hradčany on the western bank of the river; the second in the vicinity of Vyšehrad on the eastern bank, and the third on a swampy land near present-day's Charvátova and Spálená streets. As early as around 1080 CE the Prague Jews were granted juridical privileges by Vratislav II (Demetz, 1997, p.40). Soon after, Prague happened to be astride the way of the so-called People's Crusade from the Northern France to the Holy Land (Demetz, 1997, p.41). The crusaders, accompanied by the local Christian burghers, carried out attacks against the Jews, killing or forcing many into conversion (Zaremska, 2005, p.41–42). Following these events, many Jews fled the city. In 1142 CE Moravian forces attacked Prague castle and plundered and burnt the settlement on the left riverbank. The conflagration forced the Jews to re-settle on the right bank, creating the 'Jewish town' (Demetz, 1997, p.34 and 42).

In the late twelfth and early thirteenth century the Church called for the separation of Jews and Christians (Demetz, 1997, p.44). The Jews of Prague were forced to dress in distinctive yellow hats, live only in a restricted part of the city and were forbidden from certain occupations. The Prague Jewry sought help from the crown, and in the mid-thirteenth century the King Přemysl Otakar II gave them some privileges in the *Statutes Iudaeorum* bill (Demetz, 1997, p.44).

The bill also stated that the Bohemian Jews were royal property and violence against them would be punishable. Přemysl Otakar II, although a controversial figure, protected the common people and merchants of all nations, including the Jews. He created a city in which people of different nations coexisted in relative peace (Demetz, 1997, p.66).

During the reign of Charles IV in the mid-fourteenth century, the Jews mostly inhabited the Jewish Town. Nonetheless, small clusters of Jewish houses were present in Minor Town and near the oldest Jewish cemetery south to the Old Town (Demetz, 1997, p.112). Most of Prague Jews were craftsmen or petty merchants, gradually being put out of their business by their Christian counterparts (Demetz, 1997, p.113). Few Jews living in the Jewish Town were rich, but their combined wealth was one of the largest in entire Bohemia. The Prague Jews of the Charles' era enjoyed a few decades of prosperity, because the Emperor protected them in most Bohemian cities (Demetz, 1997, p.114). Charles, at the same time, cold-bloodedly allowed organised anti-Jewish *pogroms* to take place in many German cities, when he could benefit politically from them (Graus, 1997). In the late fourteenth century, years after Charles' passing, religious tension between Catholic and Protestants also affected the Jews. In one of the deadliest *pogroms* of the medieval Europe, on Easter of 1389 in Prague, most of the Prague Jews (presumably several hundred but some sources claim it was a few thousands) were brutally massacred, and the Jewish Town was mercilessly plundered and burnt (Putík, 1995; Demetz, 1997, p.115–117). A few decades later, during the Hussite wars further *pogroms* occurred and Jews were expelled from many other Bohemian cities (Demetz, 1997, p.167–168). The situation of the Jews was insecure in the second half of the fifteenth century when further *pogroms* happened.

In the mid-sixteenth century the Jewish community of Prague was near extinction. The Jews were expelled from Prague twice and many settled in Poland, but each time they were allowed to return at some point (Demetz, 1997, p.200–201). The king Ferdinand I, being in favour of Jews, confirmed their privileges and provided protection. The number of Jewish inhabitants doubled due to migration of Jews expelled from Germany, Austria, Spain, and Moravia, and reached approximately 1300 in its peak in the mid-sixteenth century (Kieval, 2011) In the late sixteenth century, the reign of Maximillian II and Rudolf II brought prosperity to the Jewish community (Demetz, 1997, p.201). The population increased and the Jewish Town developed reaching its 'golden age'. The Jewish community of Prague became the largest Ashkenazic community in the world reaching a population of 5000 in the early seventeenth century and more than 10,000 a century later; this accounted for 30% of the city's population (Demetz, 1997, p.201; Kieval, 2011). One of the prominent Prague figures of that time was rabbi Judah Loew ben Bezalel, a Judaic scholar, known from legends about *Golem* of Prague (Demetz, 1997, p.203).

The 'golden age' was not always golden. The social interactions between Jews and Christians were filled with competition, conflict, and fear (Kieval, 2011). The Jewish Town suffered during the Thirty Years War, when it was robbed and pillaged (Demetz, 1997, p.225). The Prague Jews supported the Catholic Habsburgs in the war, and loyally defended Prague against the Swedish invasion of 1648. In exchange, the Prague Jewish Community was protected and favoured by the royal dynasty in this deadly war and after it (Demetz, 1997, p.230–231). In the end of the seventeenth century many Jews died due to the plague followed by the conflagration of the Jewish Town (Kulka and Jelinek, 2007). Subsequently, the authorities moved some of the remaining Jewry to Libeň. In the eighteenth century, during the reign of Maria Theresa of Habsburgs, anti-Jewish sentiment reached its peak. On several occasions the Jewish Town was plundered, burnt, and the Jews temporally expelled (Demetz, 1997, p.243–245).

4.4.2 Židovské město — the Jewish Town in Old Town Prague

The 'Jewish Town', named Josefov in the nineteenth century, is a district in the Old Town on the right bank of the Vltava River. The beginning of the 'Jewish town' is not well known due to a lack of literary sources on the topography of the Jewish habitation prior to the thirteenth century (Putík, 1995). Traditional sources claim that it was formed by the Jews who moved there from the left riverbank after its conflagration in 1142 CE (Demetz, 1997, p.42). At the beginning the district comprised of several wooden houses and the 'Old Shul' synagogue built near Kozí and Vězeňská streets. Later, German Jews who settled along the Široká street built their own synagogue, called Staronová (Demetz, 1997, p.42).

In the fourteenth century, during King Charles reign, the district was called Jewish Town, and was not yet formally a ghetto and in some places the Jews and Christians resided in mixed neighbourhoods (Demetz, 1997, p.112; Musílek, 2015). The quarter was not enclosed with a defensive wall, but the streets

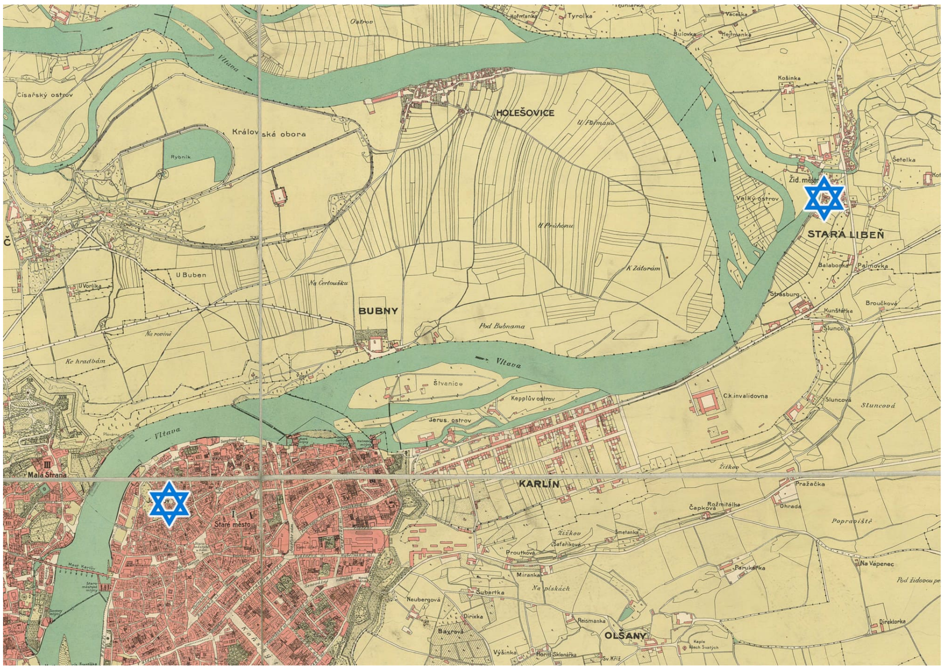

Fig. 4.22 Prague. Map of the city from 1848 CE. Location of Staronová synagogue (left-hand side) and the Jewish town in Libeň (right-hand side) are marked with blue stars (figure courtesy of M. Vyšohlíd)

and blocks of houses constituted a boundary and the access to the district was marked with gates (Putík, 1995). The majority of buildings in the quarter were densely packed wooden dwellings, susceptible to conflagrations. It was estimated that in the fourteenth century in the Jewish Town 65 out of 79 houses were inhabited by the Jews (Putík, 1995). The total Jewish population of the district is estimated to approximately 750 people. In the late fifteenth and early sixteenth century the Jewish Town considerably grew, doubling its Jewish population and expanding spatially (Kieval, 2011). That time several important buildings were built, including the Jewish Town Hall and a few new synagogues. In the late sixteenth century the Jewish Town gained the basic legal independence in a royal decree of Ferdinand I (Kieval, 2011).

4.4.3 Jewish settlement in Prague Libeň

Libeň (pronunciation *Ly-beh-ny*), located 5 km east from the Prague Old Town (fig. 4.22), was Prague's agricultural hinterland in the medieval period and one of the city's suburbs until the early twentieth century, when it was incorporated into *Praha 8* municipal district (Vyšohlíd, 2012a). The historical Jewish settlement in Libeň was one of the most important Jewish centres in the Prague

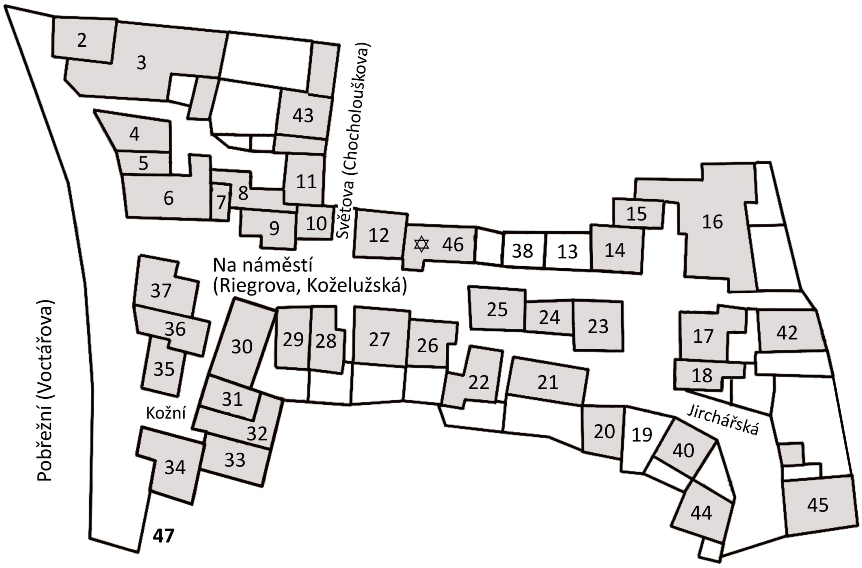

Fig. 4.23 Prague. Map of the Jewish town in Libeň based on a map from 1841 CE. ✡ marks the location of the synagogue (figure courtesy of M. Vyšohlíd)

region (Biegel, 1996). The Libeň and Prague Old Town Jewish communities maintained very close contacts throughout their history (Vyšohlíd, 2012a). The Jews lived on present-day streets Koželužská, Voctářova, Vojenova; and streets Jirchářská, Kožní, and Chocholoušek which do not exist anymore (fig. 4.23). Nowadays, very few remnants of the historic Libeň Jewish town still remain. It has gradually been demolished since the 1930s (Biegel, 1996).

The oldest sources mention the Jewish presence in Libeň in the mid-sixteenth century, but Jews presumably lived there earlier (Pěkný, 1993, p.288). The Libeň Jewish town started emerging after the influx in 1540s and 1550s, when the Jews were expelled from the Prague Old Town. In the late sixteenth century Libeň Jews already constituted a majority of the townsfolk and were given the right to buy properties. The community built a synagogue and first Jewish stone buildings at the Koželužská street (Vyšohlíd, 2014). In 1656 the Jews were granted privileges which gave them legal autonomy and equated their rights with the Christian townsfolk. In the mid-seventeenth century the Jewish ghetto of Libeň comprised of 12 houses (Biegel, 1996). The most common occupations for Libeň Jews of the seventeenth and eighteenth century were cattle traders and butchers, but also tailors, shoemakers, merchants, tanners, and others (Vyšohlíd, 2012a, 2014). Another substantial Jewish migration to Libeň happened at the end of the seventeenth century, when the authorities re-settled many of Prague Jews who survived the plague and the conflagration of the Jewish Town (Kulka and Jelinek, 2007). After the influx, the Jewish population rose to 286 inhabitants (ca. 65% of the townsfolk) and they inhabited 50 houses (Biegel, 1996). In the 1740s another expulsion of the Prague Jewry doubled the Libeň's Jewish population to 766 people who lived in 35 stone buildings and many less permanent wooden houses (Vyšohlíd, 2014). With this influx, the Jewish town of Libeň reached its peak and did not expand further.

4.4.4 The archaeological sites

In this thesis I have used faunal remains from two sites in Prague, the famous Staronová synagogue and several houses in Jewish town in Prague Libeň (fig. 4.22). The sites provide good temporal and spatial variety. The first site provides an insight into the medieval record from the beginnings of the Prague Jewish Town, whilst the second covers the period of the early modern Jewish community of Prague suburb in Libeň.

4.4.4.1 Excavations in Staronová synagogue

Staronová (Eng. *Old–New*) (fig. 4.24) synagogue is the oldest preserved synagogue in Central Europe, and one of the oldest still in use for religious services (Demetz, 1997, p.42). The temple was built in Gothic style in the 1270s and 1280s. The building has a characteristic double-nave form and was designed according to architectural trends known from synagogues in Worms and Regensburg (for detailed architectural descriptions see e.g. Münzer, 1932; Vlček, 2000; Pařík, 2003). The temple was probably located on the north–western edge of the Jewish Town in the fourteenth century, next to its gates (fig. 4.25) (Putík, 1995).

The development of the Staronová synagogue was carried out in four phases (Dragoun, 2000, 2003b) (fig. 4.26):

1. the construction of the main hall of the temple in the 1270s;
2. expanding the temple with two annexes, the southern and western, in the early fourteenth century;
3. connecting the two annexes, and some other minor developments in the late fourteenth and early fifteenth century;

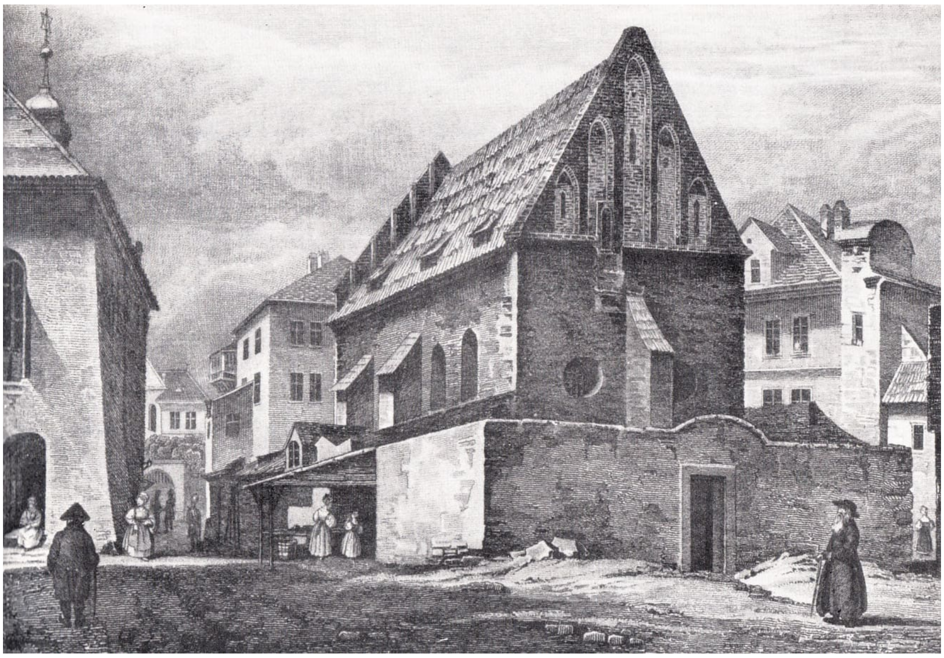

Fig. 4.24 Prague, Staronová synagogue. Illustration from 1836 CE by Karel Würbs

4. adding the northern and a small eastern annexe before 1732 CE.

The material analysed in this thesis was obtained during the excavations in the Staronová synagogue carried out by Czech Heritage (Národní památkový ústav) in late 1998. The results were published by Dragoun (Dragoun, 2000, 2003a,b), and the animal bone were previously analysed by Petříčková (2002), but never published, except for a brief summary included in Dragoun (2003b). The excavation preceded the construction of underground ventilation pipes and covered most of the area inside the temple (see fig. 4.26). Inside the main Gothic hall, trenches were 80 cm wide and 80 cm deep (trench 4, 4a and 4b). The stratigraphy of this part was mostly destroyed by the on-going construction earthworks, and the only archaeological record was preserved in the sections, in the bottom layers of the trenches, and below the *aron kodesh*. The most extensive excavations were carried out in the southern annexe (trench 1). In the western area archaeological work ceased at the level of the exposed flooring, whilst the eastern area was excavated up to 2.5 metres of depth (Dragoun, 2003a,b). In the northern annexe (trench 5) the upper layers were documented, and the bottom layers were recorded in several trial trenches. Smaller trenches (2, 3 and 6) were set in the western and eastern annexes.

There is very little record of layers accumulated after the Gothic temple was erected, and the construction of thereof disturbed most of the younger layers

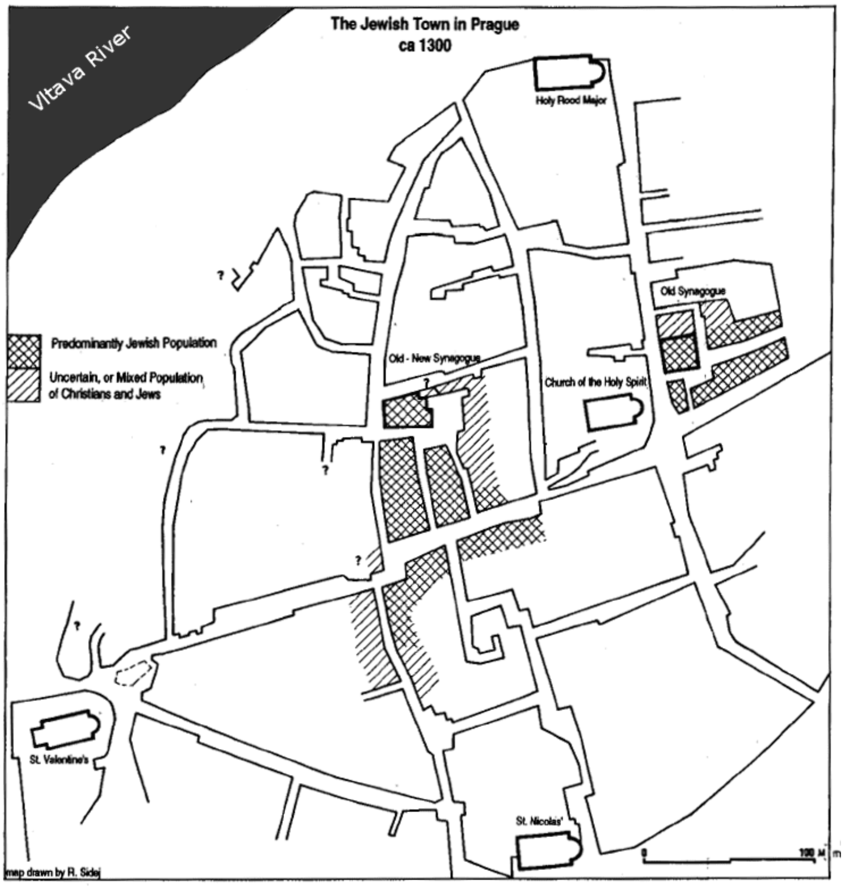

Fig. 4.25 Prague. Map of Jewish Town in Old Town Prague in the fourteenth century (figure from Putík, 1995)

(Dragoun, 2003a). The excavations of all parts of the synagogue, however, uncovered layers accumulated before the temple was erected (Dragoun, 2003a,b). These mostly consisted of thin habitation layers and shallow features. Beneath the southern annexe a 5 metre long row of postholes and a furrow were discovered (Dragoun, 2003a,b). The line they formed was oriented in the same way as the Gothic synagogue. In the northern annexe there were a large number of pot holes and cultural layers including layers of burnt soil. The presence of construction features and layers in both southern and northern annexes suggest the presence of a wooden construction predeceasing the Gothic temple but oriented in the same way. This may be the evidence of the presence of a wooden synagogue predating the construction of Staronová synagogue (Dragoun, 2003a,b).

The stratigraphic units were dated based on the artefacts embedded in them. Finds excavated in the synagogue include coins, metal objects, and a probable

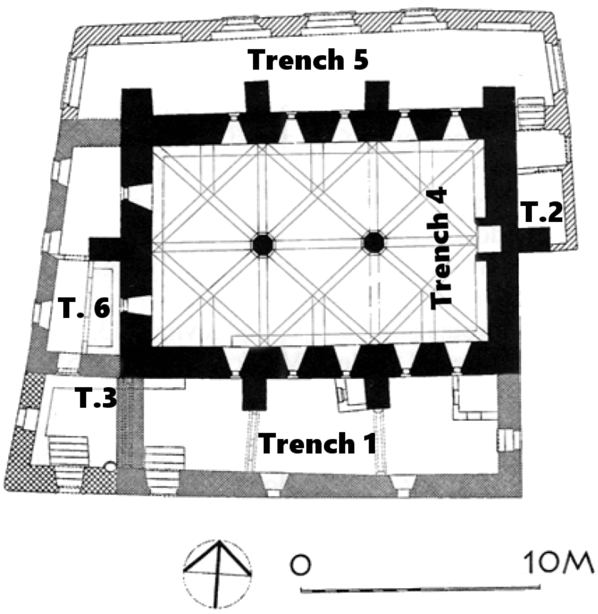

Fig. 4.26 Prague. Floor plan of Staronová synagogue with the location of the archaeological trenches. The building development phases: the 1st phase of the building (ca. 1270s CE) is marked in black; the 2nd phase (early 14th century) is in grey; the 3rd phase (late 14th/early 15th) is cross-hatched; the 4th phase (before 1732) is marked by oblique hatching (figure after Dragoun, 2003b; author K. S. Matoušová, edited by the author)

part of a *chanukiah* (Dragoun, 2003b). The pottery does not differ from finds from the same period excavated in different parts of the city.

For the use of this thesis I have amalgamated archaeological layers and features of similar characteristics into **three spatial/chronological groups**. The first two groups represent the horizon of habitation of the space preceding the construction of Staronová synagogue, probably associated with the wooden building which stood there earlier, and was possibly also a synagogue:

The first group (SN1) comprises of stratigraphic units from trench 5 (in the northern annexe), which are dated to the twelfth century. To this group I have also assigned several units from trenches 4 and 2, which had the same dating but did not have faunal assemblages large enough to be analysed as stand-alone units.

The second group (SN2) comprises of stratigraphic units from trench 1 (in the southern annexe) which are dated to eleventh–twelfth century. For reasons similar to those described above, this group includes a few units from trenches 3 and 6, which have corresponding dating.

Table 4.4 Prague. List of archaeological features and units used in the thesis with their description

Site	Trench/ Square	Inventory numbers(in Staronová) / Stratigraphic units (in Libeň)	Description	Dating	Context
Staronová synagogue	2	64	Staronová synagogue, northern part, habitation layers from before the construction of the temple	12th century	SN1
	4	1, 3, 17, 180, 181, 182			
	5	79, 82, 85, 92, 93, 94, 97, 98, 105, 109, 112, 123, 124, 145, 147, 153, 156, 157, 163, 164, 165, 170, 171, 177, 179, 183, 185, 188, 190, 192, 193			
	1	21, 23, 27, 31, 32, 34, 35, 37, 38, 39,44, 48, 50, 62, 63, 65, 66, 68, 69, 70, 71, 73, 75, 76, 77, 78, 83, 87, 88, 89, 101, 102, 103, 113, 115, 116, 117, 118, 136, 140	Staronová synagogue, southern part, habitation layers from before the construction of the temple	11th-12th century	SN2
	3	158, 159			
	6	125			
	2	10, 51, 52, 54, 55, 57, 60	Staronová synagogue, eastern part, layers accumulated after the temple was built	13th-14th century	SN3
Libeň	H18, H19, H20	**H18:**O15, O17; **H19:**O05, O07, O08, O10, O11, O12, O17, O18; **H20:**O07, O09, O10, O13, O16, O17, O18	Libeň, house 29, phase 1	17th century–begening of the 18th century	Lib29/Ph1
	I18	**I18:** O06, O07, O09, O10, O12	Libeň, house 29, phase 2	18th century	Lib29/Ph2
	E19, E20	**E19:**O08, O09, O11, O13, O14, O15, O23, O24, O28, O41; **E20:** O07, O08, O09	Libeň, house 30	late 16th - 1st half of the 17th century	Lib30
	E18	**E18:** O06, O07, O08, O10, O13	Libeň, house 31	1st half of the 17th century	Lib31
	E14	**E14:**O53, O54, O63, O67, O71	Libeň, house 34, eastern part of the house	late 16th - 1st half of the 17th century	Lib34

The third group (SN3) includes a small assemblage from units chronologically younger (thirteenth–fourteenth century), from trench 2 in the eastern annexe of the Gothic temple. Units included in group SN3 were the

Fig. 4.27 Prague. Map of excavation at Libeň with house location and numbers showing (figure after Vyšohlíd, 2012a)

> only discovered layers undisturbed by the construction of the synagogue (Dragoun, 2003a).

The comprehensive list of units embodying each group can be found in table 4.4.

4.4.4.2 The site at Prague Libeň

The excavations of the Jewish town in Prague Libeň were undertaken in 2011–2012 by *Archaia Praha* company (Vyšohlíd, 2012a, 2014). The preliminary results of the excavations were published in 2012 and 2014 (published papers: Vyšohlíd, 2012a, 2014; unpublished reports: Militký, 2012; Vyšohlíd, 2012b, but a comprehensive analysis of the site has not yet been produced.

The site in Libeň constitutes the first instance of an extensively excavated large area of a historic Jewish town in Bohemia (Vyšohlíd, 2012a). The excavations yielded a huge number of artefacts: almost 130,000 fragments of pottery, almost 15,000 stove tiles mostly from the late sixteenth and early seventeenth century, a plethora of metal goods (seals, buckles, book fittings, weights, pins, and others), 200 coins (analysed by Militký, 2012), 130 local and imported clay pipes (analysed by Vyšohlíd, 2014).

The site was divided into two parts, (1) the area which consisted of historical buildings (1860 square metres), and (2) the area of courtyard gardens (2350 square metres), where buildings did not appear until the late nineteenth century (Vyšohlíd, 2012a, 2014). In the first area, 11 plots were located, eight of which constituted the remnants of historic Jewish houses (numbers XXIX–XXXVI, hitherto referred to in Arabic numerals, i.e. 29–36) (fig. 4.27).

Faunal remains for the use of this thesis derive from selected stratigraphic units (comprehensive list to be found in table 4.4) from the area of four houses located in the northern part of the excavated area, on Koželužská and Voctářova streets. Stratigraphic units were dated based on the finding of coins, clay pipes, and pottery. Faunal remains were found mostly in habitation layers, pits, and flooring layers associated to houses (Vyšohlíd, 2014). Refuse pits with large quantities of bones are virtually absent from the site due to the proximity of the river, which served as a rubbish dump for Libeň townsfolk (Vyšohlíd, 2012a, 2014). There is also extensive evidence of brick and lime production on this part of the site, along with extraction of limestone (Vyšohlíd, 2012a, 2014).

The analysed houses are:

- House 29 (fig. 4.28: this is the oldest house in the excavated area, dated to the late sixteenth/early seventeenth century (Vyšohlíd, 2014). It was located on Koželužská street. The archaeological units taken into consideration here derive from two arbitrary phases of habitation of the house: phase 1, which was represented in the western part of the house, was dated to the seventeenth century and early eighteenth century, and phase 2, uncovered in the eastern part of the house, was dated to the eighteenth century.

- Houses 30 and 31 (fig. 4.28: the two stone houses were built in 1700s, but the archaeological units predate the building of the stone houses (Vyšohlíd, 2014). House 30 was located on Koželužská street, whilst

Fig. 4.28 Prague–Libeň. Foundations of houses 30 (closer to the viewer) and 29 at the ground level (figure after Vyšohlíd, 2012b)

house 31 was located on Kožní street. Units from house 30 are dated to the late sixteenth to the first half of the seventeenth century, and units from house 31 to the first half of the seventeenth century. The analysed units therefore represent the habitation of the wooden buildings, which stood on these lots before the stone houses were erected.

- House 34: the stone house was constructed in the late eighteenth century, but the analysed material comes from earlier habitation, dated to the late sixteenth–first half of the seventeenth century (Vyšohlíd, 2014). It was located on the corner of Voctářova and Kožní streets. Light wooden structures, including a butcher's shop, were present on this lot before the construction of the stone house, according to literary sources (Vyšohlíd, 2014).

Chapter 5

Methods

5.1 Recording

For the purpose of this thesis I have recorded mammal bones from well stratified archaeological contexts with little disturbance. In my analysis I have utilised a reference collection of the Adam Mickiewicz University in Poznań, Poland. Difficult cases of bones of uncommon species were confirmed with Daniel Makowiecki from Nicolaus Copernicus University in Toruń, Poland.

In this thesis I have used a variant of the diagnostic zone approach (see description in the next section), which is a modified version of Albarella and Davis (1994b) protocol, developed earlier by Davis (1992). Albarella and Davis (1994b) protocol is based on a limited number of defined zones, generally only one per anatomical element (e.g., for the humerus only the distal epiphysis), which are sufficient for providing most zooarchaeological data. Because a large part of my investigation concerns butchery, I have broadened the number of zones to include shafts as well as epiphyses to be able to investigate all possible locations of butchery marks. I recorded the presence of a zone when more than half was present. I have used the following zones (see also red zones in Appendix A):

- Skull: (1) 4th premolar, (2) 1st molar, (3) 2nd molar, (4) 3rd molar, (5) zygomatic, (6) occipital condyle, (7) (in ruminants) the base of the horncore (recorded if more than half of the circumference of the horn was present), (8) supraorbital margin of frontal bone. Zones were recorded for left and right side separately

- Mandible: (1) canine, (2) 3rd deciduous premolar, (3) 3rd premolar, (4) 4th deciduous premolar, (5) 4th premolar, (6) 1st molar, (7) 2nd molar, (8) 3rd molar, (9) 3rd/4th premolar, (10) 1st/2nd molar, (11) angle of the mandible, (12) articular process

- Scapula: (1) glenoid cavity, (2) supraglenoid tubercle, (3) neck of scapula, (4) caudal border

- Humerus: Proximal epiphysis: (1) major tubercle, (2) minor tubercle. Distal epiphysis: (3) medial part of the condyle, (4) lateral part of the condyle. Diaphysis: (5) proximal half, (6) distal half

- the head, (2) lateral part of the head. Distal epiphysis: (3) medial part of the epiphysis, (4) lateral part of the epiphysis. Diaphysis: (5) proximal half, (6) distal half

- Ulna: (1) olecranon tuber

- Metacarpus. Proximal epiphysis: (1) medial part of the base, (2) lateral part of the base. Distal epiphysis: (3) medial head, (4) lateral head. Diaphysis: (5) proximal half, (6) distal half

- Pelvis: (1) iliac part of lunar surface of the acetabulum, (2) ischial part of lunar surface of the acetabulum, (3) pubic (lesser) part of lunar surface of the acetabulum, (4) area of muscle attachment on the body of ilium above acetabulum

- Femur. Proximal epiphysis: (1) head, (2) major trochanter, (3) intertrochanteric fossa and minor trochanter. Distal epiphysis: (4) medial condyle and medial part of femoral trochlea. (5) lateral condyle and lateral part of femoral trochlea. Diaphysis: (6) proximal half, (7) distal half

- Tibia. Proximal epiphysis: (1) medial condyle, (2) lateral condyle. Distal epiphysis: (3) tibial cochlea, (4) lateral part of the epiphysis. Diaphysis: (5) proximal half, (6) distal half

- Astragalus: (1) proximal trochlea, (2) distal trochlea

- Calcaneum: (1) tuber calcanei, (2) sustentaculum tali, (3) articular surface for malleolus

- Centroquartal: (1) medial part (central/cuboid tarsal), (2) lateral part (fourth tarsal)

- Metatarsus. Proximal epiphysis: (1) medial part of the base, (2) lateral part of the base. Distal epiphysis: (3) medial head, (4) lateral head. Diaphysis: (5) proximal half, (6) distal half
- Phalanx 1: (1) base, (2) body, (3) head
- Phalanx 2: (1) base, (2) body, (3) head
- Phalanx 3: (1) articular surface

In the case of zones located on epiphyses of long bones, they consist in fact of fusion lines (marked separately as *unfused epiphysis, unfused diaphysis, unfused both, fused*), not the epiphysis of the bone itself. Fragments of long bone shafts were recorded when they included more than a half of the length of the zone and more than a half of the circumference of the shaft.

One of the most common issues in taxonomic identification concerns distinction between bones of the caprines: that is of sheep and goat. In this paper I have attempted to perform this identification on the skull and epiphyses of certain long bones. The definite list of elements comprises: cranium with horncores present; mandible with at least two of the following teeth: dP4, P4, M1, M2, and M3; distal humerus; proximal radius; distal metacarpal; distal tibia; astragalus; calcaneum; distal metatarsal. I utilised the sheep/goat identification criteria published in the classic papers on this topic (see Boessneck, 1969; Payne, 1985; Halstead et al., 2002; Zeder and Lapham, 2010; Zeder and Pilaar, 2010). The most recent papers on sheep/goat distinction had not yet been published when I carried out my data recording (i.e. Salvagno and Albarella, 2017; Wolfhagen and Price, 2017)

5.2 Quantification

For the purpose of this thesis I have used three quantification systems: Number of Identified Specimens (NISP), Number of Recorded Diagnostic Zones (NRDZ), and Minimum Number of Sections (MNS). Whilst the first method is well-established in the zooarchaeological literature, the latter two derive from the diagnostic zone approach.

The NISP (e.g., Lyman, 2008, p.27 and references therein) is often believed to be the simplest, most fundamental and straight-forward quantification unit, and is widespread in the literature. It counts all faunal remains identified to the taxon and the body part. NISP suffers from many issues (see the discussion in Grayson, 1984, p.20–26; Lyman, 2008, p.29–30), including the researcher's bias and the definition of what is an identifiable specimen. In the most common approach, the researcher aims to identify as many as possible bones recovered from a site and then tallies the identified specimens in NISP. I will refer to this protocol as the fragment approach (cf. Watson, 1979). In this approach, the concept of the identifiable specimen, and hence the whole Number of Identified Specimens, is dependent on many factors. Whilst the more complete specimens will often be correctly recorded by most researchers, the identification of smaller, less diagnostic fragments will be influenced by the analysts' experience or their decision making process (e.g., recording or omitting ribs or long bone shafts), in addition to a large number of other difficult to quantify variables (work conditions, time, reference collection etc.). This bias influences the overall NISP numbers obtained by different analysts in the fragment approach and, in the end, compromises comparability between archaeological sites. A recent study (Morin et al., 2016a,b) has raised further concerns about the nature of NISP in the fragment approach. Blind tests on an experimentally produced assemblage of bones showed that NISP tallies for long bones have correlated poorly or even negatively with actual abundances. NISP also underestimated the number of specific body parts and it was suggested that did not even meet the criteria of being primary data (Morin et al., 2016a).

One of the solutions to the issue of bone counting in the fragment approach is applying the diagnostic zone approach. This approach was proposed on several occasions, e.g. by Watson (1979), then by Davis (1992) in the form of POSAC (Parts Of Skeleton Always Counted), and recently by Morin et al. (2016b) as Number of Distinct Elements. In the diagnostic zone approach all excavated remains are examined, but only those which include one or more predefined zones, preserved in at least 50% of its defined shape, are recorded (cf. Watson, 1979; Davis, 1992). Diagnostic zones are predefined to represent all major parts of the skeleton, and include the parts which bear the most data, such as the ossification centres or measurable epiphyses (Davis, 1992). These parts are also often very distinctive and relatively easy to identify. This potentially reduces the subjectivity of bone identification and produces results more comparable between researchers. Additionally, it avoids the problem of spending a substantial amount of time identifying specimens that provide limited information. Trentacoste (2009) has shown that both approaches (traditional fragment and diagnostic zone), used in recording of the same assemblage, may provide similar results. The recording of all fragments, whilst being much more time consuming, results in a higher number of specimens, but this does not provide more useful data and does "not contribute to a better understanding of the site or a useful increase in sample size for analysis" (Trentacoste, 2009, p.42).

In this thesis I used my version of diagnostic zones I called NRDZ. The zones are defined in the previous section of this chapter and can be seen on Appendix A.

The Minimum Number of Sections (MNS) is a variation of the Minimum Number of Elements (MNE) (see Lyman, 1994, p.102; Lyman, 2008, p.215, and references therein). The only difference between those two systems is the difference between element and section; in MNE elements are complete, discrete anatomical units (e.g., a humerus is an element), whilst in MNS 'sections' are parts of anatomical units, such as proximal-shaft-distal parts of long bone (e.g., a proximal part of humerus and a distal part of humerus are two sections, counted separately).

MN(E/S) is a system used to minimise some of the NISP's problems. Similarly as in the case of the Minimum Number of Individuals, which one of the basic principles is to avoid counting the same animal twice (Ringrose, 1993), one of the main principles of MN(E/S) is to avoid counting the same element or section of the same animal twice. There are, however, issues also with the MN(E/S) (see Lyman, 2008, chapter 6), such as the problem of aggregation (see Lyman, 2008, p.57). In this paper, I tallied MNS based on diagnostic zones NRDZ , not on the NISP. In the case of long bones, I determined the MNS for both ends and the shaft separately, with body side distinction as well. Each section of long bone (i.e., proximal–shaft–distal) has at least two diagnostic zones and the MNS was tallied based on the more abundant zone; for example, in an archaeological context with 40 fragments of humeri which include zone "1" of distal humerus and 50 which include zone "2" of distal humerus, the MNS of distal humerus was 50, because we may be sure there were at least 50 distal humeri. I tallied MNS separately for archaeological contexts (features or connected group of features) which were proved to have distinct chronological and spatial character.

5.3 Ageing and sexing

In the estimation of the age at death I used mandibular tooth eruption and wear, epiphyseal fusion, and horncore shape and texture.

I recorded **mandibular cheek tooth eruption and wear** using the methods and coding proposed by Grant (1982) for cattle and pigs, and Payne (1973, 1987), for caprines. Following Payne (1973), I grouped caprine mandibles into nine age stages and applied his method for reconstruction of age stages when tooth rows were incomplete. I assigned approximate age to stages based on Zeder's data (2006, figures 31 and 32). Regarding pig, I estimated the mandibular age according to the age stages defined by O'Connor (2003, p.160, table 31), and estimated the age stage for incomplete mandibles based on Grant's data (1982, table 4). In the case of cattle, I adapted Grant's (1982) method of calculating Mandibular Wear Stage (MWS) for each mandible. One of the problematic traits of MWS method is that results are presented in more than fifty different age stages. To reduce this problem I grouped MWSs into seven age stages corresponding to actual age at death. I based the translation of MWS into absolute age on Jones and Sadler (2012, figure 13) in which they applied MWS to mandibles of cattle of known age from reference collections. The seven age stages are:

- A birth – 6 months old, MWS 0–6
- B 6 m/o – 1 year old, MWS 7–13
- C 1 y/o – 1.5 y/o, MWS 14–24
- D 1.5 y/o – 2 y/o, MWS 25–29
- E 2 y/o – 3 y/o, MWS 30–37
- F 3 y/o – 6 y/o, MWS 38–40 or M3 at TWS 'g'
- G 4 y/o and older, MWS 41<

Based on Jones and Sadler (2012) data, MWSs are relatively precise up to the 3rd year, but at later stages the definition is much coarser, which causes the overlap of stages F and G. To slightly improve the ageing of the last two stages, I included mandibles with M3 at Tooth Wear Stage 'g' by Grant (1982) into my age stage F, even if the overall MWS was above 41. The reason for this is that

Jones and Sadler (2012, figure 10) data show that a M3 with TWS 'g' — used also by Halstead (1985) to define his age stage 'G' — corresponds to the absolute age at death of 3 up to ca. 6 years.

Another ageing method relies on the **fusion of bones** of the appendicular skeleton (see table 5.1). I recorded the stage of fusion as unfused when parts were completely separate; fusing, when they were attached but the fusion line was noticeable; and fused when the fusion line was not visible any more. Calculations of the numbers of unfused bones are based either on the number of epiphyses present or on the number of diaphyses present, whichever were more abundant in a particular archaeological context.

Table 5.1 Age stages of three main domestic taxa based on epiphyseal bone fusion (data from Silver, 1969)

Cattle		Caprines		Pig	
Age stage I (ca 7-10 mos.)	Scapula	Age stage I (ca 6-10 mos.)	Scapula	Age stage I (ca 10 mos.)	Scapula
	Pelvis		Pelvis		Pelvis
Age stage II (ca 12-18 mos.)	Humerus, distal		Radius, proximal		Radius, proximal
	Radius, proximal		Humerus, distal		Humerus, distal
	Phalanx 1	Age stage II (ca 18-28 mos.)	Metacarpal, distal		Phalanx 2
	Phalanx 2		Metatarsal, distal	Age stage II (ca 24-30 mos.)	Metacarpal, distal
Age stage III (ca 24-36 mos.)	Metacarpal, distal		Tibia, distal		Metatarsal, distal
	Metatarsal, distal		Phalanx 1		Tibia, distal
	Tibia, distal		Phalanx 2		Calcaneum
Age stage IV (ca 36-48 mos.)	Radius, distal	Age stage III (ca 30-42 mos.)	Radius, distal		Phalanx 1
	Humerus, proximal		Humerus, proximal	Age stage III (ca 36-42 mos.)	Radius, distal
	Ulna		Ulna		Humerus, proximal
	Femur, distal		Femur, proximal		Ulna
	Tibia, proximal		Femur, distal		Femur, proximal
	Calcaneum		Tibia, proximal		Femur, distal
			Calcaneum		Tibia, proximal

I have mostly used the classic work by Silver (1969) to determine the fusion age. I have grouped body parts into age stages according to age estimation of their epiphyseal fusion. These stages are presented in table 5.1. In rely on relative differences; thus, I mainly compare proportions of fused and unfused epiphyses between phases and sites (based on MNS). Using fusion stages as an analytical method may be problematic. The literature provides estimated dates of fusion of particular bones; however, these may seriously vary between different sources (Moran and O'Connor, 1994). Another factor largely affecting the age of fusion is castration, which delays it (Moran and O'Connor, 1994; Davis, 2000).

Lastly, I have used Armitage (1982) method of **ageing cattle horncores**. This method, however, was proven to be ambiguous to use, highly subjective, and provides only a rough estimate of age at best (see Sykes and Symmons, 2007 and references therein; and Salvagno et al., 2017), hence the results need to be treated with caution.

Sexing of bones and teeth was performed on the morphological and biometrical basis. I assessed the shape of cattle and caprine pelvis according to features described in Grigson (1982), Prummel and Frisch (1986), and Greenfield (2006). For pig canines I followed the guidelines by Mayer and Brisbin (1988). I have made no attempt to differentiate sex based on the morphology of cattle horncores, due to the low reliability of this method (cf. Sykes and Symmons, 2007).

5.4 Biometry

The biometric protocol I applied follows many standard ones in the field and it is designed to provide information on sex, size, and morphotypes of animals. I took the majority of measurements with standard Vernier callipers with 0.1mm precision, whilst the Greatest Length of long bones with an osteometric board with 1mm precision, and the length of horncores with a tape measure with precision of 1cm due to common breakage of the tip.

I measured all recordable bones and teeth. If not stated otherwise, measurements follow the classic work by Driesch (1976). Long bones were measured only when fused. The full list of taken measurements is:

Mandible: depending on the species:

- Cattle and caprines: the greatest width of the posterior **WP** (in dP4, M1, M2) or anterior **WA** (in M3) pillar
- Pig: the greatest widths of anterior **WA**, central **WC** and posterior **WP** cusps of M3 (from Albarella and Payne, 2005), and crown length **L** of M3 (from Payne and Bull, 1988)

Horncores: greatest length on the outer curvature of the cattle horncore (number **47** by Driesch, 1976, p.28) and frontal margin in caprines (number

43 by Driesch, 1976, p.34), greatest diameter (**Wmax** or number **45** for cattle and **41** for caprines), and the smallest diameter (**Wmin** or number **46** for cattle and **42** for caprines) of the base

Scapula: **GLP** and **SLC**

Humerus: **GLC**, **SD**, **BT** (in ungulates, as in Payne and Bull, 1988) or **Bd** (in other mammals), **HTC** (from Payne and Bull, 1988)

Radius: **Bp**, **Bd**, **GL**, **SD**

Metapodials: depending on the species:

- Cattle: **GL**, **SD**, **BFd**, **BatF**, **a/BFdm**, **b/BFdl**, **3**, **6** (from Davis, 1992)
- Caprines: **GL**, **SD**, **BFd**, **BatF**, **a/BFdm**, **b/BFdl**, **1**, **2**, **3**, **4**, **5**, **6** (from Davis, 1992)
- Pig: **GL**
- Cervids: **GL**, **SD**, **BFd**; and **3** (from Davis, 1992)
- Horse: **GL**, **SD**, **Bd**, **Dd**

Pelvis: **LA** in ruminants, **LAR** in other mammals

Femur: **GL**, **SD**, **DC**, **Bd**

Tibia: **GL**, **SD** (anterior–posterior aspect), **Dd**, **Bd**

Astragalus: depending on the species:

- bovids and cervids: **GLl**, **GLm**, **Bd**, **Dl**
- pig: **GLl**, **GLm**
- carnivores: **GL**
- equids: **GH**, **GB**, **BFd**, **LmT**

Calcaneum: **GL**, **GD** (from Albarella and Payne, 2005)

Annotation: **SD** was only taken along with **GL**.

I have used log ratio (also called LSI: Meadow, 1999; Albarella, 2002) for the analysis of size of cattle and sheep, but not the pig, which suitable measurements were to scarce in the majority of contexts. Following advice from Meadow (1999) and Davis (1996), the measurements of the length, width, and depth were not mixed, as well as the measurements of bones and teeth. Elements used for log ratios were humerus (BT), radius (GL, Bp), metacarpal (GL, BFd, '6') femur (DC – only for cattle), tibia (GL, Bd, Dd), calcaneum (GL), astragalus (GLl, Bd, Dl), and metatarsal (GL, BFd, '6'). Due to the lack of widely available local standard for log ratios for cattle, I have used the mean measurements from the most abundant archaeological contexts analysed in this thesis (rationale behind this was provided in Albarella, 2002; for a similar approach see Johnstone and Albarella, 2002). I decided not to use already available standards for modern populations (such as Davis, 1996), or for archaeological populations (for example, Johnstone and Albarella, 2002; Viner, 2010) because of a substantial chronological and geographical differences between them and the sites under scrutiny. Of course, in an archaeological assemblage one cannot control sex or age of the population used as a standard (Albarella, 2002), but this disadvantage is overshadowed by the possibility of using the population of a comparable same size and shape of the individuals. The adopted standard for cattle is the mean of the measurements from Period A at Lelów (except of humerus which standard, due to the paucity of the data in Period A, derives from Lelów, Period B). Hence, this context will always be plotted centred on zero, functioning as the reference point for other contexts. The standard I used for caprines was taken from Davis (1996, table 2). Unfortunately, no contexts from the analysed sites could be a standard for caprines due to the insufficient data. The values of the log ratio were calculated from the formula $d = \log 10x - \log 10m$, where d is the log ratio value, $\log 10x$ is a decimal logarithm of the measurement of the archaeological specimen, and $\log 10m$ is a decimal logarithm of the analogous measurements from the standard. To estimate the withers height I used the coefficient developed by Tsalkin (1970) for the measurements of the length (GLl) of cattle astragalus which value is 1.83. I used the length of the astragalus for two reasons. Firstly, it is one of the least sex-dependent bones, which reduces the probability of sex dimorphism affecting the values in my rather small set of measurements (cf. Higham, 1969; Albarella, 1997a). Secondly, other elements useful for this exercise were scarce or absent at most of the sites. Additionally, in many cases I used biometrical indices to show the shape of bones. These were calculated by dividing the breath of the bone by its length and multiplying it by hundred; for example, $(Bd \div GL) \times 100$. The formulas are always present on the particular graphs. These indices compare the shape of the assemblage, regardless of the metrical size of bones; the more robust bones will have larger values.

5.5 Pathology

All abnormalities and pathologies I encountered were described according to their morphology, location, and type. I used Baker and Brothwell (1980) to facilitate some of the descriptions.

5.6 Taphonomy

For the purpose of this dissertation I recorded butchery, burning, fragmentation, fracturing, and dog gnawing. I have also applied taphonomic interpretational methods, mainly the recovery bias assessment and density mediated attrition. To locate the presence of taphonomic modifications on bones I used a zone system (see green zones in Appendix A).

5.6.1 Recovery bias

Research shows that hand collection may result in a substantial alteration of the archaeological bone assemblage, manifesting itself in an underrepresentation of bones of smaller species and small bones of the larger ones (Payne, 1972). Since no sieving was performed on the sites I analysed it was important to assess the extent of the recovery bias. To do this, I performed an exercise in which the number of small bones, easy to overlook during excavation, is compared to the number of adjacent larger bones. In this case, the number of 'large bones', such as distal epiphyses of tibia and distal and proximal epiphyses of metapodials were compared to the numbers of adjacent 'small bones': astragali and 1st phalanges, and even smaller centroquartals and 2nd phalanges. In an assemblage affected by recovery bias, the number of tibiae and metapodials would be expected to exceed the number of adjacent astragali and 1st phalanges, which would also presumably be larger than the number of the smallest bones - centroquartals and 2nd phalanges. This bias would be more pronounced for smaller species e.g. for caprines compared to cattle.

5.6.2 Density mediated attrition analysis

Density mediated attrition analysis is a well-established method for assessing the extent of taphonomic destruction on an assemblage (eg. Lyman, 1994;

Table 5.2 Bone structural density values of bones used in this thesis. Values obtained using CT scans of *Connachaetes taurinus* bones (Lam et al., 1999)

Body part	Code	Density (g/cm^3)	Zones included (Lam *et al.* 1999)
Mandible	MD	0.64	DN4, DN5, DN6, DN7
Atlas	AT	0.59	AT1, AT2, AT3
Axis	AX	0.87	AX1
Scapula	SC	0.68	SP1
Humerus, proximal	HUp	0.32	HU1
Humerus, shaft	HUs	0.70	HU3
Humerus, distal	HUd	0.51	HU5
Ulna	UL	0.60	UL1, UL2
Radius, proximal	RAp	0.47	RI1
Radius, shaft	RAs	0.65	RI3
Radius, distal	RAd	0.41	RI5
Metacarpal, proximal	MCp	0.58	MC1
Metacarpal, shaft	MCs	0.86	MC3
Metacarpal, distal	MCd	0.56	MC5
Pelvis	PE	0.64	AC1
Femur, proximal	FEp	0.42	FE1, FE2
Femur, shaft	FEs	0.65	FE4
Femur, distal	FEd	0.38	FE6
Tibia, proximal	TIp	0.42	TI1
Tibia, shaft	TIs	0.77	TI3
Tibia, distal	TId	0.48	TI5
Astragalus	AS	0.72	AS1, AS2, AS3
Calcaneum	CM	0.66	CA1, CA3, CA4
Centroquartal	CQ	0.61	NC1, NC2, NC3
Metatarsal, proximal	MTp	0.63	MR1
Metatarsal, shaft	MTs	0.84	MR3
Metatarsal, distal	MTd	0.54	MR5
Phalanx1	PH1	0.58	P1-1, P1-2, P1-3
Phalanx2	PH2	0.52	P2-1, P2-2
Phalanx3	PH3	0.42	P3-1

Lam et al., 1999, 2003; Lam and Pearson, 2005, and references therein). With an assumption that some taphonomic factors, for example feeding dogs, will more easily destroy less dense elements (as evidenced by Brain, 1983), the assemblage heavily affected by such factors should show an underrepresentation of the elements of low structural density of bone. Statistical testing (Spearman's ρ) of anatomical composition of the assemblage (%survivorship or %MAU) against experimentally assessed structural density values of the corresponding elements may reveal if the pattern of body part representation may be attributed to a taphonomic factor instead of being attributed to the human activity. In this thesis I use structural density values assessed for wildebeest *Connachaetes taurinus* using CT scanner (Lam et al., 1999). I have not used values assessed for cattle and sheep (e.g. Ioannidou, 2003) because they were obtained using a photon densitometry (PD) method, which has been demonstrated to be less precise (Lam et al., 2003; Lam and Pearson, 2005). Lam et al. (1999) claim that in the analysis of domestic bovids, using CT structural density values obtained for another bovid species, such as wildebeest is methodologically more correct than using PD values obtained for the same species. The density values I have used in this thesis are in table 5.2.

5.6.3 Butchery

Butchery analysis performed in this thesis was partially inspired by a complex method of distinguishing butchery marks and their orientation, depth, and intentions of the butcher by Seetah (2006, 2010). I have adapted some of the features and traits of butchery marks he distinguishes, and based others on Binford (1981). In my recording protocol I recorded observable variables such as type of mark, their location, direction, number of occurrences, and depth. Additionally, I recorded function behind the marks, which was an interpretative variable based on all other traits.

Types of mark are a very basic parameter of butchery mark description. Although the methodology of butchery mark identification and interpretation is currently being accused of poor reproducibility, thus being scientifically inaccurate (Domínguez-Rodrigo et al., 2017), this discussion mostly concerns stone age cut marks, whilst marks left by the standardised butchery of late Middle Ages and modern periods seem to be less ambiguous. I differentiated the usually recorded slice marks (also known as cut marks), chop marks, and expanded this variable by distinguishing scooping or shaving marks, and knick marks (Seetah, 2006, p.121). Slice marks (e.g. fig. 6.73) are made by a sharp implement in a cutting action and "are characterised by a delineated striation along the bone, with a V cross-section" (Seetah, 2006, p.125). Chop marks (e.g. fig. 7.15) are marks mostly left by cleavers. Their shape will be dependent largely on the angle the bone was hit as well as of the thickness and type of bone. On the compact bone they will usually leave one wall of the kerf smooth, whilst the other will be rough with possible conchoidal flaking (cf. Lewis, 2008). In the case of the cancellous bone, a cleaver entering it with sufficient force will chop it through leaving an even surface of the cut (Seetah, 2006, p.125; also, fig. 6.76 in this thesis). Scoop marks, also known as shaving marks, (e.g. fig. 7.13) result when a sharp blade is driven alongside the surface of the bone, removing tightly attached soft tissues along with a thin shaving of a bone (Seetah, 2006, p.128). Knick mark is similar to scoop mark, but it occurs when the architecture of the bone is more complex and the knife stops in its prominent feature (Seetah, 2006, p.129). A part of the knick mark will resemble a scoop mark but it will end abruptly with a small kerf.

Other possible butchery marks – saw marks (Seetah, 2006, p.130), percussion marks (see Fisher, 1995, p.25–28; Pickering and Egeland, 2006) and scraping marks (see Fisher, 1995, p.18; Reitz and Wing, 2008, fig. 5.9) — were recorded, but are almost absent in the analysed assemblage. Saw marks in this period are mainly associated with bone working rather than butchery (Seetah, 2006, p.129), whilst percussion and scraping marks are more commonly found in assemblages deriving from technologically less developed societies, where hammerstones were being used for smashing bones.

The location of the marks was recorded using a system of zones (see green zones in Appendix A). The direction of marks was determined in relation to the main axis of the bone: vertical, horizontal, and oblique (Seetah, 2006, p.121). The depth of the marks indicates the depth of the kerf: shallow, moderate, deep, cut through (Seetah, 2006, p.121). Additionally, I counted the number of occurrences of the marks.

Based on recordable traits of cut marks, during recording I assessed the presumable function of butchery, also referred to as activity, which left the mark or group of marks (see Binford, 1981, p.106; Seetah, 2006, chapter 6.3.1.3). Skinning, often performed as one of the first butchery activities, will result in fine slice marks or sometimes knick marks on cranial bones or limb extremities. Disarticulation/jointing (referred to simply as disarticulation) consists of gross division of the carcass and subsequent parting it into chunks, which often is performed on anatomical joints. This activity will leave chopping and slicing marks near the epiphyses. Meat removal/filleting (referred to simply as filleting) denotes cutting of the meat off the bone. It will be visible on shafts or bone ends as scoop and knick marks, or repetitive series of oblique or vertical slice marks. Bone breaking/pot-sizing (referred to simply as breaking) is one of the latest stages of butchery or carcass dressing. It is splitting of bones into smaller pieces, often carried out after filleting, performed to acquire marrow and fat out of the bone or to fit a chunk of meat in a cooking utensil. It may be visible in systematic chopping of a bone shaft or epiphysis in different places and in various angles. Pot-sizing will be characterised by occurrence of more than one blow aimed at dividing a bone in a section of a predetermined size. Lastly, during the recording process I sought patterns of slice, scoop and knick marks on bones of hind limbs which may be connected to nikur practice. These patterns will be described in chapter 7.

The final issue concerning the butchery marks is their quantification. There is little consensus amongst the researchers on how to quantify butchery marks on bones (Otárola-Castillo, 2010). Research shows that butchery marks analysis based on NISP bone counts can produce misleading results and MNE should be used to tally butchery marks instead (Otárola-Castillo, 2010). However, there is an even more crucial issue here; regardless of the method of counting, we still have very little idea of what the variation of the frequency of butchery marks on different bones and in different assemblages actually represent (Lyman, 2005). Often, the number of marks would be treated as a proxy for the 'intensity' of butchery, but experimental data (eg. Egeland, 2003; Pobiner et al., 2018) conclude that there is no consistent relationship between the number of cut marks on bones and the number of strokes performed by the butcher and thus the 'intensity' of butchery. Therefore, the frequencies of butchery marks in relation to the entire number of bones tallied for each body part or the assemblage do not necessarily compare the amount of work or interest butchers put in processing of different cuts, or differences between the ways of carcass processing performed by butchers from different sites. This practice, in general, was argued to have little heuristic value (cf. Domínguez-Rodrigo and Yravedra, 2009)

In section 6.6 the proportion of butchered bones refers to the number or bones (NISP) with any kind of butchery marks in relation to the total number of NISP in the particular assemblage. In comparisons of proportions of types of butchery marks (e.g., slicing, chopping, etc.) or types of butchery activities (e.g., filleting, skinning, etc.) in the assemblage, the n values represent the number of butchery activities, not the actual number of bones with marks. Each bone with butchery marks may have one or more instances of butchery activities. For example, a bone with a set of slice marks on the shaft, left after filleting, and a chopping mark made during the disarticulation of the joint, has two separate types of butchery activities – filleting and disarticulation. This specimen, therefore, will add the value of two to the number of butchery activities: it will be counted both in the group of filleted bones and in the group of disarticulated bones.

5.6.4 Fragmentation and fractures

Fragmentation and fracture analysis of the assemblage may provide very useful information on carcass processing, culinary activity, and depositional history. To estimate the intensity of fragmentation (Lyman, 1994, p.333) I tallied the number of diagnostic zones present for each specimen and assessed the portion of the whole bone they constitute; e.g., a humerus on which I recorded 2 out of 6 possible zones defined for this particular body part constitutes a fraction of 2/6 of a whole humerus. Subsequently, I grouped the bones into four categories, (1) specimens preserved in less than ¼ of the whole bone, (2) specimens of size between ¼ and ½ of the whole bone, (3) specimens of size between ½ and ¾ of the whole bone, and (4) specimens of size larger than ¾ of the whole bone. Of course, assessing fragmentation of an assemblage with this method is highly dependent on recovery bias. Assemblages analysed in this thesis were not sieved, therefore it is expected that the 1st category, comprising of the smallest bone fragments, will be underrepresented. Thus, I propose this method to be treated as a rough estimation of completeness of specimens in the assemblage. In the assessment of the freshness factor of long bone fractures I applied a very simplified version of fracture analysis. I recorded an interpretative assessment of the amount of breaks of green bones and breaks on dry or mineralised bone based on observations of outline, surface texture and angle of breaks on bones (Johnson, 1985; Villa and Mahieu, 1991; Outram, 2001). In cases when it was possible to determinate the freshness of the break, I assigned these specimens to one of four groups; (1) only fractures on dry/mineralised bone, (2) mostly fractures on dry/mineralised bone, (3) mostly fractures on green bone, and (4) only fractures on green bone.

5.6.5 Gnawing

Gnawing is a direct evidence of scavenger activity on site and provides information on rubbish disposal. Actualistic research, most notably conducted by Binford (1981) and Brain (1983), provides information on scavenger patterns of activity and sets up the framework for gnawing mark identification (see Binford, 1981, p.44–49; Lyman, 1994, p.206–210). Carnivore scavenging will be reflected in the presence of gnawing marks, but severe and prolonged chewing on bones will remove them from the record. This will especially affect parts of the skeleton with high porosity, low durability, and high nutritious value, such as long bone epiphyses or unfused juvenile bones. Hence, intensive scavenging will result in selective destruction of parts of the assemblage: epiphyses will be underrepresented (Binford, 1981, p.51), and the lack of unfused and low density elements may be noticeable (Brain, 1983, chapter 2). This means that intensive scavenging is one of the density–mediated factors affecting the composition of an assemblage (see above).

5.6.6 Burning

Burning on bones may indicate culinary practice, cultural practice of disposing of animal remains, or post-depositional modification of the assemblage. In this thesis I adopted the common classification of burning on bones based predominately on their colour and state of preservation; four stages are defined, (1) unburnt, (2) scorched, (3) carbonised/charred, and (4) calcined (Johnson, 1989).

5.6.7 Abiotic factors

For the purpose of this thesis I recorded the presence of some abiotic taphonomic factors which may provide information on waste management, depositional history, and the geological context of bone finds. I focused mostly on weathering, which I recorded according to the stages suggested by Behrensmeyer (1978), and abrasion, which was only recorded as present or absent.

Weathering is a process of decomposition and destruction of bone by physical and chemical agents (Behrensmeyer, 1978). It may affect the bone in situ, but usually the process will advance in the presence of direct environmental agents such as changes of humidity or direct sunlight (Brain, 1983).

Abrasion is a mechanical action of removal of edges and surfaces of bone due to physical impact of particles of surrounding sediment (Shipman and Rose, 1988). This action can often be caused by trampling, sediment perturbation, as well as fluvial and eolian activity (Brain, 1967; Shipman and Rose, 1988; Lyman, 1994, p.187).

Eolian abrasion produces severe etching, visible only on parts of the bone susceptible to eolian conditions, while fluvial abrasion abrades the entire surface of the bone, smoothing it (Brain, 1967; Shipman and Rose, 1988; Lyman, 1994, p.187).

Trampling abrades bones but also leaves an irregular pattern of long scratches (Olsen and Shipman, 1988; Lyman, 1994, p.187).

Sedimentary erosion affects the whole surface of the bone, but usually does not leave long scratches or grooves (Shipman and Rose, 1988).

Chapter 6

Zooarchaeological analysis

This chapter presents the results of the zooarchaeological investigation of assemblages from five sites in four cities/towns: Chełm, Wrocław, Lelów, Prague Staronová and Prague Libeň. The detailed archaeological and historical context of the sites can be found in chapter 4. The sites under scrutiny in this thesis were carefully selected according to a few criteria: each town and city hosted a vibrant and important Jewish community in the past; the archaeological sites came from districts of those towns and cities historically inhabited by the Jews; and they represent mostly domestic contexts. It was also crucial for the sites to represent different regions (even countries) and centuries to show the wider geographical and chronological span of the described phenomena.

The employed methods, including bone counting methods, such as Number of Identified Specimens (NISP), Number of Recorded Diagnostic Zones (NRDZ), Minimum Number of Sections (MNS), and Minimum Number of Anatomical Units (MAU), are discussed in detail in section 5.2.

6.1 Species and body part distribution

The following section provides the basic zooarchaeological information about the analysed sites (fig. 6.1).

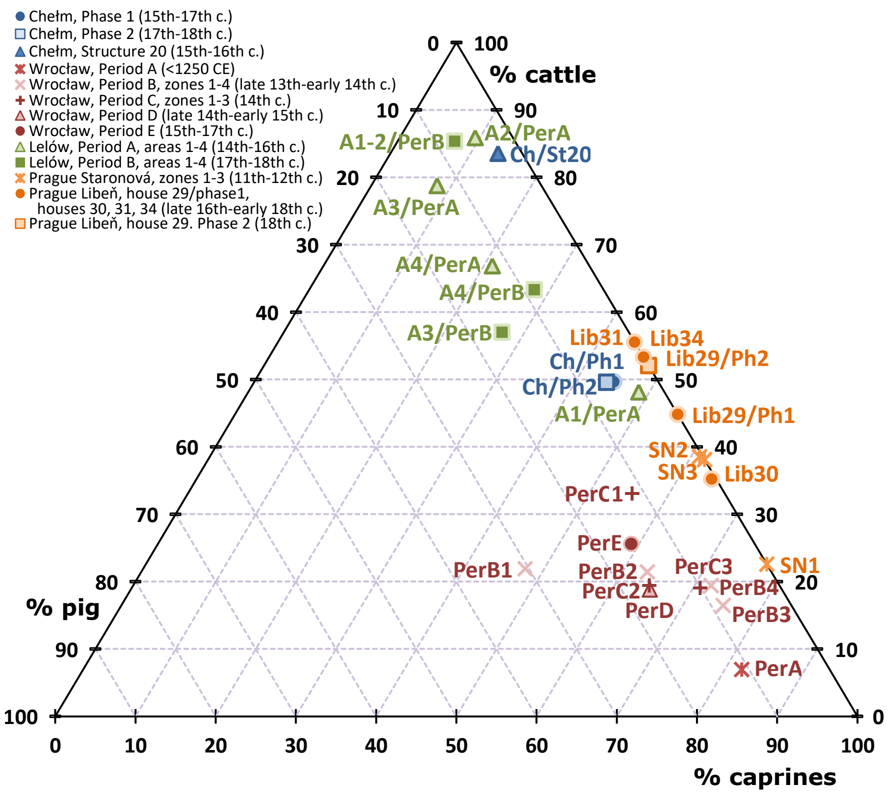

Fig. 6.1 Tertiary plot of the representation of three major domestic taxa at the analysed sites (% of MNS). Contexts from Chełm are in blue, Wrocław in red, Lelów in green, and Prague in orange

6.1.1 Chełm

The assemblage derives from twenty archaeological features excavated from eight different archaeological sites in the historic Jewish district of Chełm. Features were grouped into **three entities**:

Phase 1 (Ph1) consists of features dated from the fifteenth century up to the seventeenth century, with some residual material from the fourteenth century.

Phase 2 (Ph2) includes features dated to the late seventeenth century and the eighteenth century.

Structure 20 (St20) is a part of a ditch from the fifteenth/sixteenth century, possibly with remnants of a timber house, with a substantial faunal assemblage.

Table 6.1 Chełm. Number of Identified Specimens (NISP) and Number of Recorded Diagnostic Zones (NRDZ) for each species of mammals

Context:	Phase 1		Phase 2		Structure 20		Total	
Unit:	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ
Cattle	**213**	**401**	**415**	**784**	**197**	**451**	**825**	**1636**
Caprines	**209**	**413**	**370**	**769**	**24**	**69**	**603**	**1251**
Sheep	51	150	53	157	6	29	110	336
Goat	64	95	57	93	7	16	128	204
Sheep/Goat	94	168	260	519	11	24	365	711
Pig	**16**	**43**	**44**	**108**	**6**	**10**	**66**	**161**
Horse	**33**	**80**	**4**	**7**	**3**	**4**	**40**	**91**
Roe deer	**1**	**1**	**1**	**2**			**2**	**3**
Dog	**51**	**242**	**8**	**25**			**59**	**267**
Cat	**2**	**13**	**1**	**4**			**3**	**17**
Fox	**3**	**14**					**3**	**14**
Hare	**2**	**8**					**2**	**8**
Total	**530**	**1215**	**843**	**1699**	**230**	**534**	**1603**	**3448**

The assemblage from Chełm consists of 1603 specimens NISP, on which I recorded 3448 diagnostic zones NRDZ (table 6.1). The Minimum Number of Sections (MNS) derived from NRDZ consisted of 1667 remains (table 6.2). The largest assemblage, from phase 2, includes 850 remains; phase 1 assemblage contains 584 remains, whilst 233 remains were recorded from structure 20.

Table 6.2 Chełm. Minimum Number of Sections (MNS) for each species of mammals

Context:	Phase 1		Phase 2		Structure 20		Total	
Cattle	**225**	39%	**412**	48%	**193**	83%	**830**	50%
Caprines	**203**	35%	**365**	43%	**31**	13%	**599**	36%
Sheep	63		65		9		137	
Goat	53		55		9		117	
Sheep/Goat	87		245		13		345	
Pig	**25**	4%	**54**	6%	**7**	3%	**86**	5%
Horse	**37**	6%	**6**	0.7%	**2**	1%	**45**	3%
Roe deer	**1**	0.2%	**1**	0.1%			**2**	0.1%
Dog	**83**	14%	**10**	1%			**93**	6%
Cat	**6**	1%	**2**	0.2%			**8**	0.5%
Fox	**2**	0.3%					**2**	0.1%
Hare	**2**	0.3%					**2**	0.1%
Total	**584**		**850**		**233**		**1667**	

6.1.1.1 Taxonomic frequency

The material from Chełm consists predominantly of the remains of domestic species, amounting to 1661 remains (99.6% of total MNS). The majority of the remains derive from domestic ruminants; cattle make up 50% of the

Table 6.3 Chełm. Body part representation for cattle

	Cattle	Phase 1			Phase 2			Structure 20			Total		
		MNE	MAU	%MAU	MNE	MAU	%MAU	MNE	MAU	%MAU	MNE	MAU	%MAU
Axial	Skull	16	16	100%	17	17	100%	8	8	52%	41	41	100%
	Horn core	4	4	25%	7	7	41%	2	2	13%	13	13	32%
	Mandible	21	10.5	66%	27	13.5	79%	25	12.5	81%	73	36.5	89%
	Atlas	9	9	56%	8	8	47%	1	1	6%	18	18	44%
	Axis	2	2	13%	6	6	35%	0	0	0%	8	8	20%
Front limb	Scapula	7	3.5	22%	22	11	65%	2	1	6%	31	15.5	38%
	Humerus (p)	1	0.5	3%	3	1.5	9%	1	0.5	3%	5	2.5	6%
	Humerus (s)	23	11.5	72%	25	12.5	74%	3	1.5	10%	51	25.5	62%
	Humerus (d)	15	7.5	47%	20	10	59%	6	3	19%	41	20.5	50%
	Ulna	11	5.5	34%	11	5.5	32%	0	0	0%	22	11	27%
	Radius (p)	17	8.5	53%	15	7.5	44%	2	1	6%	34	17	41%
	Radius (s)	19	9.5	59%	15	7.5	44%	2	1	6%	36	18	44%
	Radius (d)	6	3	19%	9	4.5	26%	1	0.5	3%	16	8	20%
	Metacarpal (p)	5	2.5	16%	33	16.5	97%	21	10.5	68%	59	29.5	72%
	Metacarpal (s)	8	4	25%	31	15.5	91%	14	7	45%	53	26.5	65%
	Metacarpal (d)	4	2	13%	16	8	47%	12	6	39%	32	16	39%
Hind limb	Pelvis	1	0.5	3%	4	2	12%	5	2.5	16%	10	5	12%
	Femur (p)	6	3	19%	3	1.5	9%	3	1.5	10%	12	6	15%
	Femur (s)	4	2	13%	7	3.5	21%	3	1.5	10%	14	7	17%
	Femur (d)	1	0.5	3%	2	1	6%	1	0.5	3%	4	2	5%
	Tibia (p)	0	0	0%	0	0	0%	0	0	0%	0	0	0%
	Tibia (s)	9	4.5	28%	10	5	29%	1	0.5	3%	20	10	24%
	Tibia (d)	7	3.5	22%	3	1.5	9%	2	1	6%	12	6	15%
	Astragalus	1	0.5	3%	5	2.5	15%	4	2	13%	10	5	12%
	Calcaneum	4	2	13%	2	1	6%	5	2.5	16%	11	5.5	13%
	Centroquartal	3	1.5	9%	1	0.5	3%	0	0	0%	4	2	5%
	Metatarsal (p)	4	2	13%	23	11.5	68%	31	15.5	100%	58	29	71%
	Metatarsal (s)	7	3.5	22%	31	15.5	91%	24	12	77%	62	31	76%
	Metatarsal (d)	2	1	6%	21	10.5	62%	10	5	32%	33	16.5	40%
Feet	Phalanx1	3	0.38	2%	23	2.88	17%	4	0.5	3%	30	3.75	9%
	Phalanx2	1	0.13	1%	9	1.13	7%	0	0	0%	10	1.25	3%
	Phalanx3	4	0.5	3%	3	0.38	2%	0	0	0%	7	0.88	2%
Total MNE		225			412			193			830		

assemblage, and caprines 36% (table 6.2). In caprines, sheep and goats are represented fairly evenly (table 6.2), but most remains could not be attributed to either sheep or goat. The MNS of other domesticates is much lower; only 5% of remains were attributed to pig, 3% to horse, and 6% to dog. Species represented only by a few specimens are cat, roe deer, fox, and hare (table 6.2).

Cattle remains are predominant in all the assemblages, but in phases 1 and 2 the differences between the incidence of cattle and caprines are small (fig. 6.1; table 6.2). The predominance of cattle is much more pronounced in structure 20, where it makes up to 83% of the assemblage, whereas caprine bones account for 13%. Pig constitutes a small proportion of each assemblage. Horse composes a noticeable part of the phase 1 assemblage (6%), but its presence is minimal in other groups. The high presence of dog remains in phase 1 (14%) is noteworthy, but little evidence would suggest this species was eaten. A few specimens of bones of roe deer and cat were recorded in both phases, whilst fox and hare are present only in phase 1. In structure 20, however, only remains

Table 6.4 Chełm. Body part representation for caprines

Caprines		Phase 1			Phase 2			Structure 20			Total		
		MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU
Axial	Cranium	**23**	23	43%	**18**	18	56%	**1**	1	N/A	**42**	42	47%
	Horn core	**54**	54	100%	**32**	32	100%	**4**	4	N/A	**90**	90	100%
	Mandible	**26**	13	24%	**54**	27	84%	**7**	3.5	N/A	**87**	43.5	48%
	Atlas	**2**	2	4%	**3**	3	9%	**0**	0	N/A	**5**	5	6%
	Axis	**2**	2	4%	**7**	7	22%	**0**	0	N/A	**9**	9	10%
Front limb	Scapula	**5**	2.5	5%	**17**	8.5	27%	**1**	0.5	N/A	**23**	11.5	13%
	Humerus (p)	**1**	0.5	1%	**1**	0.5	2%	**0**	0	N/A	**2**	1	1%
	Humerus (s)	**12**	6	11%	**30**	15	47%	**2**	1	N/A	**44**	22	24%
	Humerus (d)	**8**	4	7%	**19**	9.5	30%	**1**	0.5	N/A	**28**	14	16%
	Ulna	**9**	4.5	8%	**17**	8.5	27%	**0**	0	N/A	**26**	13	14%
	Radius (p)	**10**	5	9%	**17**	8.5	27%	**0**	0	N/A	**27**	13.5	15%
	Radius (s)	**18**	9	17%	**31**	15.5	48%	**0**	0	N/A	**49**	24.5	27%
	Radius (d)	**4**	2	4%	**16**	8	25%	**0**	0	N/A	**20**	10	11%
	Metacarpal (p)	**3**	1.5	3%	**6**	3	9%	**3**	1.5	N/A	**12**	6	7%
	Metacarpal (s)	**3**	1.5	3%	**8**	4	13%	**3**	1.5	N/A	**14**	7	8%
	Metacarpal (d)	**0**	0	0%	**6**	3	9%	**2**	1	N/A	**8**	4	4%
Hind limb	Pelvis	**3**	1.5	3%	**3**	1.5	5%	**0**	0	N/A	**6**	3	3%
	Femur (p)	**0**	0	0%	**5**	2.5	8%	**0**	0	N/A	**5**	2.5	3%
	Femur (s)	**1**	0.5	1%	**8**	4	13%	**0**	0	N/A	**9**	4.5	5%
	Femur (d)	**0**	0	0%	**2**	1	3%	**0**	0	N/A	**2**	1	1%
	Tibia (p)	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	0%
	Tibia (s)	**4**	2	4%	**18**	9	28%	**3**	1.5	N/A	**25**	12.5	14%
	Tibia (d)	**4**	2	4%	**13**	6.5	20%	**2**	1	N/A	**19**	9.5	11%
	Astragalus	**1**	0.5	1%	**5**	2.5	8%	**0**	0	N/A	**6**	3	3%
	Calcaneum	**1**	0.5	1%	**2**	1	3%	**0**	0	N/A	**3**	1.5	2%
	Centroquartal	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	0%
	Metatarsal (p)	**4**	2	4%	**10**	5	16%	**1**	0.5	N/A	**15**	7.5	8%
	Metatarsal (s)	**4**	2	4%	**11**	5.5	17%	**1**	0.5	N/A	**16**	8	9%
	Metatarsal (d)	**1**	0.5	1%	**4**	2	6%	**0**	0	N/A	**5**	2.5	3%
Feet	Phalanx1	**0**	0	0%	**2**	0.25	1%	**0**	0	N/A	**2**	0.25	0%
	Phalanx2	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	0%
	Phalanx3	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	0%
Total MNS		**203**			**365**			**31**			**599**		

of domestic ungulates were recorded. Apart from a fragment of an antler, in the whole Chełm assemblage I have not found traces of two common wild artiodactyls, red deer and wild boar.

6.1.1.2 Body part representation

All recordable anatomical elements of **cattle** are present in the Chełm assemblage (table 6.3). Cranial bones are predominant, but the abundance of metapodials is also clearly visible. The forequarters are substantially better represented than the hindquarter. Between the three assemblages, some differences emerge. The phase 1 assemblage shows a clear predominance of the parts of the skull and the upper parts of forequarters, the humerus and radius, with an underrepresentation of the metapodials and the hindquarter bones. There is an interesting difference in the number of the atlases and the axes with the underrepresentation of the latter, and also an underrepresentation of

Table 6.5 Chełm. Body part representation for pig, horse, and dog

MNS		Pig				Horse				Dog		
		Phase 1	Phase 2	Structure 20	Total pig	Phase 1	Phase 2	Structure 20	Total horse	Phase 1	Phase 2	Total dog
Axial	Skull	2	1	0	**3**	1	0	1	**2**	3	0	**3**
	Horn core	0	0	0	**0**	0	0	0	**0**	0	0	**0**
	Mandible	0	3	2	**5**	5	0	1	**6**	9	2	**11**
	Atlas	0	4	0	**4**	1	0	0	**1**	3	1	**4**
	Axis	0	0	0	**0**	1	0	0	**1**	0	1	**1**
Front limb	Scapula	1	3	0	**4**	0	0	0	**0**	4	0	**4**
	Humerus (p)	0	0	0	**0**	0	0	0	**0**	6	0	**6**
	Humerus (s)	1	10	1	**12**	0	0	0	**0**	6	0	**6**
	Humerus (d)	0	2	1	**3**	0	0	0	**0**	6	0	**6**
	Ulna	1	0	0	**1**	0	0	0	**0**	3	0	**3**
	Radius (p)	2	2	0	**4**	1	0	0	**1**	2	0	**2**
	Radius (s)	2	2	1	**5**	1	0	0	**1**	2	0	**2**
	Radius (d)	0	1	0	**1**	1	0	0	**1**	2	0	**2**
	Metacarpal (p)	1	1	0	**2**	0	1	0	**1**	0	0	**0**
	Metacarpal (s)	1	1	0	**2**	0	1	0	**1**	0	0	**0**
	Metacarpal (d)	1	1	0	**2**	0	1	0	**1**	0	0	**0**
Hind limb	Pelvis	0	0	0	**0**	2	0	0	**2**	6	0	**6**
	Femur (p)	3	3	0	**6**	1	0	0	**1**	5	0	**5**
	Femur (s)	3	5	1	**9**	3	0	0	**3**	5	0	**5**
	Femur (d)	2	0	1	**3**	3	0	0	**3**	4	0	**4**
	Tibia (p)	0	0	0	**0**	2	0	0	**2**	5	0	**5**
	Tibia (s)	1	5	0	**6**	2	0	0	**2**	5	0	**5**
	Tibia (d)	1	4	0	**5**	2	0	0	**2**	5	0	**5**
	Astragalus	0	1	0	**1**	1	0	0	**1**	0	0	**0**
	Calcaneum	1	0	0	**1**	1	0	0	**1**	0	0	**0**
	Centroquartal	0	0	0	**0**	0	0	0	**0**	0	0	**0**
	Metatarsal (p)	1	1	0	**2**	1	2	0	**3**	1	2	**3**
	Metatarsal (s)	1	1	0	**2**	1	0	0	**1**	1	2	**3**
	Metatarsal (d)	0	0	0	**0**	1	0	0	**1**	0	2	**2**
Feet	Phalanx1	0	0	0	**0**	2	0	0	**2**	0	0	**0**
	Phalanx2	0	3	0	**3**	1	0	0	**1**	0	0	**0**
	Phalanx3	0	0	0	**0**	3	1	0	**4**	0	0	**0**
Total MNS		25	54	7	**86**	37	6	2	**45**	83	10	**93**

the scapulae comparing to the adjacent humeri. In the phase 2 assemblage, an equivalent abundance of parts of the skull and forelimb is seen, but metapodials are much better represented, to the point of being some of the most abundant bones in the assemblage. The structure 20 assemblage is somewhat in contrast to phase 1; metapodials and parts of the skull prevail with little presence of bones of the upper limbs.

Caprine bones in the Chełm assemblage represent most parts of the skeleton (table 6.4). A clear predominance of parts of the skull, mostly horncores, is noticeable in all three assemblages. In the appendicular skeleton, a bias towards forequarters emerges in phases 1 and 2 but the discrepancy is not as evident as in cattle. In both phases a slight underrepresentation of the metapodial bones is noticeable. There is little difference between sheep and goat in the body part representation except the horn cores. The number of goat horncores largely surpasses that of the sheep (62 MNS vs. 28 MNS), whilst the opposite is true for the mandible (40 MNS of sheep and 14 MNS of goat).

The **pig** assemblage suffers from a small size, and the differences between body parts appear to be taphonomic (table 6.5).

Other species present in the Chełm assemblage are mostly represented by stray finds of complete bones of random parts of the skeleton. This applies to horse, dog (table 6.5), cat (two complete femora and a complete tibia), fox (a cranium and a mandible), and hare (two pelves). Roe deer was only represented by a cranium fragment and the shaft of a metacarpal.

6.1.2 Wrocław

The analysed animal remains derive from site Więzienna 11 in the medieval Jewish district of Wrocław. It was recovered from 40 stratigraphic units which were grouped into five periods (A to E) and four functional zones (1 to 4) of the medieval residential lot (see 4.2.3).

Periods B and C provided the opportunity to investigate differences amidst spatial zones (see 4.2.3): the main house, the manufacture/production zone, the back buildings (*hinterhäusen*), and the 'sanitary area'. The 'sanitary area' in period C, however, did not yield any stratigraphic units with bones.

Thus, the list of contexts analysed in this chapter comprises of:

Period A (PerA) habitation prior to 1250 CE

Period B, zone 1 (PerB1) the main building in period B: 1250 CE till early 1300's

Period B, zone 2 (PerB2) the manufacture/production zone in period B: 1250 CE till early 1300's

Period B, zone 3 (PerB3) the buildings at the back of the lot (*hinterhäusen*) in period B: 1250 CE till early 1300's

Period B, zone 4 (PerB4) the 'sanitary area' in period B: 1250 CE till early 1300's

Period C, zone 1 (PerC1) the main building in the fourteenth century

Period C, zone 2 (PerC2) the manufacture/production zone in the fourteenth century

Period C, zone 3 (PerC3) the buildings at the back of the lot (*hinterhäusen*) in the fourteenth century

Period D (PerD) habitation in the late fourteenth–early fifteenth centuries

Period E (PerE) habitation in the fifteenth till seventeenth centuries

The assemblage from Więzienna 11 consists of 3514 specimens (NISP) out of which I recorded 8076 diagnostic zones (NRDZ) (table 6.6). The MNS, derived from NRDZ, consists of 3982 remains (table 6.7). The largest assemblage, from period B3, includes 1339 remains MNS; whilst the smallest, from period B1 contains 108 remains MNS.

6.1.2.1 Taxonomic frequency

The assemblage consists predominately of the remains of domestic mammals, amounting to 3953 remains MNS (99.3% of total assemblage). The majority of the assemblage is comprised of the remains of domestic ruminants, with caprines making up 63% MNS and cattle 18% of the MNS (table 6.7). Amidst caprines, sheep remains are three times as abundant as goat's. Pig constitutes 11% of the assemblage, horse and cat 3–4% each, and dog, roe deer, red deer, and hare are represented by a few specimens only.

Caprine remains are the most abundant in all periods (table 6.7), but a closer examination of taxonomic frequencies reveals a few differences between periods and areas of the site:

- Period A shows a striking predominance of caprines with little presence of other species compared to other periods (fig. 6.1)
- The *hinterhäusen* and 'sanitary' zones in periods B and C (i.e. PerB3, PerB4, PerC3) present similar patterns of low numbers of pigs and predominance of caprines (fig. 6.1)
- The main house area presents a different pattern from the other areas: in period B (PerB1) it is characterised by an exceptionally high frequency of pig remains, whilst in period C (PerC1) it stands out due to a frequency

Table 6.6 Wrocław. Number of Identified Specimens (NISP) and Number of Recorded Diagnostic Zones (NRDZ) for each species of mammals. for each species of mammals

Context:	Period A		Period B1		Period B2		Period B3		Period B4		Period C1		Period C2		Period C3		Period D		Period E		Total	
Unit:	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ
Cattle	**13**	**18**	**24**	**37**	**56**	**80**	**221**	**364**	**73**	**119**	**48**	**59**	**52**	**74**	**62**	**102**	**156**	**232**	**118**	**160**	**823**	**1245**
Caprines	**93**	**330**	**38**	**88**	**143**	**379**	**830**	**2013**	**210**	**516**	**60**	**138**	**89**	**215**	**161**	**383**	**276**	**714**	**184**	**462**	**2084**	**5238**
Sheep	36	188	8	26	21	73	119	384	42	143	5	13	18	61	25	78	48	165	35	124	357	1255
Goat	7	29	4	10	10	34	64	177	13	29	3	12	2	4	10	24	12	38	5	11	130	368
Sheep/Goat	50	113	26	52	112	272	647	1452	155	344	52	113	69	150	126	281	216	511	144	327	1597	3615
Pig	**18**	**46**	**29**	**61**	**39**	**89**	**101**	**234**	**21**	**53**	**13**	**29**	**24**	**67**	**26**	**54**	**79**	**171**	**52**	**129**	**402**	**933**
Horse	**2**	**2**	**1**	**2**	**14**	**31**	**46**	**108**	**11**	**30**			**9**	**16**	**8**	**15**	**19**	**40**	**3**	**6**	**113**	**250**
Red deer							**3**	**3**									**1**	**1**			**4**	**4**
Roe deer	**3**	**5**			**1**	**1**	**4**	**20**	**1**	**3**							**3**	**10**	**2**	**6**	**14**	**45**
Wild boar							**1**	**1**							**1**	**3**					**2**	**4**
Dog							**2**	**5**	**4**	**21**							**1**	**3**			**7**	**29**
Cat			**1**	**4**	**13**	**76**	**16**	**75**	**21**	**113**			**2**	**10**	**3**	**14**	**3**	**12**	**3**	**14**	**62**	**318**
Hare	**1**	**3**					**1**	**3**											**1**	**4**	**3**	**10**
Total	**130**	**404**	**93**	**192**	**266**	**656**	**1225**	**2826**	**341**	**855**	**121**	**226**	**176**	**382**	**261**	**571**	**538**	**1183**	**363**	**781**	**3514**	**8076**

of cattle bones that is almost twice as large than in other areas in this period, but the number of pig remains is low (fig. 6.1)

- The manufacture areas in period B and C (PerB2, PerC2) show similar patterns to the assemblages from periods D and E, though period E has a larger representation of cattle bones (fig. 6.1)
- Horse is represented in small quantities in most periods and areas, but in period A, in the main building in periods B and C (i.e. PerB1 and PerC1) and in period E its remains are particularly scanty (table 6.7)
- Cat bones constitute a noticeable portion of the assemblage in most periods, and in period B they are very abundant (table 6.8) in manufacture and sanitation areas (i.e. PerB2 and PerB4)
- Wild species, namely red and roe deer, wild boar and hare, are present in most contexts, and are most abundant in period B3 (table 6.7)

6.1.2.2 Body part representation

All recordable remains of **cattle** are present in the assemblage from Więzienna 11, but the predominance of skull bones is clearly noticeable (table 6.8).

- In period A, cattle bones are scarce, but they seem to represent all portions of the skeleton
- In all zones in period B, crania and mandibles are much better represented than the appendicular skeleton. Horncores prevail in zone B4, but are underrepresented in other zones in this period. The distribution of cattle limb bones in period B is mostly uniform with some key points emerging: (1) in zones B1 and B2 upper parts of hindlimbs are more numerous than forelimbs (however, the assemblages are not very large), whereas the opposite seems to be true for zone B3; (2) feet are the most abundant remains in zones B1 and B3; (3) some solitary remains are much better represented than others; such as pelvis in B2, humerus and calcaneum in B3 and femur in B4.
- In period C, at the back of the residential lot at Więzienna 11 (i.e. C2 and C3) parts of the skull, again, clearly prevail. Most appendicular bones are few in numbers but represent most parts of limbs evenly, with slightly

Table 6.7 Wrocław. Minimum Number of Sections (MNS) for each species of mammals

Context:	Period A		Period B1		Period B2		Period B3		Period B4		Period C1		Period C2		Period C3		Period D		Period E		Total	
Cattle	**14**	7%	**23**	21%	**54**	18%	**205**	15%	**66**	16%	**43**	33%	**32**	17%	**53**	18%	**103**	18%	**108**	25%	**701**	18%
Caprines	**165**	80%	**50**	46%	**159**	52%	**935**	70%	**245**	59%	**72**	55%	**110**	59%	**197**	68%	**341**	61%	**249**	57%	**2523**	63%
Sheep	93		13		30		184		63		8		29		37		79		67		603	
Goat	14		6		19		96		20		6		3		16		22		7		209	
Sheep/Goat	58		31		110		655		162		58		78		144		240		175		1711	
Pig	**22**	11%	**32**	30%	**39**	13%	**105**	8%	**29**	7%	**15**	12%	**28**	15%	**25**	9%	**86**	15%	**65**	15%	**447**	11%
Horse	**1**	0.5%	**1**	0.9%	**15**	4.9%	**50**	3.7%	**13**	3.1%			**11**	5.9%	**7**	2.4%	**20**	3.6%	**3**	0.7%	**121**	3.0%
Red deer							**1**	0.1%									**1**	0.2%			**2**	0.1%
Roe deer	**3**	1.5%			**1**	0.3%	**5**	0.4%	**1**	0.2%							**5**	0.9%	**4**	0.9%	**19**	0.5%
Wild boar							**1**	0.1%							**2**	0.6%					**3**	0.1%
Dog							**3**	0.2%	**8**	1.9%							**2**	0.4%			**13**	0.3%
Cat			**2**	1.9%	**36**	12%	**33**	2.5%	**54**	13%			**5**	2.7%	**5**	1.7%	**6**	1.1%	**7**	1.6%	**148**	3.7%
Hare	**1**	0.5%					**2**	0.1%											**2**	0.5%	**5**	0.1%
Total	**206**		**108**		**304**		**1340**		**416**		**130**		**186**		**290**		**564**		**438**		**3982**	

more abundant upper hindquarter bones in C2, and metapodials in C3. Area C1 shows different pattern in which bones of edible parts are scarce but horncores dominate.

- Period D presents a predominance of skull bones (albeit without horns), an overrepresentation of lower portions of limbs comparing to upper parts, and hindquarters slightly more abundant than forequarters.
- Period E shows a low, but fairly uniform, representation of appendicular skeleton, and a large predominance of horncores.

In the majority of the phases there is a noticeable underrepresentation of first and second phalanges compared to the third one, and of astragali compared to calcanei. This may be due to the removing of astragali for their use for working or as game pieces.

Caprine bones from Więzienna 11 make up the largest part of the assemblage, with all body part represented, except some of the smallest foot bones (table 6.9).

- In period A, metapodials prevail, followed by a higher number of parts of the skull. There is an intriguing disproportion between atlases and axes with the former being represented by several specimens and the latter being absent. The upper parts of the forequarters are slightly more abundant then the upper parts of the hindquarters.
- In all areas in period B mandibles are the most frequent remains; crania are also abundant, but mostly without the horncores. In the distribution of appendicular skeleton zones B2, B3, and B4 show some similarities: good representation of meaty parts of legs with higher numbers of radii and tibiae; generally small number of girdle bones (except of B2); epiphyses are underrepresented compared to shafts with a large discrepancy in hindlimbs. Additionally, metapodials are common in B3, but much less so in B2 and B4. The pattern in B1 differs slightly; radii, which are common elsewhere, are scarce here, and metapodials are common.
- In period C the most common remains are metapodials and parts of the skull (mostly mandibles). In zones C1 and C2 the upper parts of hindquarters are more frequent than those of the forequarters. In C3 upper parts of limbs are more abundant than in C1 and C2. Likewise, as

Table 6.8 Anatomical representation of cattle in assemblages from Wrocław

	Cattle	Period A			Period B1			Period B2			Period B3			Period B4			Period C1			Period C2			Period C3			Period D			Period E			Total		
		MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU
Axial	Cranium	**1**	1	N/A	**1**	1	N/A	**6**	6	100%	**14**	14	100%	**4**	4	73%	**2**	2	N/A	**2**	2	N/A	**4**	4	89%	**7**	7	100%	**4**	4	30%	**45**	45	100%
	Horn core	**0**	0	N/A	**1**	1	N/A	**3**	2	25%	**12**	6	43%	**11**	6	100%	**21**	11	N/A	**0**	0	N/A	**8**	4	89%	**2**	1	14%	**27**	14	100%	**85**	42.5	94%
	Mandible	**1**	1	N/A	**3**	2	N/A	**5**	3	42%	**19**	10	68%	**9**	5	82%	**2**	1	N/A	**6**	3	N/A	**9**	5	100%	**11**	6	79%	**9**	5	33%	**74**	37	82%
	Atlas	**0**	0	N/A	**0**	0	N/A	**2**	2	33%	**3**	3	21%	**1**	1	18%	**2**	2	N/A	**1**	1	N/A	**3**	3	67%	**3**	3	43%	**1**	1	7%	**16**	16	36%
	Axis	**2**	2	N/A	**0**	0	N/A	**0**	0	0%	**3**	3	21%	**1**	1	18%	**0**	0	N/A	**0**	0	N/A	**0**	0	0%	**2**	2	29%	**1**	1	7%	**9**	9	20%
Front limb	Scapula	**0**	0	N/A	**0**	0	N/A	**2**	1	17%	**3**	2	11%	**3**	2	27%	**0**	0	N/A	**1**	1	N/A	**1**	1	11%	**4**	2	29%	**4**	2	15%	**18**	9	20%
	Humerus (p)	**0**	0	N/A	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**2**	1	N/A	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**2**	1	2%
	Humerus (s)	**0**	0	N/A	**0**	0	N/A	**1**	1	8%	**13**	7	46%	**2**	1	18%	**1**	1	N/A	**2**	1	N/A	**1**	1	11%	**1**	1	7%	**5**	3	19%	**26**	13	29%
	Humerus (d)	**0**	0	N/A	**0**	0	N/A	**2**	1	17%	**8**	4	29%	**2**	1	18%	**0**	0	N/A	**1**	1	N/A	**0**	0	0%	**2**	1	14%	**3**	2	11%	**18**	9	20%
	Ulna	**2**	1	N/A	**1**	1	N/A	**1**	1	8%	**5**	3	18%	**2**	1	18%	**0**	0	N/A	**0**	0	N/A	**1**	1	11%	**1**	1	7%	**4**	2	15%	**17**	8.5	19%
	Radius (p)	**2**	1	N/A	**0**	0	N/A	**1**	1	8%	**4**	2	14%	**2**	1	18%	**1**	1	N/A	**0**	0	N/A	**0**	0	0%	**2**	1	14%	**1**	1	4%	**13**	6.5	14%
	Radius (s)	**1**	1	N/A	**0**	0	N/A	**0**	0	0%	**6**	3	21%	**2**	1	18%	**2**	1	N/A	**0**	0	N/A	**0**	0	0%	**1**	1	7%	**1**	1	4%	**13**	6.5	14%
	Radius (d)	**0**	0	N/A	**1**	1	N/A	**0**	0	0%	**4**	2	14%	**3**	2	27%	**0**	0	N/A	**0**	0	N/A	**1**	1	11%	**2**	1	14%	**3**	2	11%	**14**	7	16%
	Metacarpal (p)	**0**	0	N/A	**3**	2	N/A	**1**	1	8%	**9**	5	32%	**1**	1	9%	**0**	0	N/A	**1**	1	N/A	**1**	1	11%	**3**	2	21%	**3**	2	11%	**22**	11	24%
	Metacarpal (s)	**0**	0	N/A	**2**	1	N/A	**1**	1	8%	**12**	6	43%	**1**	1	9%	**1**	1	N/A	**1**	1	N/A	**2**	1	22%	**6**	3	43%	**2**	1	7%	**28**	14	31%
	Metacarpal (d)	**0**	0	N/A	**0**	0	N/A	**0**	0	0%	**4**	2	14%	**1**	1	9%	**0**	0	N/A	**2**	1	N/A	**1**	1	11%	**2**	1	14%	**2**	1	7%	**12**	6	13%
Hind limb	Pelvis	**0**	0	N/A	**2**	1	N/A	**8**	4	67%	**6**	3	21%	**0**	0	0%	**2**	1	N/A	**2**	1	N/A	**2**	1	22%	**3**	2	21%	**3**	2	11%	**28**	14	31%
	Femur (p)	**0**	0	N/A	**1**	1	N/A	**1**	1	8%	**7**	4	25%	**1**	1	9%	**1**	1	N/A	**2**	1	N/A	**2**	1	22%	**3**	2	21%	**5**	3	19%	**23**	11.5	26%
	Femur (s)	**1**	1	N/A	**0**	0	N/A	**3**	2	25%	**5**	3	18%	**5**	3	45%	**0**	0	N/A	**1**	1	N/A	**0**	0	0%	**3**	2	21%	**1**	1	4%	**19**	9.5	21%
	Femur (d)	**0**	0	N/A	**1**	1	N/A	**1**	1	8%	**5**	3	18%	**2**	1	18%	**0**	0	N/A	**0**	0	N/A	**0**	0	0%	**1**	1	7%	**1**	1	4%	**11**	5.5	12%
	Tibia (p)	**0**	0	N/A	**2**	1	N/A	**1**	1	8%	**0**	0	0%	**0**	0	0%	**1**	1	N/A	**1**	1	N/A	**1**	1	11%	**1**	1	7%	**2**	1	7%	**9**	4.5	10%
	Tibia (s)	**1**	1	N/A	**0**	0	N/A	**1**	1	8%	**7**	4	25%	**1**	1	9%	**0**	0	N/A	**3**	2	N/A	**1**	1	11%	**3**	2	21%	**4**	2	15%	**21**	10.5	23%
	Tibia (d)	**0**	0	N/A	**0**	0	N/A	**1**	1	8%	**2**	1	7%	**1**	1	9%	**1**	1	N/A	**0**	0	N/A	**1**	1	11%	**4**	2	29%	**3**	2	11%	**13**	6.5	14%
	Astragalus	**0**	0	N/A	**0**	0	N/A	**4**	2	33%	**5**	3	18%	**2**	1	18%	**0**	0	N/A	**0**	0	N/A	**1**	1	11%	**4**	2	29%	**2**	1	7%	**18**	9	20%
	Calcaneum	**0**	0	N/A	**2**	1	N/A	**0**	0	0%	**13**	7	46%	**3**	2	27%	**2**	1	N/A	**1**	1	N/A	**3**	2	33%	**1**	1	7%	**0**	0	0%	**25**	12.5	28%
	Centroquartal	**1**	1	N/A	**1**	1	N/A	**0**	0	0%	**4**	2	14%	**0**	0	0%	**0**	0	N/A	**1**	1	N/A	**1**	1	11%	**3**	2	21%	**2**	1	7%	**13**	6.5	14%
	Metatarsal (p)	**0**	0	N/A	**0**	0	N/A	**1**	1	8%	**6**	3	21%	**1**	1	9%	**0**	0	N/A	**1**	1	N/A	**0**	0	0%	**5**	3	36%	**3**	2	11%	**17**	8.5	19%
	Metatarsal (s)	**0**	0	N/A	**1**	1	N/A	**2**	1	17%	**6**	3	21%	**2**	1	18%	**0**	0	N/A	**1**	1	N/A	**3**	2	33%	**5**	3	36%	**3**	2	11%	**23**	11.5	26%
	Metatarsal (d)	**0**	0	N/A	**0**	0	N/A	**2**	1	17%	**6**	3	21%	**1**	1	9%	**0**	0	N/A	**0**	0	N/A	**2**	1	22%	**5**	3	36%	**3**	2	11%	**19**	9.5	21%
Feet	Phalanx1	**0**	0	N/A	**0**	0	N/A	**1**	0	2%	**3**	0	3%	**1**	0	2%	**0**	0	N/A	**0**	0	N/A	**0**	0	0%	**2**	0	4%	**0**	0	0%	**7**	0.88	2%
	Phalanx2	**0**	0	N/A	**0**	0	N/A	**0**	0	0%	**3**	0	3%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**1**	0	3%	**3**	0	5%	**0**	0	0%	**7**	0.88	2%
	Phalanx3	**2**	0	N/A	**1**	0	N/A	**3**	0	6%	**8**	1	7%	**1**	0	2%	**2**	0	N/A	**2**	0	N/A	**3**	0	8%	**8**	1	14%	**6**	1	6%	**36**	4.5	10%
Total MNS		**14**			**23**			**54**			**205**			**66**			**43**			**32**			**53**			**103**			**108**			**701**		

in period B, shafts are much more frequent than epiphyses, especially in femur and tibia.

- Periods D and E present very high frequencies of metapodials and higher numbers of forequarters than hindquarters. In period D there are also high numbers of mandibles and radius shafts.

Differences between sheep and goat anatomical frequencies are noticeable only in skull. In total, goat is much better represented by horncores than sheep (goat horncores MNS n=27, 13% of the goat assemblage; sheep horncore MNS n=4, 0.7% of the sheep assemblage), whilst the opposite is true for mandibles (goat mandibles MNS n=12, 6%; sheep mandibles MNS n=90, 15%).

Pig skeleton in the assemblage (table 6.10) is represented predominately by parts of the skull and upper 'meaty' parts of the appendicular skeleton, whilst metapodials are mostly absent, presumably due to taphonomic factors. Most assemblages are meagre and insufficient for analysis with the exception of B3 and D. In those two assemblages, limbs are more abundant than parts of the head.

Horse bones (table 6.10) are very scarce in periods A and E, and in the main house in periods B and C (i.e. B1 and C1). In assemblages C2, C3, and D horse remains derive mostly from lower portions of limb (metapodials, tarsals, and phalanges), suggesting that these may derive from primary butchery, hide processing, or production waste. There is little doubt though that horse flesh was acquired in period B at the back of the residential lot, possibly for its consumption. Assemblages from B2, B3, and B4 include most parts of the skeleton — in many cases with butchery marks — including heads, but most remains come from lower portions of limbs with feet and middle portions (radii and tibiae). The previous analysis of the assemblage (Socha et al., 1999, p.154), however, concluded that there was no evidence of consumption of horse.

Cat bones are surprisingly numerous in the assemblage (table 6.11). They are present in all periods except A and the main building B1 and C1. The vast majority of cat bones were unbroken upper parts of limbs: femora, tibiae, humeri, scapulae, and pelves. This body part composition suggests that cat carcasses were dismembered and utilised, but for purposes other than consumption.

Other species are scarce in the assemblage. Roe deer (table 6.11) is represented by several random remains. In periods A and B these are mostly heads and necks, whilst in periods D and E only metapodials are present. Dog bones are

Table 6.9 Anatomical representation of caprines in assemblages from Wrocław

	Caprines	Period A			Period B1			Period B2			Period B3			Period B4			Period C1			Period C2			Period C3			Period D			Period E			Total		
		MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU
Axial	Cranium	**3**	3	26%	**2**	2	80%	**7**	7	70%	**26**	26	57%	**7**	7	45%	**1**	1	18%	**5**	5	71%	**5**	5	53%	**5**	5	31%	**7**	7	54%	**68**	68	59%
	Horn core	**0**	0	0%	**1**	1	20%	**5**	3	25%	**9**	5	10%	**7**	4	23%	**0**	0	0%	**2**	1	14%	**3**	2	16%	**1**	1	3%	**3**	2	12%	**31**	15.5	13%
	Mandible	**8**	4	35%	**5**	3	100%	**20**	10	100%	**91**	46	100%	**31**	16	100%	**7**	4	64%	**12**	6	86%	**14**	7	74%	**31**	16	97%	**11**	6	42%	**230**	115	100%
	Atlas	**4**	4	35%	**0**	0	0%	**3**	3	30%	**7**	7	15%	**1**	1	6%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**3**	3	19%	**5**	5	38%	**23**	23	20%
	Axis	**0**	0	0%	**0**	0	0%	**0**	0	0%	**7**	7	15%	**2**	2	13%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**3**	3	19%	**2**	2	15%	**14**	14	12%
Front limb	Scapula	**2**	1	9%	**1**	1	20%	**7**	4	35%	**19**	10	21%	**10**	5	32%	**2**	1	18%	**3**	2	21%	**7**	4	37%	**7**	4	22%	**6**	3	23%	**64**	32	28%
	Humerus (p)	**2**	1	9%	**0**	0	0%	**0**	0	0%	**7**	4	8%	**1**	1	3%	**1**	1	9%	**1**	1	7%	**2**	1	11%	**6**	3	19%	**5**	3	19%	**25**	12.5	11%
	Humerus (s)	**4**	2	17%	**3**	2	60%	**8**	4	40%	**45**	23	49%	**16**	8	52%	**1**	1	9%	**3**	2	21%	**9**	5	47%	**18**	9	56%	**13**	7	50%	**120**	60	52%
	Humerus (d)	**3**	2	13%	**3**	2	60%	**7**	4	35%	**39**	20	43%	**14**	7	45%	**2**	1	18%	**2**	1	14%	**5**	3	26%	**14**	7	44%	**8**	4	31%	**97**	48.5	42%
	Ulna	**0**	0	0%	**1**	1	20%	**3**	2	15%	**23**	12	25%	**5**	3	16%	**1**	1	9%	**1**	1	7%	**4**	2	21%	**4**	2	13%	**4**	2	15%	**46**	23	20%
	Radius (p)	**4**	2	17%	**0**	0	0%	**7**	4	35%	**37**	19	41%	**12**	6	39%	**1**	1	9%	**3**	2	21%	**5**	3	26%	**14**	7	44%	**3**	2	12%	**86**	43	37%
	Radius (s)	**6**	3	26%	**1**	1	20%	**15**	8	75%	**56**	28	62%	**22**	11	71%	**2**	1	18%	**6**	3	43%	**12**	6	63%	**26**	13	81%	**13**	7	50%	**159**	79.5	69%
	Radius (d)	**2**	1	9%	**0**	0	0%	**6**	3	30%	**21**	11	23%	**8**	4	26%	**0**	0	0%	**2**	1	14%	**5**	3	26%	**11**	6	34%	**6**	3	23%	**61**	30.5	27%
	Metacarpal (p)	**21**	11	91%	**1**	1	20%	**6**	3	30%	**66**	33	73%	**11**	6	35%	**4**	2	36%	**14**	7	100%	**15**	8	79%	**28**	14	88%	**15**	8	58%	**181**	90.5	79%
	Metacarpal (s)	**21**	11	91%	**5**	3	100%	**6**	3	30%	**65**	33	71%	**12**	6	39%	**7**	4	64%	**12**	6	86%	**19**	10	100%	**31**	16	97%	**22**	11	85%	**200**	100	87%
	Metacarpal (d)	**23**	12	100%	**4**	2	80%	**4**	2	20%	**39**	20	43%	**9**	5	29%	**3**	2	27%	**5**	3	36%	**4**	2	21%	**16**	8	50%	**17**	9	65%	**124**	62	54%
Hind limb	Pelvis	**1**	1	4%	**1**	1	20%	**10**	5	50%	**21**	11	23%	**5**	3	16%	**2**	1	18%	**4**	2	29%	**6**	3	32%	**6**	3	19%	**8**	4	31%	**64**	32	28%
	Femur (p)	**2**	1	9%	**0**	0	0%	**1**	1	5%	**7**	4	8%	**1**	1	3%	**2**	1	18%	**1**	1	7%	**4**	2	21%	**2**	1	6%	**2**	1	8%	**22**	11	10%
	Femur (s)	**1**	1	4%	**2**	1	40%	**8**	4	40%	**45**	23	49%	**11**	6	35%	**4**	2	36%	**9**	5	64%	**8**	4	42%	**9**	5	28%	**8**	4	31%	**105**	52.5	46%
	Femur (d)	**0**	0	0%	**0**	0	0%	**2**	1	10%	**12**	6	13%	**1**	1	3%	**2**	1	18%	**0**	0	0%	**2**	1	11%	**0**	0	0%	**0**	0	0%	**19**	9.5	8%
	Tibia (p)	**0**	0	0%	**1**	1	20%	**1**	1	5%	**7**	4	8%	**1**	1	3%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**1**	1	3%	**1**	1	4%	**12**	6	5%
	Tibia (s)	**5**	3	22%	**5**	3	100%	**7**	4	35%	**73**	37	80%	**17**	9	55%	**4**	2	36%	**6**	3	43%	**16**	8	84%	**14**	7	44%	**8**	4	31%	**155**	77.5	67%
	Tibia (d)	**3**	2	13%	**4**	2	80%	**3**	2	15%	**36**	18	40%	**8**	4	26%	**1**	1	9%	**3**	2	21%	**6**	3	32%	**6**	3	19%	**5**	3	19%	**75**	37.5	33%
	Astragalus	**1**	1	4%	**0**	0	0%	**0**	0	0%	**9**	5	10%	**0**	0	0%	**1**	1	9%	**0**	0	0%	**2**	1	11%	**0**	0	0%	**1**	1	4%	**14**	7	6%
	Calcaneum	**0**	0	0%	**2**	1	40%	**4**	2	20%	**11**	6	12%	**1**	1	3%	**1**	1	9%	**1**	1	7%	**6**	3	32%	**4**	2	13%	**3**	2	12%	**33**	16.5	14%
	Centroquartal	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%
	Metatarsal (p)	**15**	8	65%	**3**	2	60%	**7**	4	35%	**48**	24	53%	**12**	6	39%	**6**	3	55%	**7**	4	50%	**15**	8	79%	**26**	13	81%	**25**	13	96%	**164**	82	71%
	Metatarsal (s)	**17**	9	74%	**3**	2	60%	**9**	5	45%	**60**	30	66%	**14**	7	45%	**11**	6	100%	**6**	3	43%	**16**	8	84%	**32**	16	100%	**26**	13	100%	**194**	97	84%
	Metatarsal (d)	**14**	7	61%	**2**	1	40%	**3**	2	15%	**32**	16	35%	**6**	3	19%	**4**	2	36%	**2**	1	14%	**7**	4	37%	**16**	8	50%	**13**	7	50%	**99**	49.5	43%
Feet	Phalanx1	**1**	0	1%	**0**	0	0%	**0**	0	0%	**16**	2	4%	**0**	0	0%	**2**	0	5%	**0**	0	0%	**0**	0	0%	**7**	1	5%	**8**	1	8%	**34**	4.25	4%
	Phalanx2	**2**	0	2%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**2**	0.25	0%
	Phalanx3	**0**	0	0%	**0**	0	0%	**0**	0	0%	**1**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	0%	**1**	0	1%	**2**	0.25	0%
Total MNS		**165**			**50**			**159**			**935**			**245**			**72**			**110**			**197**			**341**			**249**			**2523**		

Table 6.10 Anatomical representation of pig and horse in assemblages from Wrocław

MNS		Pig											Horse										
		PerA	PerB1	PerB2	PerB3	PerB4	PerC1	PerC2	PerC3	PerD	PerE	Total (pig)	PerA	PerB1	PerB2	PerB3	PerB4	PerC1	PerC2	PerC3	PerD	PerE	Total (horse)
Axial	Cranium	2	4	3	5		1	2	2	2	4	**25**			1	1	1					1	**4**
	Horn core																						
	Mandible	2	3	4	12	4	2	3	3	7	9	**49**				4	1						**5**
	Atlas				1			2		2	3	**8**											
	Axis				1							**1**											
Front limb	Scapula	1	1	1	9	3	1	2	1	5	4	**28**			1	1					1		**3**
	Humerus (p)				1		1		1	1	2	**6**					1						**1**
	Humerus (s)	2	1	3	5	2	2		2	7	4	**28**					1					1	**2**
	Humerus (d)			3	5	1	2		4	1	2	**18**			1		2					1	**4**
	Ulna		1	1	2			1	1	3	1	**10**	1			2	1		1		1		**6**
	Radius (p)	1		1	6	2		3		3	3	**19**				3							**3**
	Radius (s)	1			7	2	1	3	2	5	3	**24**				3							**3**
	Radius (d)				2			1		3	2	**8**			1	2							**3**
	Metacarpal (p)		3		1				1	3	2	**10**			1	1			2				**4**
	Metacarpal (s)		3		1				1	3	2	**10**			1	1			1				**3**
	Metacarpal (d)		2		1					3	2	**8**				1			1	1			**3**
Hind limb	Pelvis	2	1	5	8	1		1	2	4	3	**27**			3	1							**4**
	Femur (p)	1		3	5				1	3		**13**							1				**1**
	Femur (s)	2	2	3	6	2		2		7	1	**25**											
	Femur (d)	2	2	2	4		1	1	1	1	4	**18**											
	Tibia (p)	2		1	1	1	1	1		2	1	**10**				1	1			1			**3**
	Tibia (s)	2	3	5	5	4		3		6	3	**31**				1							**1**
	Tibia (d)	1	2	1	3	3		1	1	4	3	**19**				1							**1**
	Astragalus		1	1		1				1	2	**6**			1	3	1			2	1		**8**
	Calcaneum			1	4			1		5		**11**			1	1				1			**3**
	Centroquartal																						
	Metatarsal (p)				2	1	1		1	1	3	**9**			1		1				1		**3**
	Metatarsal (s)				2	1	1		1	1	2	**8**									1		**1**
	Metatarsal (d)				1	1	1		1			**4**							1		1		**2**
Feet	Phalanx1	1	3	1	2					1		**8**			1	7	3			1	6		**18**
	Phalanx2							1				**1**		1		10			3		4		**18**
	Phalanx3				3					2		**5**			2	6			1	1	4		**14**
Total MNS		22	32	39	105	29	15	28	26	86	65	**447**	1	1	15	50	13		11	7	20	3	**121**

even scarcer, consisting of what is probably a part of a dog burial in period B (a humerus, two pelves, two femora and a tibia) and a solitary femur in period D. Hare is represented by a pelvis (Per A), a humerus (Per B3), and a radius (Per E). Wild boar humerus was recovered in Per C3 and a mandible in B3.

6.1.3 Lelów

The assemblage was obtained from 36 stratigraphic units in four areas of Lelów town centre. The list of archaeological features and units and the detailed description and interpretation of the archaeological contexts and and can be found in section 4.3.2.

Based on chronological and spatial differences, I divided the assemblage into **seven entities**:

Table 6.11 Anatomical representation of cat, and roe deer in assemblages from Wrocław

MNS		Cat											Roe deer										
		PerA	PerB1	PerB2	PerB3	PerB4	PerC1	PerC2	PerC3	PerD	PerE	Total (cat)	PerA	PerB1	PerB2	PerB3	PerB4	PerC1	PerC2	PerC3	PerD	PerE	Total (roe deer)
Axial	Cranium				1						1	**2**	1				1						**2**
	Horn core																						
	Mandible					1						**1**	1			2							**3**
	Atlas															1							**1**
	Axis									1		**1**				1							**1**
Front limb	Scapula				3	1			2			**6**											
	Humerus (p)		1		3	6		1		1		**12**											
	Humerus (s)		1		3	6		1		1		**12**											
	Humerus (d)				3	6		1				**10**											
	Ulna				1							**1**											
	Radius (p)										1	**1**											
	Radius (s)										1	**1**			1	1							**2**
	Radius (d)										1	**1**											
	Metacarpal (p)																				2		**2**
	Metacarpal (s)																				2	1	**3**
	Metacarpal (d)																					1	**1**
Hind limb	Pelvis				2	1						**3**	1								1		**2**
	Femur (p)			5	1	3			1			**10**											
	Femur (s)			6	1	4			1			**12**											
	Femur (d)			4	1	3			1			**9**											
	Tibia (p)			7	5	8		1		1	1	**23**											
	Tibia (s)			7	5	8		1		1	1	**23**											
	Tibia (d)			7	4	7				1	1	**20**											
	Astragalus																						
	Calcaneum																						
	Centroquartal																						
	Metatarsal (p)																						
	Metatarsal (s)																					1	**2**
	Metatarsal (d)																					1	**1**
Feet	Phalanx1																						
	Phalanx2																						
	Phalanx3																						
Total MNS			2	36	33	54		5	5	6	7	**148**	3		1	5	1				5	4	**20**

Period A (14th–16th century):

- Area 1 (A1/PerA): Krótka Street
- Area 2 (A2/PerA): central part of Partyzantów (vel Market) Square, numbers 29–38; Kościelna Street, number 25
- Area 3 (A3/PerA): eastern part of Partyzantów (vel Market) Square, numbers 2–5
- Area 4 (A4/PerA): Szczękocińska Square, numbers 1–15; Klasztorna Street

Period B (17th–18th century):

- Areas 1 and 2 (A1–2/PerB): Krótka Street; central part of Partyzantów (vel Market) Square, numbers 29–38; Kościelna Street, number 25; includes remnants of a butcher shop

Table 6.12 Lelów. Number of Identified Specimens (NISP) and Number of Recorded Diagnostic Zones (NRDZ) for each species of mammals

Context:	A1/PerA		A2/PerA		A3/PerA		A4/PerA		A1-2/PerB		A3/PerB		A4/PerB		Total	
Unit:	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ
Cattle	**122**	**421**	**146**	**456**	**62**	**221**	**330**	**986**	**287**	**772**	**67**	**112**	**70**	**154**	**1084**	**3122**
Caprines	**165**	**267**	**18**	**41**	**9**	**21**	**102**	**266**	**23**	**53**	**22**	**52**	**32**	**64**	**371**	**764**
Sheep	35	85	5	15	4	11	18	66	3	8	6	19	4	10	75	214
Goat	118	138	6	7	2	2	19	32	6	8	4	9	11	11	166	207
Sheep/Goat	12	44	7	19	3	8	65	168	14	37	12	24	17	43	130	343
Pig	**11**	**40**	**14**	**36**	**15**	**39**	**72**	**181**	**35**	**65**	**16**	**32**	**11**	**20**	**174**	**413**
Horse	**36**	**124**	**13**	**36**	**4**	**12**	**66**	**186**	**15**	**42**			**9**	**22**	**143**	**422**
Red deer	**1**	**3**	**1**	**0**											**2**	**3**
Roe deer			**1**	**4**											**1**	**4**
Dog	**1**	**4**							**1**	**6**					**2**	**10**
Total	**336**	**859**	**193**	**573**	**90**	**293**	**570**	**1619**	**361**	**938**	**105**	**196**	**122**	**260**	**1777**	**4738**

- Area 3 (A3/PerB): eastern part of Partyzantów (vel Market) Square, numbers 2–5
- Area 4 (A4/PerB): Szczękocińska Street, numbers 1–15; Klasztorna Street

Areas 1 and 2 in period B were grouped together because of the similarity of the assemblages and a small size of the A1 assemblage.

The assemblage from Lelów consists of 1777 specimens (NISP). Period A comprises of 1189 fragments (NISP), out of which I recorded 3344 diagnostic zones (NRDZ) (table 6.12). Period B consists of 588 fragments with 1394 diagnostic zones (table 6.12). The MNS, derived from NRDZ, consists of 1660 remains in period A and 768 remains in period B (table 6.13). The largest assemblage was recorded in period A in area 4, it contains 802 remains; the smallest was area 3 in period B, 114 remains.

Table 6.13 Lelów. Minimum Number of Sections (MNS) for each species of mammals

Context:	A1/PerA		A2/PerA		A3/PerA		A4/PerA		A1-2/PerB		A3/PerB		A4/PerB		Total	
Cattle	**181**	42%	**219**	80%	**115**	75%	**470**	59%	**408**	81%	**65**	57%	**88**	58%	**1546**	64%
Caprines	**183**	42%	**24**	9%	**12**	8%	**148**	18%	**34**	7%	**31**	27%	**39**	26%	**471**	19%
Sheep	44		8		6		36		5		10		5		114	
Goat	121		7		2		24		7		5		11		177	
Sheep/Goat	18		9		4		88		22		16		23		180	
Pig	**12**	3%	**12**	4%	**19**	12%	**85**	11%	**36**	7%	**18**	16%	**12**	8%	**194**	8%
Horse	**53**	12%	**17**	6%	**7**	5%	**99**	12%	**22**	4%			**12**	8%	**210**	9%
Red deer	**1**	0.2%													**1**	0.04%
Roe deer			**2**	0.7%											**2**	0.1%
Dog	**1**	0.2%							**3**	0.6%					**4**	0.2%
Total	**431**		**274**		**153**		**802**		**503**		**114**		**151**		**2428**	

6.1.3.1 Taxonomic frequency

The assemblage from Lelów comprises predominately of the remains of domestic mammals, 2425 remains (99.9% of total assemblage MNS). The majority are domestic ruminants, largely cattle, comprising 59% in period A and 73% in period B. Caprines are much fewer, making up 22% of the assemblage in period A and 14% in period B. Pig constitutes 8–9% of both assemblages and horse 11% in period A and 4% in period B. Other present species; roe deer, red deer, and dog were present only in a few stray finds. In the assemblage some patterns emerge:

- The assemblages from Lelów seem to fit into three groups based on the frequency of three main artiodactyl taxa (fig. 6.1). In general, these groups are also coherent spatially. The first group comprises of contexts located in the Market Square during both periods (contexts A2/PerA, A1–2/PerB, A3/PerA); it is characterised by cattle predominance with little presence of other taxa. The second group has a larger caprine fraction then the first group, and slightly larger pig percentage. This group includes contexts from the eastern part of the Market Square and Szczękocińska Street eastwards (A4/PerA, A3/PerB, A4/PerB). The third group is only one assemblage different from the others, north–west to the Market Square, with equal frequencies of cattle and caprines with few pig bones (A1/PerA). This area had a large deposit of goat horncores. The taxonomic preference in areas 2 and 4 changes only slightly with time, whilst in areas 1 and 3 there are radical changes between periods.

- The amount of pig bones varies largely in different areas, with the largest numbers occurring in the eastern part of the Market Square: in areas 3 in both periods, and area 4 in period A (table 6.13). The least amount of pig bones was recorded in areas 1 and 2.

- In most assemblages there is little difference between numbers of sheep and goat. Sheep seem to dominate in A4/PerA and A3/PerB. Goats on the other hand are slightly predominant in A4/PerB and massively outnumber sheep in A1/PerA due to the already mentioned deposit of goat horncores (table 6.13).

- Horse is present in almost all assemblages, with frequencies ranging up to 12%. It is most common in period A in areas 1 and 4.

- Red and roe deer are present only in areas 1 and 2 in period A. Dog is present in both periods, but only in areas 1 and 2.

6.1.3.2 Body part representation

Body part representation of **cattle** from Lelów shows a very distinctive pattern:

- In period A, cattle body part representation is strongly dominated by metapodials in all areas (table 6.14). Parts of the head are common in some areas: all parts of the head in area 1, horncores in area 2, and mandibles in area 4. In areas 1, 2, and 4 upper parts of limbs are scarce, except of scapulae. In area 3 all parts of the skeleton except of the metapodials are scarce. Very few phalanges were found.
- In period B, the pattern resembles the previous one (table 6.14). Metapodials dominate in all areas, metatarsals being more numerous than metacarpals. In general, more upper parts of limb bones are present in this period compared to the previous one. Differences between the

Table 6.14 Anatomical representation of cattle in Lelów

Cattle		A1/PerA			A2/PerA			A3/PerA			A4/PerA			A1-2/PerB			A3/PerB			A4/PerB			Total		
		MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU
Axial	Cranium	5	5	43%	1	1	6%	0	0	0%	2	2	6%	5	5	17%	1	1	33%	1	1	20%	15	15	14%
	Horn core	20	10	87%	11	5.5	31%	2	1	13%	6	3	10%	12	6	21%	0	0	0%	4	2	40%	55	27.5	27%
	Mandible	23	11.5	100%	8	4	23%	3	1.5	20%	18	9	29%	6	3	10%	1	0.5	17%	3	1.5	30%	62	31	30%
	Atlas	1	1	9%	1	1	6%	1	1	13%	1	1	3%	2	2	7%	1	1	33%	1	1	20%	8	8	8%
	Axis	0	0	0%	2	2	11%	0	0	0%	1	1	3%	2	2	7%	0	0	0%	1	1	20%	6	6	6%
Front limb	Scapula	10	5	43%	11	5.5	31%	3	1.5	20%	27	14	43%	6	3	10%	1	0.5	17%	1	0.5	10%	59	29.5	29%
	Humerus (p)	0	0	0%	1	0.5	3%	0	0	0%	0	0	0%	3	1.5	5%	0	0	0%	0	0	0%	4	2	2%
	Humerus (s)	1	0.5	4%	4	2	11%	1	0.5	7%	5	2.5	8%	18	9	31%	2	1	33%	2	1	20%	33	16.5	16%
	Humerus (d)	0	0	0%	1	0.5	3%	1	0.5	7%	5	2.5	8%	18	9	31%	6	3	100%	1	0.5	10%	32	16	15%
	Ulna	0	0	0%	1	0.5	3%	1	0.5	7%	2	1	3%	8	4	14%	1	0.5	17%	1	0.5	10%	14	7	7%
	Radius (p)	2	1	9%	1	0.5	3%	1	0.5	7%	9	4.5	14%	5	2.5	9%	2	1	33%	3	1.5	30%	23	11.5	11%
	Radius (s)	0	0	0%	0	0	0%	2	1	13%	6	3	10%	3	1.5	5%	0	0	0%	1	0.5	10%	12	6	6%
	Radius (d)	1	0.5	4%	1	0.5	3%	1	0.5	7%	10	5	16%	2	1	3%	0	0	0%	2	1	20%	17	8.5	8%
	Metacarpal (p)	18	9	78%	22	11	63%	12	6	80%	52	26	83%	39	20	67%	5	2.5	83%	10	5	100%	158	79	76%
	Metacarpal (s)	18	9	78%	23	12	66%	12	6	80%	50	25	79%	35	18	60%	2	1	33%	9	4.5	90%	149	74.5	72%
	Metacarpal (d)	16	8	70%	16	8	46%	11	5.5	73%	39	20	62%	30	15	52%	4	2	67%	7	3.5	70%	123	61.5	59%
Hind limb	Pelvis	2	1	9%	4	2	11%	2	1	13%	10	5	16%	6	3	10%	2	1	33%	4	2	40%	30	15	14%
	Femur (p)	2	1	9%	4	2	11%	4	2	27%	8	4	13%	2	1	3%	3	1.5	50%	1	0.5	10%	24	12	12%
	Femur (s)	0	0	0%	2	1	6%	4	2	27%	4	2	6%	3	1.5	5%	0	0	0%	1	0.5	10%	14	7	7%
	Femur (d)	1	0.5	4%	0	0	0%	0	0	0%	2	1	3%	0	0	0%	0	0	0%	1	0.5	10%	4	2	2%
	Tibia (p)	0	0	0%	0	0	0%	0	0	0%	2	1	3%	0	0	0%	0	0	0%	0	0	0%	2	1	1%
	Tibia (s)	1	0.5	4%	1	0.5	3%	2	1	13%	6	3	10%	4	2	7%	0	0	0%	1	0.5	10%	15	7.5	7%
	Tibia (d)	1	0.5	4%	0	0	0%	2	1	13%	7	3.5	11%	6	3	10%	2	1	33%	2	1	20%	20	10	10%
	Astragalus	0	0	0%	2	1	6%	5	2.5	33%	9	4.5	14%	4	2	7%	3	1.5	50%	2	1	20%	25	12.5	12%
	Calcaneum	1	0.5	4%	1	0.5	3%	3	1.5	20%	7	3.5	11%	5	2.5	9%	1	0.5	17%	2	1	20%	20	10	10%
	Centroquartal	0	0	0%	0	0	0%	1	0.5	7%	2	1	3%	3	1.5	5%	1	0.5	17%	0	0	0%	7	3.5	3%
	Metatarsal (p)	20	10	87%	34	17	97%	13	6.5	87%	55	28	87%	58	29	100%	6	3	100%	9	4.5	90%	195	97.5	94%
	Metatarsal (s)	20	10	87%	35	18	100%	15	7.5	100%	63	32	100%	58	29	100%	6	3	100%	10	5	100%	207	103.5	100%
	Metatarsal (d)	18	9	78%	29	15	83%	11	5.5	73%	47	24	75%	39	20	67%	3	1.5	50%	6	3	60%	153	76.5	74%
Feet	Phalanx1	0	0	0%	2	0.3	1%	1	0.1	2%	10	1.3	4%	18	2.3	8%	7	0.9	29%	0	0	0%	38	4.75	5%
	Phalanx2	0	0	0%	0	0	0%	0	0	0%	3	0.4	1%	7	0.9	3%	4	0.5	17%	2	0.3	5%	16	2	2%
	Phalanx3	0	0	0%	1	0.1	1%	1	0.1	2%	2	0.3	1%	1	0.1	0%	1	0.1	4%	0	0	0%	6	0.75	1%
Total MNS		181			219			115			470			408			65			88			1546		

Table 6.15 Anatomical representation of caprines in Lelów

	Caprines	A1/PerA			A2/PerA			A3/PerA			A4/PerA			A1-2/PerB			A3/PerB			A4/PerB			Total		
		MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU
Axial	Cranium	7	7	10%	1	1	N/A	0	0	N/A	0	0	0%	0	0	N/A	0	0	N/A	0	0	N/A	8	8	8%
	Horn core	135	67.5	100%	8	4	N/A	3	1.5	N/A	17	8.5	100%	6	3	N/A	1	0.5	N/A	13	6.5	N/A	183	91.5	88%
	Mandible	11	5.5	8%	2	1	N/A	2	1	N/A	2	1	12%	1	0.5	N/A	1	0.5	N/A	1	0.5	N/A	20	10	10%
	Atlas	0	0	0%	1	1	N/A	0	0	N/A	1	1	12%	1	1	N/A	0	0	N/A	0	0	N/A	3	3	3%
	Axis	0	0	0%	1	1	N/A	0	0	N/A	0	0	0%	0	0	N/A	0	0	N/A	1	1	N/A	2	2	2%
Front limb	Scapula	1	0.5	1%	0	0	N/A	1	0.5	N/A	6	3	35%	2	1	N/A	0	0	N/A	0	0	N/A	10	5	5%
	Humerus (p)	0	0	0%	0	0	N/A	0	0	N/A	1	0.5	6%	1	0.5	N/A	0	0	N/A	0	0	N/A	2	1	1%
	Humerus (s)	1	0.5	1%	2	1	N/A	0	0	N/A	8	4	47%	3	1.5	N/A	4	2	N/A	0	0	N/A	18	9	9%
	Humerus (d)	0	0	0%	1	0.5	N/A	0	0	N/A	5	2.5	29%	1	0.5	N/A	4	2	N/A	1	0.5	N/A	12	6	6%
	Ulna	0	0	0%	0	0	N/A	0	0	N/A	3	1.5	18%	0	0	N/A	1	0.5	N/A	1	0.5	N/A	5	2.5	2%
	Radius (p)	0	0	0%	1	0.5	N/A	0	0	N/A	6	3	35%	1	0.5	N/A	3	1.5	N/A	1	0.5	N/A	12	6	6%
	Radius (s)	1	0.5	1%	1	0.5	N/A	0	0	N/A	12	6	71%	2	1	N/A	2	1	N/A	2	1	N/A	20	10	10%
	Radius (d)	1	0.5	1%	0	0	N/A	0	0	N/A	8	4	47%	1	0.5	N/A	0	0	N/A	1	0.5	N/A	11	5.5	5%
	Metacarpal (p)	3	1.5	2%	0	0	N/A	0	0	N/A	7	3.5	41%	2	1	N/A	2	1	N/A	2	1	N/A	16	8	8%
	Metacarpal (s)	3	1.5	2%	0	0	N/A	0	0	N/A	7	3.5	41%	2	1	N/A	2	1	N/A	3	1.5	N/A	17	8.5	8%
	Metacarpal (d)	3	1.5	2%	0	0	N/A	0	0	N/A	6	3	35%	1	0.5	N/A	2	1	N/A	1	0.5	N/A	13	6.5	6%
Hind limb	Pelvis	1	0.5	1%	0	0	N/A	1	0.5	N/A	7	3.5	41%	0	0	N/A	1	0.5	N/A	1	0.5	N/A	11	5.5	5%
	Femur (p)	0	0	0%	0	0	N/A	0	0	N/A	1	0.5	6%	2	1	N/A	0	0	N/A	0	0	N/A	3	1.5	1%
	Femur (s)	0	0	0%	0	0	N/A	0	0	N/A	3	1.5	18%	1	0.5	N/A	1	0.5	N/A	0	0	N/A	5	2.5	2%
	Femur (d)	0	0	0%	1	0.5	N/A	0	0	N/A	4	2	24%	0	0	N/A	0	0	N/A	0	0	N/A	5	2.5	2%
	Tibia (p)	0	0	0%	0	0	N/A	0	0	N/A	0	0	0%	0	0	N/A	0	0	N/A	0	0	N/A	0	0	0%
	Tibia (s)	1	0.5	1%	0	0	N/A	1	0.5	N/A	6	3	35%	4	2	N/A	1	0.5	N/A	4	2	N/A	17	8.5	8%
	Tibia (d)	1	0.5	1%	0	0	N/A	1	0.5	N/A	3	1.5	18%	3	1.5	N/A	2	1	N/A	1	0.5	N/A	11	5.5	5%
	Astragalus	0	0	0%	0	0	N/A	0	0	N/A	1	0.5	6%	0	0	N/A	1	0.5	N/A	1	0.5	N/A	3	1.5	1%
	Calcaneum	0	0	0%	0	0	N/A	0	0	N/A	1	0.5	6%	0	0	N/A	2	1	N/A	0	0	N/A	3	1.5	1%
	Centroquartal	0	0	0%	0	0	N/A	0	0	N/A	0	0	0%	0	0	N/A	0	0	N/A	0	0	N/A	0	0	0%
	Metatarsal (p)	5	2.5	4%	2	1	N/A	1	0.5	N/A	12	6	71%	0	0	N/A	0	0	N/A	1	0.5	N/A	21	10.5	10%
	Metatarsal (s)	5	2.5	4%	2	1	N/A	1	0.5	N/A	12	6	71%	0	0	N/A	1	0.5	N/A	2	1	N/A	23	11.5	11%
	Metatarsal (d)	4	2	3%	1	0.5	N/A	1	0.5	N/A	8	4	47%	0	0	N/A	0	0	N/A	2	1	N/A	16	8	8%
Feet	Phalanx1	0	0	0%	0	0	N/A	0	0	N/A	1	0.1	1%	0	0	N/A	0	0	N/A	0	0	N/A	1	0.125	0%
	Phalanx2	0	0	0%	0	0	N/A	0	0	N/A	0	0	0%	0	0	N/A	0	0	N/A	0	0	N/A	0	0	0%
	Phalanx3	0	0	0%	0	0	N/A	0	0	N/A	0	0	0%	0	0	N/A	0	0	N/A	0	0	N/A	0	0	0%
Total MNS		183			24			12			148			34			31			39			471		

upper parts of limbs are not large; one of the more significant ones is a higher number of humeri in areas 1–2, and 3 compared to other upper limb bones. Also, scapulae which are so common in period A, are much sparser here.

In the **caprine** assemblage:

- In period A (table 6.15) the caprine skeleton is predominately represented by horncores, mostly of goats, with other body parts being very scarce or absent in areas 1, 2, and 3. In area 1, north–west to the square, the most substantial find was a large assemblage of horncores comprising of 114 goat and 21 sheep specimens. Apart of horncores, several metapodials (mostly sheep) are present in area 1. In area 4 appendicular skeleton is not as scarce as at other areas; forelimbs are more frequent here than the hindlimbs.
- In period B (table 6.15), caprine bones are also sparse. In general, in this period horncores dominate and the appendicular skeleton is relatively uniformly present

Table 6.16 Anatomical representation of pig and horse in Lelów

	MNS	Pig								Horse							
		A1/PerA	A2/PerA	A3/PerA	A4/PerA	A1-2/PerB	A3/PerB	A4/PerB	Total (pig)	A1/PerA	A2/PerA	A3/PerA	A4/PerA	A1-2/PerB	A3/PerB	A4/PerB	Total (horse)
Axial	Cranium	1	1	1	2	2	1	1	**9**	3	0	0	2	0	0	0	**5**
	Mandible	6	4	3	14	8	1	2	**38**	1	0	0	3	0	0	0	**4**
	Atlas	0	2	0	2	1	0	0	**5**	0	1	0	0	0	0	0	**1**
	Axis	0	0	0	0	0	0	0	**0**	1	1	0	2	0	0	0	**4**
Front limb	Scapula	2	0	1	6	0	0	1	**10**	2	0	0	2	2	0	0	**6**
	Humerus (p)	0	0	1	3	0	0	0	**4**	3	0	0	0	0	0	0	**3**
	Humerus (s)	1	0	3	7	5	0	0	**16**	4	0	0	1	1	0	0	**6**
	Humerus (d)	0	0	2	5	6	0	0	**13**	4	0	0	1	1	0	0	**6**
	Ulna	0	0	2	2	1	1	0	**6**	0	1	1	1	0	0	0	**3**
	Radius (p)	0	0	0	1	1	1	0	**3**	0	2	0	7	2	0	0	**11**
	Radius (s)	0	0	0	3	2	1	0	**6**	0	2	0	7	3	0	0	**12**
	Radius (d)	0	0	0	4	0	0	0	**4**	0	1	0	4	1	0	0	**6**
	Metacarpal (p)	0	0	0	2	0	1	0	**3**	1	2	1	6	1	0	1	**12**
	Metacarpal (s)	0	0	0	3	0	1	0	**4**	1	2	1	6	1	0	1	**12**
	Metacarpal (d)	0	0	0	3	0	1	0	**4**	1	1	1	6	1	0	1	**11**
Hind limb	Pelvis	0	0	1	1	3	2	1	**8**	5	0	0	3	0	0	0	**8**
	Femur (p)	1	0	1	0	1	0	0	**3**	3	0	0	3	1	0	0	**7**
	Femur (s)	1	0	2	2	1	2	2	**10**	4	1	1	3	0	0	0	**9**
	Femur (d)	0	0	2	2	0	0	0	**4**	3	1	1	4	1	0	1	**11**
	Tibia (p)	0	0	0	1	0	1	0	**2**	3	0	0	3	0	0	0	**6**
	Tibia (s)	0	2	0	8	1	2	3	**16**	4	0	0	5	0	0	0	**9**
	Tibia (d)	0	1	0	10	1	2	2	**16**	3	0	0	5	0	0	0	**8**
	Astragalus	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
	Calcaneum	0	0	0	1	0	1	0	**2**	0	0	0	0	0	0	1	**1**
	Centroquartal	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
	Metatarsal (p)	0	1	0	1	1	0	0	**3**	2	0	0	5	1	0	2	**10**
	Metatarsal (s)	0	1	0	1	1	0	0	**3**	2	0	0	7	1	0	2	**12**
	Metatarsal (d)	0	0	0	1	1	0	0	**2**	1	0	0	5	1	0	2	**9**
Feet	Phalanx1	0	0	0	0	0	0	0	**0**	1	1	1	7	3	0	0	**13**
	Phalanx2	0	0	0	0	0	0	0	**0**	0	0	0	0	1	0	1	**2**
	Phalanx3	0	0	0	0	0	0	0	**0**	1	1	0	1	0	0	0	**3**
Total MNS		12	12	19	85	36	18	12	**194**	53	17	7	99	22	0	12	**210**

The **pig** assemblage from Lelów (table 6.16) consists mostly of mandibles, but humeri, tibiae, and scapulae are also represented in fair numbers. The differences between areas are inconspicuous due to the sample size.

The assemblage of **horse** remains is substantial (table 6.16). In most phases it comprises mainly of metapodials. In areas where horse remains are most common (period A, areas 1 and 4) most parts of the skeleton are generally present, but in area 1 radii are absent and in area 4 humeri are missing.

Other species are represented by stray finds only. Red deer was present in period A in area 1 (a mandible) and area 2 (a tip of an antler), roe deer in area 2 in period A (a metatarsal), dog scapula was found in area 1 in period A and a humerus in area 1 in period B.

6.1.4 Prague

The assemblage from Prague derives from two archaeological sites: one inside the Staronová synagogue and the second one in the former Jewish town of Libeň, now a district of Prague. The assemblage from **Staronová** derives from units with 88 inventory numbers which were grouped into **three spatial/chronological groups**:

Group SN1 includes stratigraphic units from the twelfth century from the northern part of the synagogue

Group SN2 includes stratigraphic units from eleventh–twelfth century from the southern part of the synagogue

Group SN3 includes stratigraphic units from thirteenth–fourteenth century from the eastern part of the synagogue.

The assemblage from **Libeň** was obtained from 24 stratigraphic units in 4 houses. All houses have layers dated to the early seventeenth century, and one has additionally a part dated to the eighteenth century. The faunal assemblage was divided into **five groups**:

House 29, phase 1 (Lib29/Ph1) at Koželužská Street; seventeenth century–early eighteenth century

House 29, phase 2 (Lib29/Ph2) at Koželužská Street; eighteenth century

House 30 (Lib30) at Koželužská Street; late sixteenth–first half of the seventeenth century

House 31 (Lib31) at Kožní Street; first half of the seventeenth century

House 34 (Lib34) at the corner of Voctářova and Kožní Streets; eastern part of the house; late sixteenth–first half of the seventeenth century.

The detailed description of the archaeological contexts at Staronová and Libeň are included in section 4.4.4.

The assemblages from Staronová synagogue and Libeň consist of 1606 specimens (NISP) out of which I recorded 2655 diagnostic zones (NRDZ) (table 6.17). The MNS, derived from NRDZ, consists of 1153 remains (table 6.18). The largest

Table 6.17 Prague. Number of Identified Specimens (NISP) and Number of Recorded Diagnostic Zones (NRDZ) for each species of mammals

Context:	SN1		SN2		SN3		Lib29/Ph1		Lib29/Ph2		Lib30		Lib31		Lib34		Total	
Unit:	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ	NISP	NRDZ
Cattle	**33**	**58**	**122**	**187**	**7**	**14**	**241**	**301**	**146**	**199**	**141**	**166**	**89**	**120**	**10**	**13**	**789**	**1058**
Caprines	**91**	**187**	**168**	**326**	**10**	**23**	**198**	**366**	**67**	**179**	**205**	**350**	**46**	**84**	**9**	**16**	**794**	**1531**
Sheep	13	41	14	48	4	12	41	105	18	60	54	131	11	32			155	429
Goat	8	20	14	41			12	32	6	15	6	13	3	6			49	127
Sheep/Goat	70	126	140	237	6	11	145	229	43	104	145	206	32	46	9	16	590	975
Pig			**1**	**1**							**1**	**1**					**2**	**2**
Horse			**3**	**25**			**1**	**0**	**2**	**4**	**1**	**1**					**7**	**30**
Red deer	**4**	**0**									**2**	**3**					**6**	**3**
Roe deer									**1**	**1**							**1**	**1**
Dog			**1**	**3**					**5**	**23**							**6**	**26**
Cat									**1**	**4**							**1**	**4**
Total	**128**	**245**	**295**	**542**	**17**	**37**	**440**	**667**	**222**	**410**	**350**	**521**	**135**	**204**	**19**	**29**	**1606**	**2655**

assemblage, from Libeň 29 phase 1, includes 270 remains. Two smallest assemblages, from Libeň 34 and Staronová SN3, which contains only 15 and 21 remains respectively, will be excluded from some of the quantitative analyses due to the small sample size.

6.1.4.1 Taxonomic frequency

The assemblage consists predominately of the remains of domestic mammals, total of 1151 remains (99.8% of the assemblage). The most abundant taxonomic group represented are the domestic ruminants, mostly caprines comprising 57% and cattle 41% of total MNS (table 6.18).

There are several patterns emerging:

- Predominance of caprine over cattle remains is clear at Staronová synagogue (i.e. SN1, SN2, SN3) and in Libeň houses located on Koželužská

Table 6.18 Prague. Minimum Number of Sections (MNS) for each species of mammals

Context:	SN1		SN2		SN3		Lib29/Ph1		Lib29/Ph2		Lib30		Lib31		Lib34		Total	
Cattle	**28**	23%	**96**	38%	**8**	38%	**121**	45%	**101**	48%	**62**	35%	**45**	56%	**8**	53%	**469**	41%
Caprines	**96**	77%	**152**	60%	**13**	62%	**149**	55%	**93**	44%	**113**	63%	**36**	44%	**7**	47%	**659**	57%
Sheep	16		23		7		43		28		46		14				177	
Goat	9		22				11		9		5		4				60	
Sheep/Goat	71		107		6		95		56		62		18		7		422	
Pig			**1**	0.4%							**1**	0.6%					**2**	0.2%
Horse			**3**	1.2%					**2**	1%	**1**	0.6%					**6**	0.5%
Red deer											**1**	0.6%					**1**	0.1%
Roe deer									**1**	0.5%							**1**	0.1%
Dog			**2**	0.8%					**11**	5%							**13**	1.1%
Cat									**2**	1%							**2**	0.2%
Total	**124**		**254**		**21**		**270**		**210**		**178**		**81**		**15**		**1153**	

Table 6.19 Anatomical representation of cattle in Prague

	Cattle	Staronová									Liběň															Total		
		SN1			SN2			SN3			Lib29/Ph1			Lib29/Ph2			Lib30			Lib31			Lib34					
		MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU
Axial	Cranium	**2**	2	N/A	**1**	1	25%	**0**	0	N/A	**6**	6	52%	**3**	3	60%	**7**	7	100%	**2**	2	N/A	**1**	1	N/A	**22**	22	72%
	Horn core	**1**	0.5	N/A	**1**	1	13%	**0**	0	N/A	**0**	0	0%	**2**	1	20%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**4**	2	7%
	Mandible	**2**	1	N/A	**6**	3	75%	**0**	0	N/A	**23**	12	100%	**8**	4	80%	**13**	7	93%	**7**	4	N/A	**2**	1	N/A	**61**	30.5	100%
	Atlas	**0**	0	N/A	**0**	0	0%	**0**	0	N/A	**1**	1	9%	**4**	4	80%	**2**	2	29%	**0**	0	N/A	**0**	0	N/A	**7**	7	23%
	Axis	**0**	0	N/A	**1**	1	25%	**0**	0	N/A	**2**	2	17%	**1**	1	20%	**4**	4	57%	**0**	0	N/A	**0**	0	N/A	**8**	8	26%
Front limb	Scapula	**2**	1	N/A	**8**	4	100%	**0**	0	N/A	**9**	5	39%	**7**	4	70%	**1**	1	7%	**1**	1	N/A	**0**	0	N/A	**28**	14	46%
	Humerus (p)	**0**	0	N/A	**1**	1	13%	**0**	0	N/A	**0**	0	0%	**1**	1	10%	**1**	1	7%	**1**	1	N/A	**0**	0	N/A	**4**	2	7%
	Humerus (s)	**1**	0.5	N/A	**5**	3	63%	**1**	1	N/A	**2**	1	9%	**7**	4	70%	**2**	1	14%	**1**	1	N/A	**0**	0	N/A	**19**	9.5	31%
	Humerus (d)	**1**	0.5	N/A	**2**	1	25%	**1**	1	N/A	**11**	6	48%	**7**	4	70%	**1**	1	7%	**3**	2	N/A	**0**	0	N/A	**26**	13	43%
	Ulna	**1**	0.5	N/A	**1**	1	13%	**0**	0	N/A	**5**	3	22%	**10**	5	100%	**2**	1	14%	**0**	0	N/A	**0**	0	N/A	**19**	9.5	31%
	Radius (p)	**0**	0	N/A	**4**	2	50%	**1**	1	N/A	**19**	10	83%	**10**	5	100%	**3**	2	21%	**7**	4	N/A	**1**	1	N/A	**45**	22.5	74%
	Radius (s)	**1**	0.5	N/A	**5**	3	63%	**1**	1	N/A	**6**	3	26%	**3**	2	30%	**2**	1	14%	**4**	2	N/A	**0**	0	N/A	**22**	11	36%
	Radius (d)	**0**	0	N/A	**0**	0	0%	**0**	0	N/A	**2**	1	9%	**1**	1	10%	**2**	1	14%	**1**	1	N/A	**0**	0	N/A	**6**	3	10%
	Metacarpal (p)	**0**	0	N/A	**3**	2	38%	**0**	0	N/A	**3**	2	13%	**1**	1	10%	**2**	1	14%	**1**	1	N/A	**0**	0	N/A	**10**	5	16%
	Metacarpal (s)	**1**	0.5	N/A	**5**	3	63%	**0**	0	N/A	**5**	3	22%	**1**	1	10%	**1**	1	7%	**2**	1	N/A	**0**	0	N/A	**15**	7.5	25%
	Metacarpal (d)	**0**	0	N/A	**1**	1	13%	**0**	0	N/A	**4**	2	17%	**3**	2	30%	**2**	1	14%	**0**	0	N/A	**0**	0	N/A	**10**	5	16%
Hind limb	Pelvis	**1**	0.5	N/A	**6**	3	75%	**1**	1	N/A	**1**	1	4%	**1**	1	10%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**10**	5	16%
	Femur (p)	**0**	0	N/A	**3**	2	38%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**3**	1.5	5%
	Femur (s)	**1**	0.5	N/A	**2**	1	25%	**1**	1	N/A	**0**	0	0%	**1**	1	10%	**1**	1	7%	**0**	0	N/A	**0**	0	N/A	**6**	3	10%
	Femur (d)	**0**	0	N/A	**0**	0	0%	**0**	0	N/A	**0**	0	0%	**1**	1	10%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**1**	0.5	2%
	Tibia (p)	**0**	0	N/A	**3**	2	38%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**3**	1.5	5%
	Tibia (s)	**0**	0	N/A	**3**	2	38%	**0**	0	N/A	**3**	2	13%	**5**	3	50%	**1**	1	7%	**0**	0	N/A	**1**	1	N/A	**13**	6.5	21%
	Tibia (d)	**0**	0	N/A	**3**	2	38%	**0**	0	N/A	**2**	1	9%	**3**	2	30%	**1**	1	7%	**0**	0	N/A	**1**	1	N/A	**10**	5	16%
	Astragalus	**0**	0	N/A	**4**	2	50%	**0**	0	N/A	**1**	1	4%	**1**	1	10%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**6**	3	10%
	Calcaneum	**2**	1	N/A	**5**	3	63%	**1**	1	N/A	**1**	1	4%	**3**	2	30%	**1**	1	7%	**0**	0	N/A	**0**	0	N/A	**13**	6.5	21%
	Centroquartal	**0**	0	N/A	**1**	1	13%	**0**	0	N/A	**1**	1	4%	**0**	0	0%	**0**	0	0%	**1**	1	N/A	**0**	0	N/A	**3**	1.5	5%
	Metatarsal (p)	**1**	0.5	N/A	**3**	2	38%	**0**	0	N/A	**2**	1	9%	**8**	4	80%	**2**	1	14%	**2**	1	N/A	**2**	1	N/A	**20**	10	33%
	Metatarsal (s)	**2**	1	N/A	**7**	4	88%	**0**	0	N/A	**3**	2	13%	**4**	2	40%	**2**	1	14%	**7**	4	N/A	**0**	0	N/A	**25**	12.5	41%
	Metatarsal (d)	**1**	0.5	N/A	**3**	2	38%	**0**	0	N/A	**2**	1	9%	**3**	2	30%	**3**	2	21%	**1**	1	N/A	**0**	0	N/A	**13**	6.5	21%
Feet	Phalanx1	**2**	0.3	N/A	**6**	1	19%	**1**	0	N/A	**3**	0	3%	**1**	0	3%	**1**	0	2%	**3**	0	N/A	**0**	0	N/A	**17**	2.13	7%
	Phalanx2	**6**	0.8	N/A	**2**	0	6%	**0**	0	N/A	**3**	0	3%	**0**	0	0%	**3**	0	5%	**0**	0	N/A	**0**	0	N/A	**14**	1.75	6%
	Phalanx3	**0**	0	N/A	**1**	0	3%	**0**	0	N/A	**1**	0	1%	**1**	0	3%	**2**	0	4%	**1**	0	N/A	**0**	0	N/A	**6**	0.75	2%
	Total MNS	**28**			**96**			**8**			**121**			**101**			**62**			**45**			**8**			**469**		

Street in the early seventeenth century (Lib30 and Lib29/Ph1). The early seventeenth century houses at Kožní Street (Lib31 and Lib34), as well as the eighteenth century phase of habitation at house 29 (Lib29/Ph2) display a slight predominance of cattle over caprines (fig. 6.1).

- In the northern part of the Staronová (SN1) the relative frequency of caprines is higher than in other parts of the synagogue (fig. 6.1, table 6.18)

- Whilst sheep remains are always more abundant than goat's, this discrepancy is much more pronounced in the assemblages from Libeň than in Staronová (table 6.18).

- Remains of species other than domestic ruminants are very scarce in the assemblage and mostly constitute of stray and solitude finds of bones of pig, horse, red deer, roe deer, cat, and dog. They are present only in the southern part of Staronová, and in Libeň in house 30 and in the second phase in house 29 (table 6.18). In the latter, several body parts of one dog were found.

6.1.4.2 Body part representation

All parts of the **cattle** skeleton were present; however, there are some very noticeable discrepancies (table 6.19):

- In the largest assemblage at Staronová, SN2, remains largest in number are the mandibles and girdle bones (scapulae and pelves), along with some elements of the hock joint (calcanea and metatarsals). Forelimbs are more numerous then hindlimbs but the difference seems to be less significant due to small numbers. The differences between SN2 and other parts of the synagogue are untraceable due to the sample size.

- House 29 in Libeň: in phase 1 of habitation the most abundant body parts are mandibles and forelimbs: most remains are from the elbow joint, but there is a striking underrepresentation of shaft fragments of the radius compared to distal humerus and proximal radius. Lower limbs are scarce and hindlimbs are almost absent. In phase 2, heads and necks are well represented along with the upper portions of forelimbs. Hindlimbs are still meagre in number comparing to forelimbs, but not so much as in phase 1, due to the presence of several tibiae. An evident

Table 6.20 Anatomical representation of caprines in Prague

Caprines		Staronová									Libeň															Total		
		SN1			SN2			SN3			Lib29/Ph1			Lib29/Ph2			Lib30			Lib31			Lib34					
		MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU	MNS	MAU	%MAU
Axial	Cranium	**1**	1	17%	**3**	3	38%	**0**	0	N/A	**7**	7	34%	**2**	2	21%	**5**	5	26%	**1**	1	N/A	**0**	0	N/A	**19**	19	30%
	Horn core	**2**	1	17%	**1**	1	6%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**3**	1.5	2%
	Mandible	**12**	6	100%	**13**	7	81%	**1**	1	N/A	**41**	21	100%	**10**	5	53%	**39**	20	100%	**11**	6	N/A	**1**	1	N/A	**128**	64	100%
	Atlas	**0**	0	0%	**2**	2	25%	**0**	0	N/A	**3**	3	15%	**0**	0	0%	**2**	2	10%	**1**	1	N/A	**0**	0	N/A	**8**	8	13%
	Axis	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**4**	4	20%	**0**	0	0%	**1**	1	5%	**0**	0	N/A	**0**	0	N/A	**5**	5	8%
Front limb	Scapula	**1**	0.5	8%	**6**	3	38%	**0**	0	N/A	**13**	7	32%	**1**	1	5%	**10**	5	26%	**3**	2	N/A	**0**	0	N/A	**34**	17	27%
	Humerus (p)	**0**	0	0%	**1**	1	6%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**1**	0.5	1%
	Humerus (s)	**10**	5	83%	**15**	8	94%	**3**	2	N/A	**5**	3	12%	**4**	2	21%	**7**	4	18%	**1**	1	N/A	**0**	0	N/A	**45**	22.5	35%
	Humerus (d)	**3**	1.5	25%	**8**	4	50%	**1**	1	N/A	**8**	4	20%	**2**	1	11%	**13**	7	33%	**3**	2	N/A	**0**	0	N/A	**38**	19	30%
	Ulna	**0**	0	0%	**2**	1	13%	**0**	0	N/A	**7**	4	17%	**3**	2	16%	**3**	2	8%	**2**	1	N/A	**0**	0	N/A	**17**	8.5	13%
	Radius (p)	**4**	2	33%	**7**	4	44%	**2**	1	N/A	**13**	7	32%	**4**	2	21%	**8**	4	21%	**4**	2	N/A	**0**	0	N/A	**42**	21	33%
	Radius (s)	**9**	4.5	75%	**15**	8	94%	**2**	1	N/A	**24**	12	59%	**8**	4	42%	**14**	7	36%	**7**	4	N/A	**2**	1	N/A	**81**	40.5	63%
	Radius (d)	**1**	0.5	8%	**0**	0	0%	**0**	0	N/A	**5**	3	12%	**2**	1	11%	**5**	3	13%	**1**	1	N/A	**2**	1	N/A	**16**	8	13%
	Metacarpal (p)	**4**	2	33%	**5**	3	31%	**0**	0	N/A	**0**	0	0%	**5**	3	26%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**14**	7	11%
	Metacarpal (s)	**7**	3.5	58%	**5**	3	31%	**0**	0	N/A	**0**	0	0%	**5**	3	26%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**17**	8.5	13%
	Metacarpal (d)	**1**	0.5	8%	**1**	1	6%	**0**	0	N/A	**0**	0	0%	**4**	2	21%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**6**	3	5%
Hind limb	Pelvis	**1**	0.5	8%	**3**	2	19%	**1**	1	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**5**	2.5	4%
	Femur (p)	**0**	0	0%	**1**	1	6%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**1**	0.5	1%
	Femur (s)	**8**	4	67%	**15**	8	94%	**0**	0	N/A	**0**	0	0%	**1**	1	5%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**24**	12	19%
	Femur (d)	**1**	0.5	8%	**0**	0	0%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**1**	0.5	1%
	Tibia (p)	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**0**	0	0%
	Tibia (s)	**12**	6	100%	**16**	8	100%	**1**	1	N/A	**1**	1	2%	**1**	1	5%	**1**	1	3%	**1**	1	N/A	**0**	0	N/A	**33**	16.5	26%
	Tibia (d)	**6**	3	50%	**3**	2	19%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**1**	1	N/A	**0**	0	N/A	**10**	5	8%
	Astragalus	**0**	0	0%	**1**	1	6%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**1**	0.5	1%
	Calcaneum	**4**	2	33%	**1**	1	6%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**5**	2.5	4%
	Centroquartal	**0**	0	0%	**1**	1	6%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**1**	0.5	1%
	Metatarsal (p)	**2**	1	17%	**9**	5	56%	**1**	1	N/A	**8**	4	20%	**15**	8	79%	**3**	2	8%	**0**	0	N/A	**1**	1	N/A	**39**	19.5	30%
	Metatarsal (s)	**4**	2	33%	**11**	6	69%	**1**	1	N/A	**9**	5	22%	**19**	10	100%	**2**	1	5%	**0**	0	N/A	**1**	1	N/A	**47**	23.5	37%
	Metatarsal (d)	**1**	0.5	8%	**3**	2	19%	**0**	0	N/A	**1**	1	2%	**7**	4	37%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**12**	6	9%
Feet	Phalanx1	**2**	0.3	4%	**4**	1	6%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**6**	0.75	1%
	Phalanx2	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**0**	0	0%
	Phalanx3	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	0%	**0**	0	0%	**0**	0	0%	**0**	0	N/A	**0**	0	N/A	**0**	0	0%
Total MNS		**96**			**152**			**13**			**149**			**93**			**113**			**36**			**7**			**659**		

discrepancy between the number of metacarpals and metatarsals is present, with the latter being more plentiful.

- In house 30 heads and necks are the most copious portions of the body, whilst the appendicular bones are scarce. Forelimbs seem to be a little more common than hindlimbs.
- The assemblage from house 31 is similar to phase 1 from house 29 which is of the same dating; the main differences are that in house 31 metatarsals are more common than metacarpals and that and the discrepancy between shafts and epiphyses in the elbow joint is not as pronounced. It is worth mentioning that upper parts of hindlimbs are entirely missing.
- In all assemblages in Staronová and Libeň horncores are almost absent.

The assemblage of caprine bones includes most parts of the skeleton (table 6.20):

- At Staronová the most abundant caprine remains include mandibles and shafts of all upper limb bones (i.e. humerus, radius, femur, and tibia). Epiphyses of long bones are much fewer than shafts, and in hindlimbs, epiphyses are scarcer than in forelimbs. Girdle bones and lower limb bones are generally less abundant than meat bearing long bones. The differences between parts of the synagogue are inconspicuous but in SN2 metatarsals are more numerous than metacarpals.
- At Libeň a clear pattern emerges. In all assemblages, mandibles prevail, but upper parts of the forelimbs are also common, with the radius more frequent than the humerus. Hindlimbs are almost entirely absent. In the assemblages from the early seventeenth century (i.e. Lib29/Ph1, Lib30, Lib31, Lib34) metacarpals are completely missing and metatarsals are rather scarce. These assemblages largely lack the 'primary' butchery waste component. In the eighteenth century house 29 (i.e. Lib29/Ph2), metacarpals are present and the number of metatarsals are the most frequent bones in the assemblage. Scapulae seem to be scarcer in the eighteenth century than in the seventeenth.
- The difference between sheep and goat body part representation is unnoticeable.

Other species are very scarce in the assemblage. Pig was represented by stray finds of a humerus and a mandible; horse by a few mandibles, a whole cranium

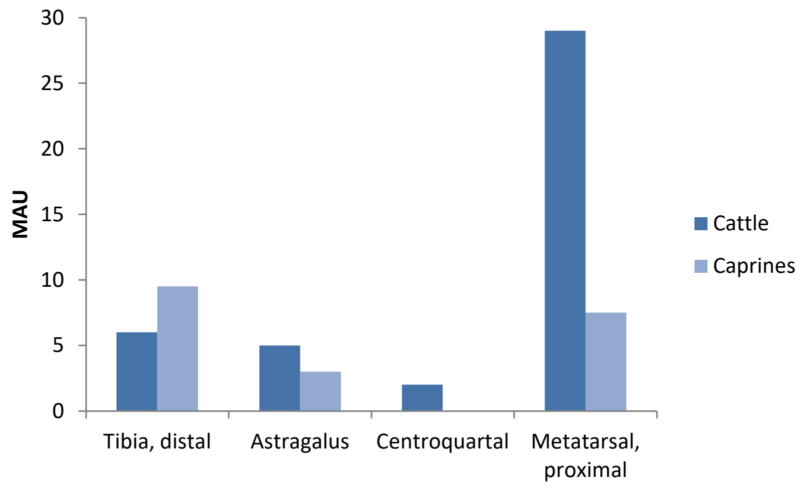

Fig. 6.2 Chełm. Frequency of the adjacent bones of the hock joint (MAU)

with mandibles (at Staronová SN2), and a tibia; red deer by a mandible; roe deer by a metatarsal; cat by a radius; and dog by a partial skeleton (humerus, ulna, radius, femur, and tibia) and a separate stray humerus.

6.2 Deposition and recovery

The following section provides information about the effect of the basic taphonomical processes on the structure of the assemblages. Butchery and burning are discussed in section 6.6.

6.2.1 Chełm

6.2.1.1 Recovery bias

The recovery bias against small bones has potentially affected all the assemblages from Chełm, since no recovery using screens was performed. The extent of recovery bias was assessed by a comparison of the number of small bones, astragali and 1st phalanges, and even smaller centroquartals and 2nd phalanges, to the number of adjacent larger bones, that is distal epiphyses of tibia and distal and proximal epiphyses of metapodials (see 5.6.1). A review of the occurrence of these bones in the Chełm assemblage (fig. 6.2; fig. 6.3) confirms that disproportions between large and small bones exist and suggests the presence of recovery bias against the latter. Unsurprisingly, the bias is more pronounced

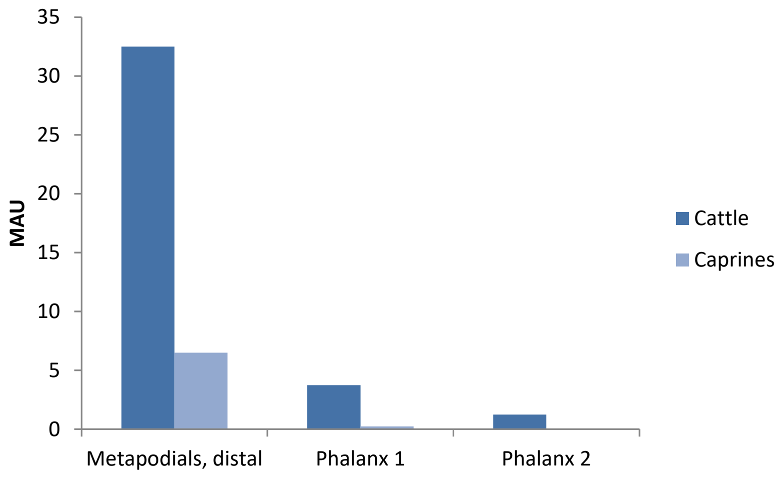

Fig. 6.3 Chełm. Frequency of the adjacent bones of the fetlock joint and the foot (MAU)

for caprines — for which the smallest bones were almost entirely missing — than for cattle. The vast disproportion between proximal ends of metapodials and adjacent centroquartals is noteworthy. The occurrence of recovery bias needs therefore to be taken into consideration for the interpretation of body part representations, especially for species smaller in size.

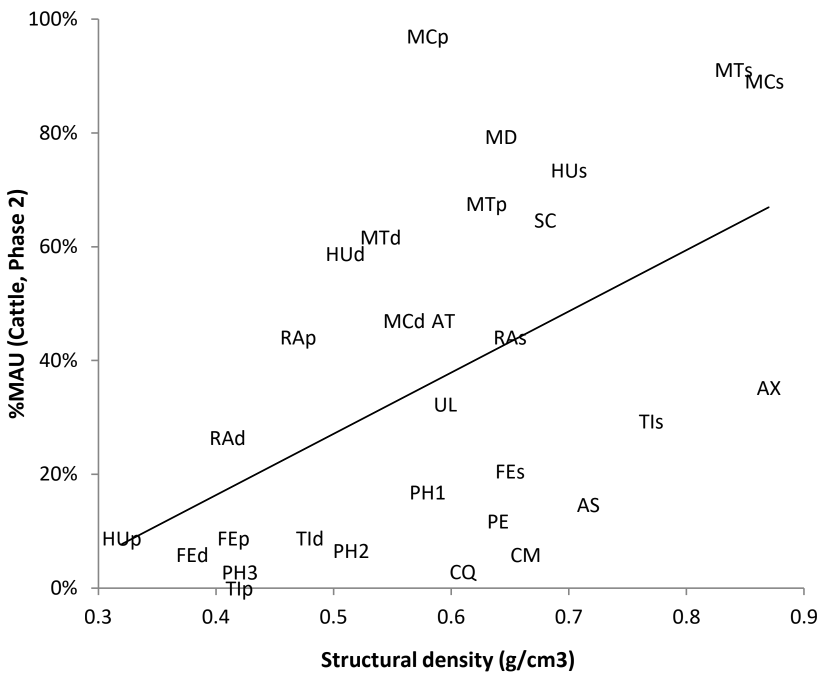

Fig. 6.4 Chełm. Body part representation of cattle (%MAU) from Phase 2 (table 6.3) compared against the structural density for different elements (table 5.2 in section 5.6.2)

6.2.1.2 Density mediated attrition

Statistical testing of body part representation (%MAU) against bone structural density (see section 5.6.2) was performed for cattle and caprine assemblages from Chełm. For caprines, correlations between %MAU from phase 1 and phase 2 and structural density are weak but marginally significant, $\rho = 0.38$, $P = 0.05$. This would suggest that non-human induced taphonomic factors probably affected the composition of the caprine assemblages, removing some of the more fragile bones from the record. Structure 20 caprines were not analysed due to the scarcity of data. Moving on to cattle, correlations for phase 1 and structure 20 density are weak and not significant $\rho = 0.39$, $P = 0.05$, suggesting little role of the density mediated taphonomic factors in the shaping of the anatomic composition. For the phase 2 assemblage, however, the correlation is significant and moderate, $\rho = 0.46$, $P = 0.01$, suggesting that the survivorship of bones was connected to their durability. Figure 6.4 shows the relationship between %MAU and structural density of bones of cattle in phase 2. Whilst the overall trend in the composition of this assemblage generally follows the density mediated attrition pattern where the occurrence of the element increases with its density, additional underrepresentation of small bones is caused by recovery bias, but some differences cannot be explained by taphonomy alone. The bones of forequarters, metapodials and mandibles are much better represented, whilst hindquarter bones are largely more underrepresented than one would have expected based on their individual density. Also, atlases are more abundant than axes, whilst the opposite would be expected based on their densities. These patterns suggest that some features of the original body part representation of the assemblage are still detectable despite taphonomic damage.

6.2.1.3 Fragmentation and fractures

Fragmentation of the recorded bones from Chełm is intense; around 50% of cattle and caprine bones are preserved in less than $\frac{1}{3}$ of their original anatomical form (fig. 6.5). Unbroken or slightly incomplete bones (more than $\frac{2}{3}$ of the bone present) are rare, making up only up less than 10% in most cases. The only exception are caprines in structure 20, but this assemblage is very small. Pig bones are somewhat less fragmented than those of ruminants; only about 40% falls into the first category of the most fragmented bones, and bones of more than $\frac{2}{3}$ of their form preserved are rare. The sample of pig bones is, however,

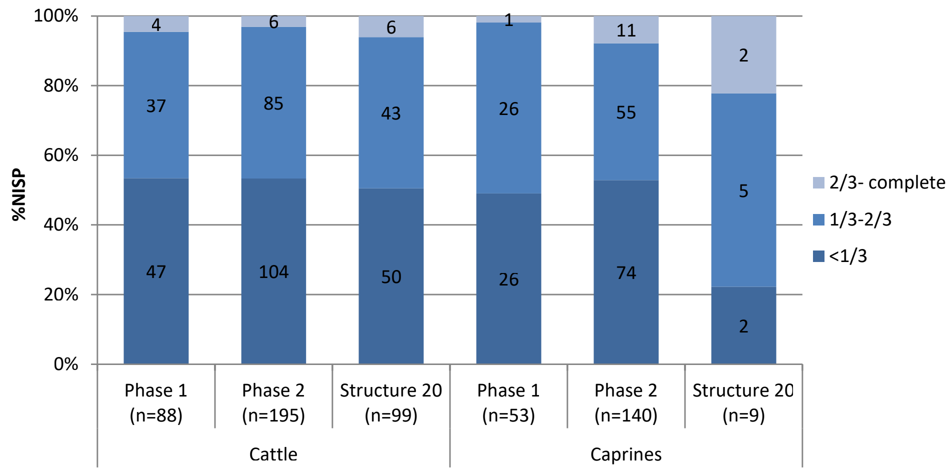

Fig. 6.5 Chełm. The intensity of fragmentation of long bones and the skull of cattle and caprines

rather small. Fragmentation of dog and horse bones was much less common and many or most bones were unbroken.

Breakage of bones in the Chełm assemblage is mostly of pre-depositional origin. In phases 1 and 2, only about 20-30% of long bones of both cattle and caprines were broken while dry or mineralised, suggesting that a non-human taphonomic fracturing actor affected only a part of the assemblages (fig. 6.6). In structure 20, post-depositional taphonomy is more visible; up to 55% of long bones presented signs of being broken while dry or mineralised. Regarding pig long bones, the fracture analysis was possible only on a few specimens, on

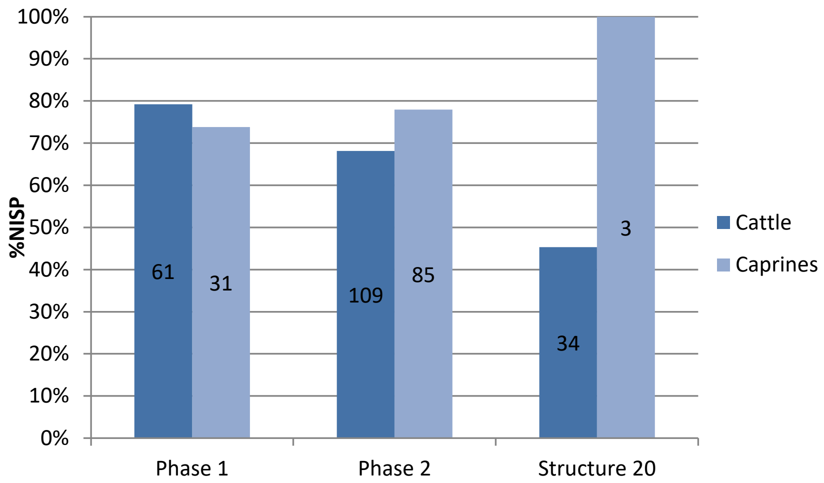

Fig. 6.6 Chełm. The incidence of green/fresh fractures of long bones. The values represent the amount of specimens broken when the bone was fresh (NISP), and the percentage is tallied in relation to the total number of specimens of the specific taxon

which about a half of the cases display breaks on dry/mineralised bone and the other half on green bone. In the case of horse and dog bones, all fractured specimens were broken long after deposition.

6.2.1.4 Gnawing

Scavenger gnawing was recorded on a substantial portion of the assemblage at Chełm. In the case of domestic ruminants, around 10 to 25% of cattle and caprine bones bore those marks (fig. 6.7). Pig remains from phase 2 and structure 20 show much higher incidence of gnawing, but the sample is rather small. Overall, the structure 20 assemblage shows the highest incidence of gnawing, and phase 1 shows the lowest. This high occurrence of gnawing suggests that rubbish was often dumped in exposed places, which is consistent with the deposition history (see 4.1.4). The higher incidence of gnawing on pig bones may be connected to their higher fat content, but it may also suggest that they derive from a different assemblage, and were brought in by the dogs. Besides dog gnawing, a single instance of rodent gnawing was recorded on a proximal metatarsal of cattle from structure 20. Bones of species other than domestic artiodactyls did not have any recordable gnawing marks.

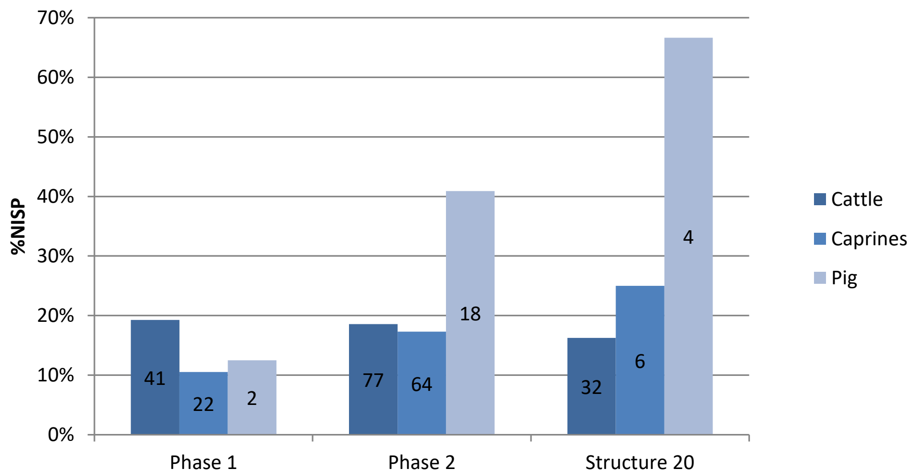

Fig. 6.7 Chełm. The incidence of dog gnawing. The values represent the amount of specimens gnawed (NISP), and the percentage is tallied in relation to the total number of specimens of the specific taxon

6.2.1.5 Abiotic factors

The effect of abiotic factors on bones from the Chełm assemblages is minimal. For cattle, the incidence of physical abrasion, trampling and chemical erosion combined varies between 1% (NISP n=2) in phase 1, 3% (n=14) in phase 2, and 6% (n=12) in structure 20. Bones from phase 1 and structure 20 are abraded and trampled, while in phase 2, chemical erosion is present besides abrasion in half of instances. Remaining species are affected even less often; 2 caprine bones from phase 1 are abraded, and another 2 and a pig bone from phase 2 eroded chemically. Weathering occurred on less than 1% of cattle bones from phases 1 and 2 (NISP n=2, n=3), and 6% of phase 1 and 2% of phase 2 pig bones (both n=1). All weathering recorded was mild. No bones of other species were weathered.

6.2.2 Wrocław

6.2.2.1 Recovery bias

Sieving was not a regular procedure during excavations carried out at Więzienna 11 and recovery bias is likely to have affected the assemblage. The comparison of large bones to adjacent small ones (see 5.6.1) shows some discrepancies between the two groups (fig. 6.8; 6.9). In cattle bones this discrepancy can be seen only in phalanges and distal metapodials. Frequencies of bones of cattle hock joints are uniform, but this may be a consequence of the effect of the pattern of missing epiphyses of the hindquarter bones seen in the assemblage. Caprine long bone epiphyses are much more abundant than adjacent tarsals and phalanges, which suggests that the recovery bias played an important role in the anatomical representation of the animals, especially the small ones, at the site.

6.2.2.2 Density mediated attrition

Assemblages of cattle and caprine bones from Więzienna 11 (%MAU) were statistically tested against bone structural density (see 5.6.2). For caprines, correlations in most periods except A and C1 are weak/moderate and marginally significant, $\rho = 0.49$, $P = 0.05$. These results suggest that taphonomy potentially contributed to the body part representation by removing remains

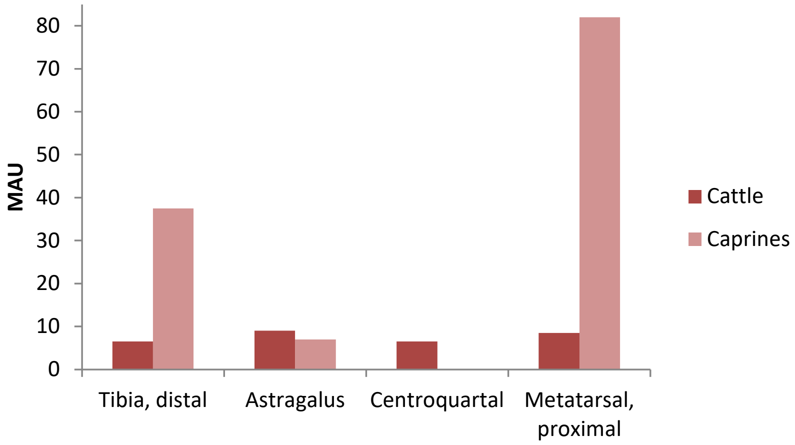

Fig. 6.8 Wrocław. Frequency of the adjacent bones of the hock joint (MAU)

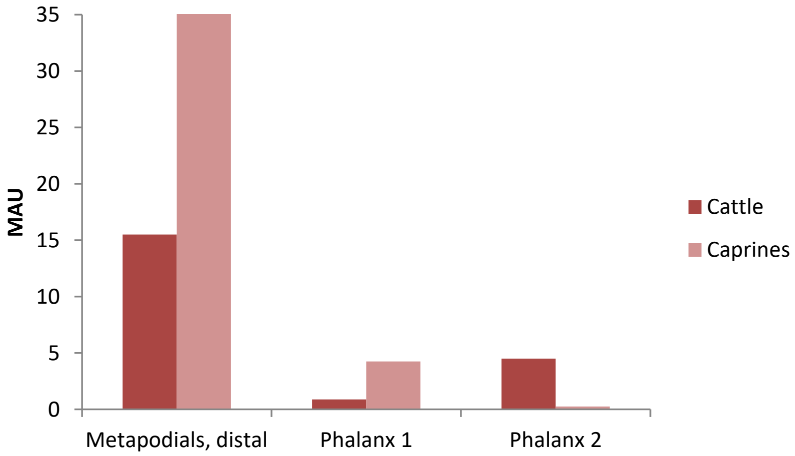

Fig. 6.9 Wrocław. Frequency of the adjacent bones of the fetlock joint and the foot (MAU)

of lower density. However, in the Wrocław's caprine assemblage there is a huge underrepresentation of epiphyses of long bones, especially of hindquarters, caused by human activity (see below). Epiphyses have structural density lower than shafts, and underrepresentation of them compared to the shafts will potentially present significant correlations between %MAU and density. Therefore, the results of density correlations here may be a result of equifinality. In the case of cattle, correlations of most periods are weak and not significant, $\rho = 0.38$, $P = 0.05$, suggesting little role of the density mediated taphonomic factors in the shaping of the anatomic composition. Significant and moderate correlations are noted for two assemblages, from phase B3, $\rho = 0.51$, $P = 0.004$, and D, $\rho = 0.45$, $P = 0.013$. This suggests that body part representation in those two assemblages was altered by taphonomic factors and the less dense remains are underrepresented.

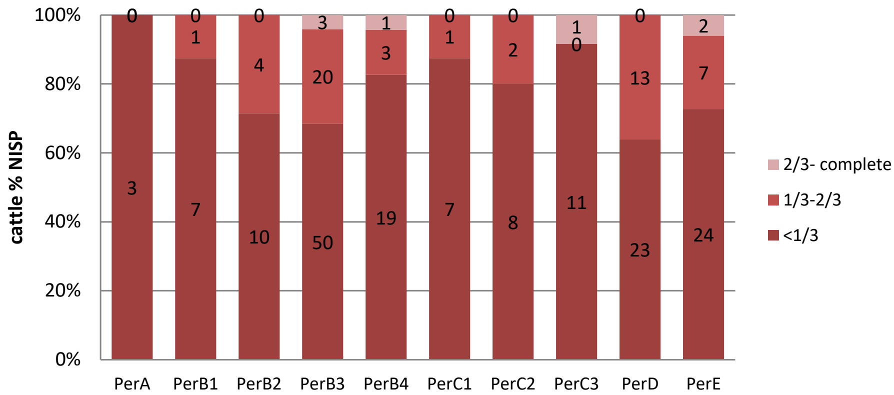

Fig. 6.10 Wrocław. The intensity of fragmentation of long bones and the skull of cattle

6.2.2.3 Fragmentation and fractures

Fragmentation of cattle long bones from Więzienna 11 is rather intense, between 70 and 90% of bones are preserved in under $\frac{1}{3}$ of their original anatomical form (fig. 6.10). In contrast to this, caprine long bones are far less fragmented; bones fragmented to less than $\frac{1}{3}$ of element's size constituted only 30–50% (fig. 6.11). Unbroken long bones of cattle are very rare, but, in the caprine assemblages, complete and nearly complete bones are more common — especially in period A, where complete bones are the most dominant fraction. Pig long bones present similar intensity of fragmentation as cattle bones: between 60 and 90% of bones were highly fragmented (under $\frac{1}{3}$ of original size) and complete specimens are very scarce (approximately a few percent in each period). The exception is again period A, where fragmentation seems less intense, but the assemblage is small. Horse bones are predominately highly fragmented (size $< \frac{1}{3}$ makes up ca. 60%), but unbroken specimens constitute a

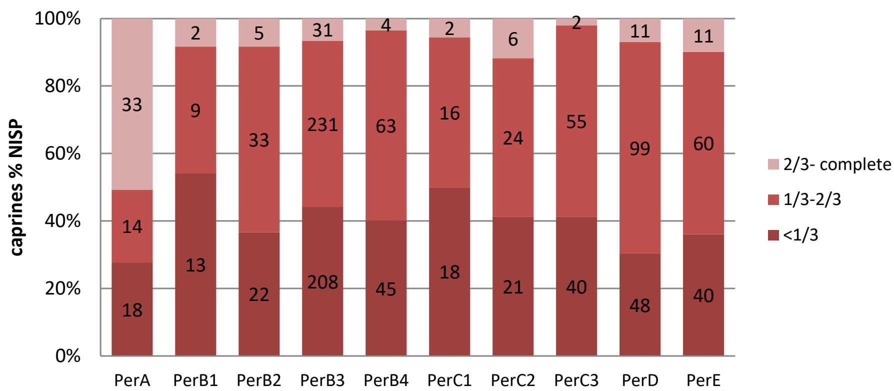

Fig. 6.11 Wrocław. The intensity of fragmentation of long bones and the skull of caprines

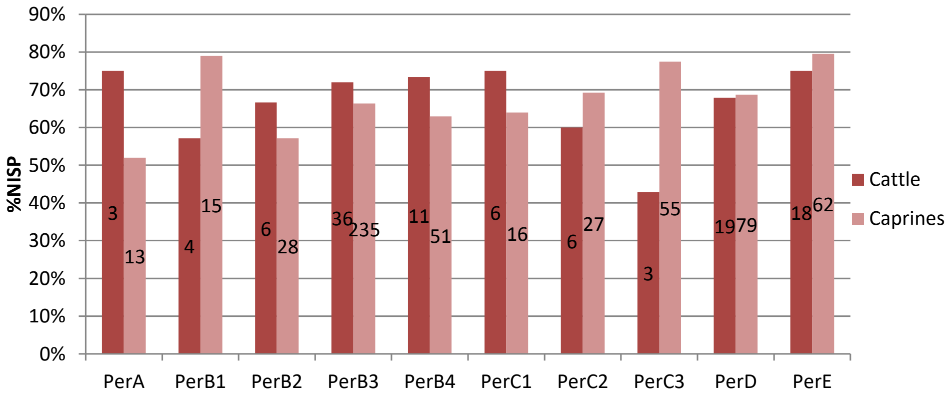

Fig. 6.12 Wrocław. The incidence of green/fresh fractures of long bones. The values represent the amount of specimens broken when the bone was fresh (NISP), and the percentage is tallied in relation to the total number of specimens of the specific taxon

significant fraction as well. Roe and red deer bones are also highly fragmented in contrast to cat and dog bones whose majority are unbroken or nearly complete.

Breakage of bones of both caprines and cattle mostly (50–80%) occurred when the bone was still fresh (fig. 6.12). Cattle bones seem to have slightly larger frequency of green bone fractures than caprine bones. For pig, this fraction is slightly smaller (50–60%) whilst for horse is about 60%. Breakage of cat and dog bones occurred when they were dry/ mineralised. The fraction and breakage analysis suggests that cattle long bones were often being broken into small pieces, which was presumably mostly done as a result of human activity. Caprine bones were likewise often the target of breaking done by humans; however, the processing did not leave them divided into fragments as small as in the case of cattle.

6.2.2.4 Gnawing

Specimens bearing gnawing marks left by carnivore feeding activity constitute a substantial part of the assemblage (fig. 6.13). These marks were recorded on up to 10% of caprine bones, and, in general, on a similar or slightly larger fraction of cattle bones. Pig bones have the highest occurrence of gnawing; in assemblages A and B4 this reaches half of the assemblage. It is interesting to note that periods B and C in general have more gnawed bones than periods D and E. Also, there are some noticeable spatial differences in periods B and C. In B, there are fewer gnawing marks in the main house and production area than in the zones 3 and 4 at the back of the residential lot. In period C, however, the

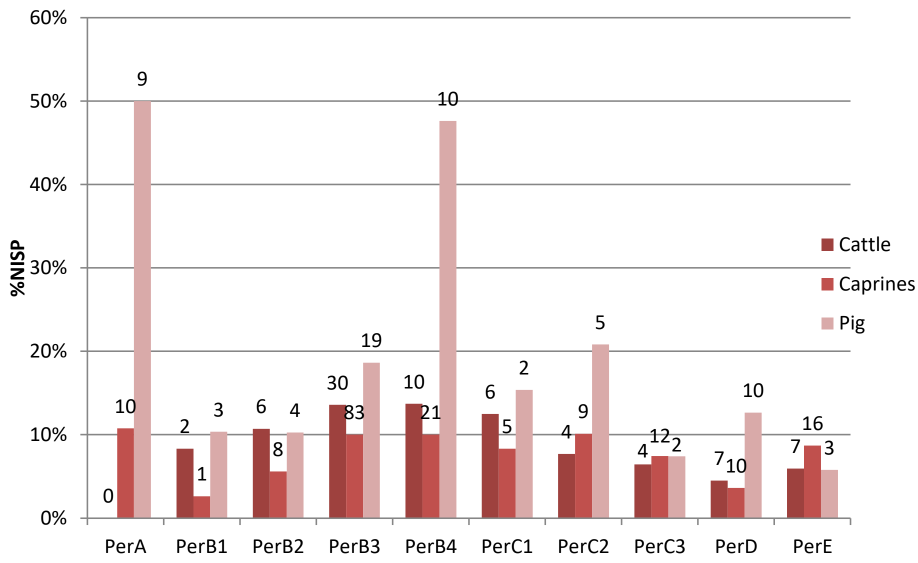

Fig. 6.13 Wrocław. The incidence of dog gnawing. The values represent the amount of specimens gnawed (NISP), and the percentage is tallied in relation to the total number of specimens of the specific taxon

back of the lot shows higher frequencies of gnawing that the front. Besides carnivore gnawing, rodent gnawing is present on one pig bone from B1 and two pig bones from B3. The presence of these marks suggests that these bones were discarded and exposed on the ground for some period of time.

The amount of gnawed bones indicated that feeding dogs played a role in the deposition of the assemblage, potentially removing some elements of the skeleton. Higher incidences of gnawing on pig bones may suggest that these were preferred by dogs (e.g. due to their higher grease content) or possibly that they were subject to a different deposition practice. Differences between areas may also be caused by different deposition practices.

6.2.2.5 Abiotic factors

The effect of abiotic factors on bones from Wrocław is small. For cattle, the incidence of physical abrasion, trampling and chemical erosion combined is 3% (NISP n=22), whereas for caprines this incidence reaches 6% (NISP n=144). The most common was trampling, predominating in the back areas of the lot during period B (i.e.PerB2, PErB3, PerB4), and drops in the following periods. This suggests that deposition in period B was different than in the later times.

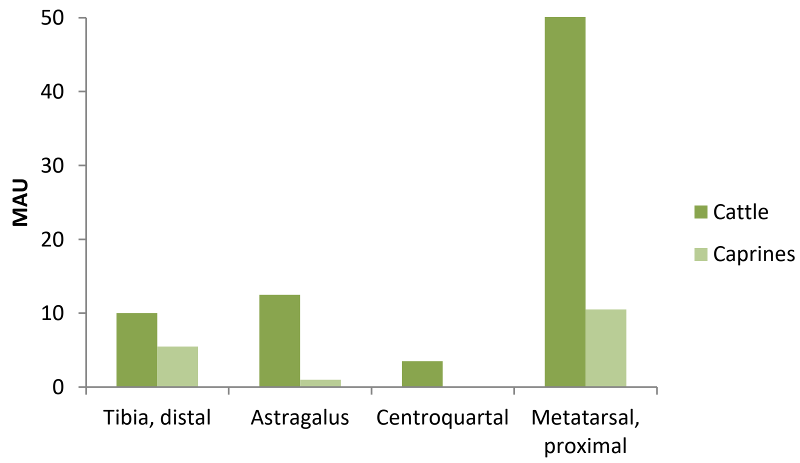

Fig. 6.14 Lelów. Frequency of the adjacent bones of the hock joint (MAU)

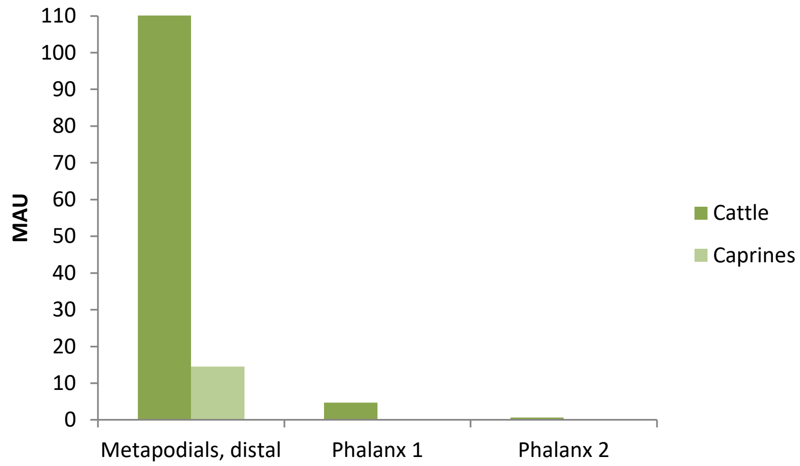

Fig. 6.15 Lelów. Frequency of the adjacent bones of the fetlock joint and the foot (MAU)

6.2.3 Lelów

6.2.3.1 Recovery bias

Sieving was not a regular practice on the site. Therefore, recovery bias may substantially affect the composition of the assemblage. The extent of the bias was assessed by comparing representation of large elements with adjacent small elements (see section 5.6.1). Figures 6.14 and 6.15 show some discrepancies between those two groups. In cattle, centroquartal bones are much scarcer than the adjacent metatarsals, but astragali are in fact more abundant than adjacent distal tibiae. Distal metapodials are much better represented than phalanges. For caprines, small elements, such as tarsals and phalanges are far fewer than adjacent large elements (tibiae and metapodials). The results suggest that in Lelów the recovery bias potentially severely affected the composition of caprine bones and presumably also cattle bones.

6.2.3.2 Density mediated attrition

Body part representation of caprines and cattle from Lelów were tested against bone structural density (see section 5.6.2). In cattle, assemblages from both periods not divided into areas, correlate moderately with the density, $\rho = 0.42$, $P = 0.05$. Tests for individual areas, however, were statistically significant only for A2/PerA, A3/PerA, and A1–2/PerB: $\rho = 0.49$, $P = 0.05$. The lack of significant correlations in other areas is presumably caused by a very specific body part representation pattern present in Lelów: cattle were represented mostly by metapodials with much smaller presence of other elements (see section 6.1.3.2). This characteristic pattern was not created by taphonomical factors. Tests for caprine body part representation from both periods are marginally significantly correlated with density, $\rho = 0.40$, $P = 0.05$. The test thus suggests the presence of density mediated destruction factors affecting the body part composition. Assemblages from specific areas were too small for individual tests.

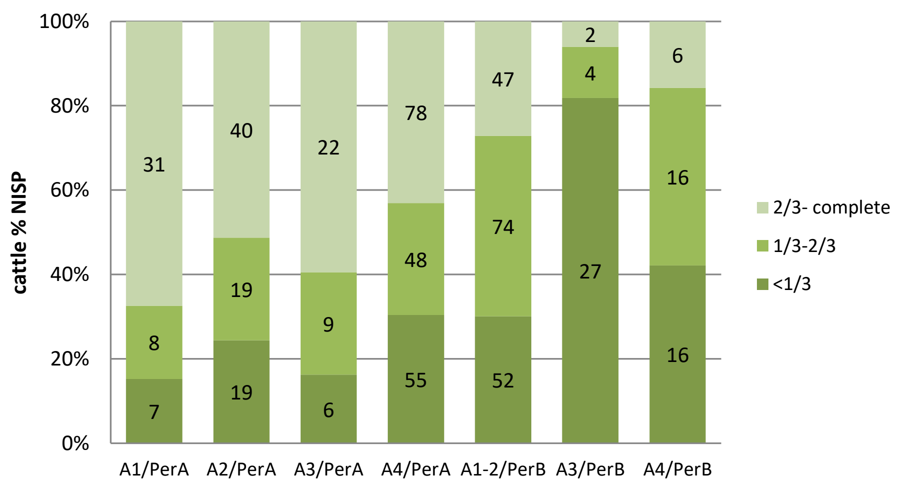

Fig. 6.16 Lelów. The intensity of fragmentation of long bones and the skull of cattle

6.2.3.3 Fragmentation and fractures

Fragmentation in Lelów is less intensive than at other analysed sites. In period A, only 15–30% of long bones were heavily fragmented (fig. 6.16; 6.17) (i.e. fall

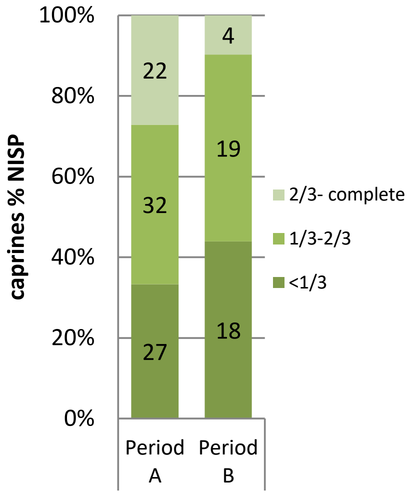

Fig. 6.17 Lelów. The intensity of fragmentation of long bones and the skull of caprines. The assemblages for individual areas are not substantial enough to be presented separately

into the category of $< \frac{1}{3}$ of the whole anatomical element preserved). In period A, the number of complete or almost complete (i.e. preserved in $> \frac{2}{3}$ of the anatomical element) cattle long bones is very high, amounting between 40% and 70% of the assemblages of particular areas. The majority of complete cattle bones found on the site are metapodials. Caprine long bones in period A tend to be more fragmented (fig. 6.17), but complete or nearly compete bones still constitute a substantial portion of the assemblage, i.e. almost 30%. Fragmentation in period B is in general more severe for both taxa than in period A (fig. 6.16; 6.17). Cattle long bones in all areas were much more fragmented

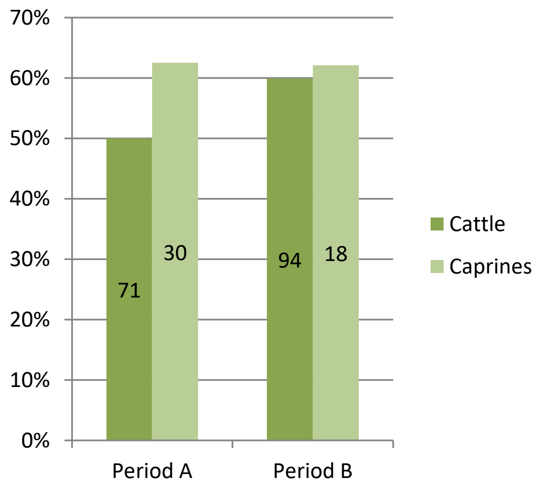

Fig. 6.18 Lelów. The incidence of green/fresh fractures of long bones. The values represent the amount of specimens broken when the bone was fresh (NISP), and the percentage is tallied in relation to the total number of specimens of the specific taxon

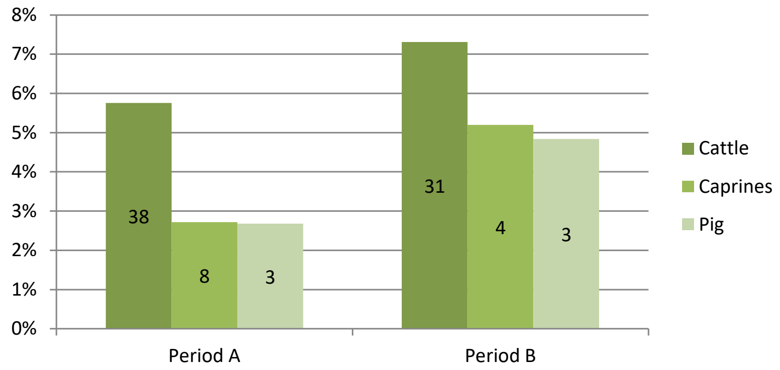

Fig. 6.19 Lelów. The incidence of dog gnawing. The values represent the amount of specimens gnawed (NISP), and the percentage is tallied in relation to the total number of specimens of the specific taxon

than in the previous period, which is represented by larger amounts of $< \frac{1}{3}$ group, and much fewer complete bones. Bones from area 3 were the most fragmented on the site.

Fracture freshness analysis suggests that fracturing of long bones happened mostly when bone was still fresh/green (fig. 6.18). Caprine bones from both periods and cattle bones from period B were fractured whilst fresh in about 60%, and the remaining 40% was fractured when dry or mineralised. The proportion is a bit different for cattle from period A; 50% of bones broken green and 50% of bones broken dry.

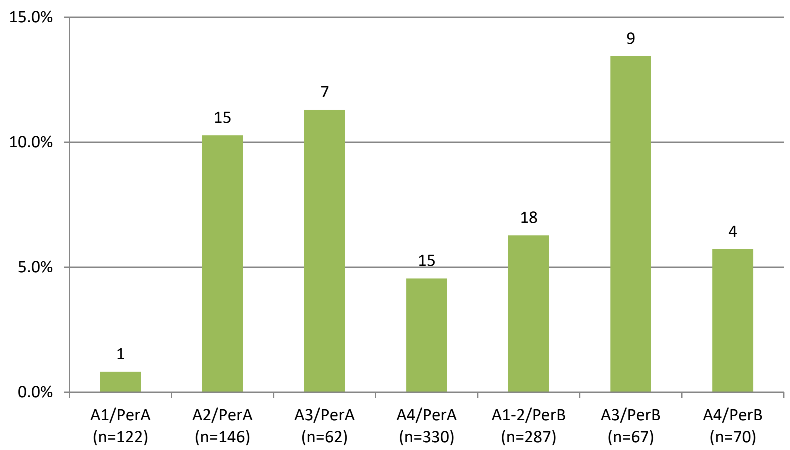

Fig. 6.20 Lelów. The incidence of dog gnawing on cattle bones. The values represent the amount of specimens gnawed (NISP), and the percentage is tallied in relation to the total number of specimens in the given context

6.2.3.4 Gnawing

Carnivore gnawing was observed, in average, on several percent of the assemblage, and it is more frequent in period B than in period A, and more frequent on bones of cattle than other species (fig. 6.19). On cattle bones, slight variation in the frequency of gnawing between the areas occurs (fig. 6.20). The least gnawing is observed in A1/PerA, and it is most frequent in A2/PerA and A3 in both periods. Gnawing occurred on a few percent of bones of caprines and pig, with no meaningful differences between areas (fig. 6.19). In horse, gnawing was found on several specimens in two contexts (3 from A1/PerA and 1 on A4/PerB NISP), constituting around 10% of those assemblages. Gnawing is absent from bones of other species.

Fig. 6.21 Lelów. Examples of cattle metatarsals with extensive trampling and abrasion

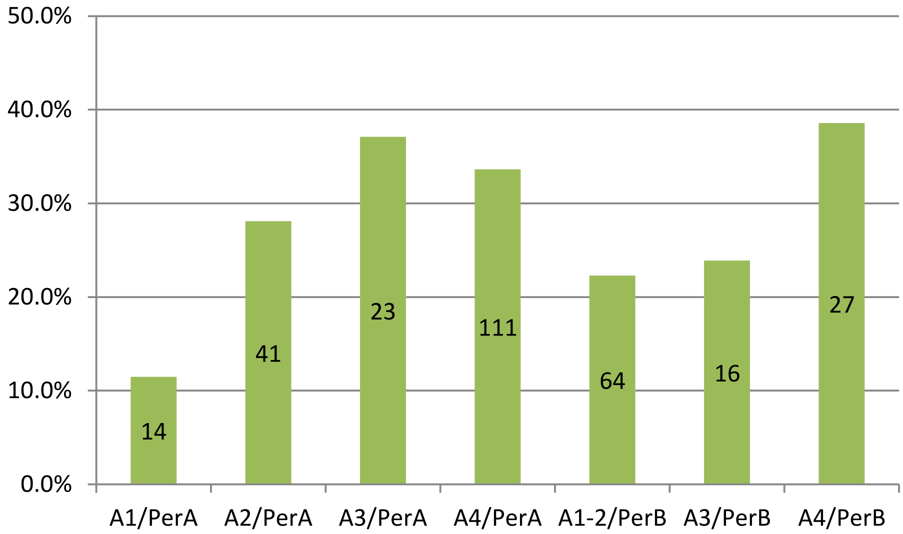

Fig. 6.22 Lelów. The incidence of cattle bones with trampling, erosion, and abrasion combined (NISP). The values represent the specimens affected, and the percentage is tallied in relation to the total number of specimens in the given context

6.2.3.5 Abiotic factors

The presence of trampling, abrasion, and erosion on bones from Lelów is common, it was observed on 27% of cattle bones, 7% of caprine bones, 11% of pig bones, and 22% of horse bones (NISP). The majority of those instances were bones with many random scratching marks left by trampling, and rounded up, abraded edges (fig. 6.21). This pattern is especially very common on cattle metapodials from both periods. In cattle, the incidence varies greatly depending on the area (fig. 6.22). The greatest numbers were recorded for areas 3 and 4 in period A and area 4 in period B. Much smaller incidence is present in area 1 in period A. For other species, the differences between contexts are untraceable due to the sample size. Weathering, in contrast, is much less common, recorded on about 1% of the assemblage (13 specimens NISP). Cattle bones from A1/PerA and A3/PerB were affected in 3%. The highest frequency was recorded for horse in A1–2/PerB, 7%, whilst horse bones from other contexts rarely bore signs of weathering. Bones of caprines and pig did not show any signs of weathering.

6.2.4 Prague

6.2.4.1 Recovery bias

At both sites, Staronová and Libeň, sieving was not a standard practice and recovery bias is one of the factors shaping the composition of the assemblage. The comparison of frequencies of caprines and cattle large bones (tibia and metapodials) and adjacent small elements (tarsals and phalanges) show large discrepancies between those two groups (fig. 6.23; 6.24). In the case of caprines, tarsals and phalanges are much fewer than the adjacent large bones. This discrepancy exists for cattle too. Similarly as on other sites, it is not as pronounced. This is expected with the recovery bias as cattle bones are larger and easier to hand pick during excavation. These results suggest that the recovery bias played an important role in the composition of the assemblage.

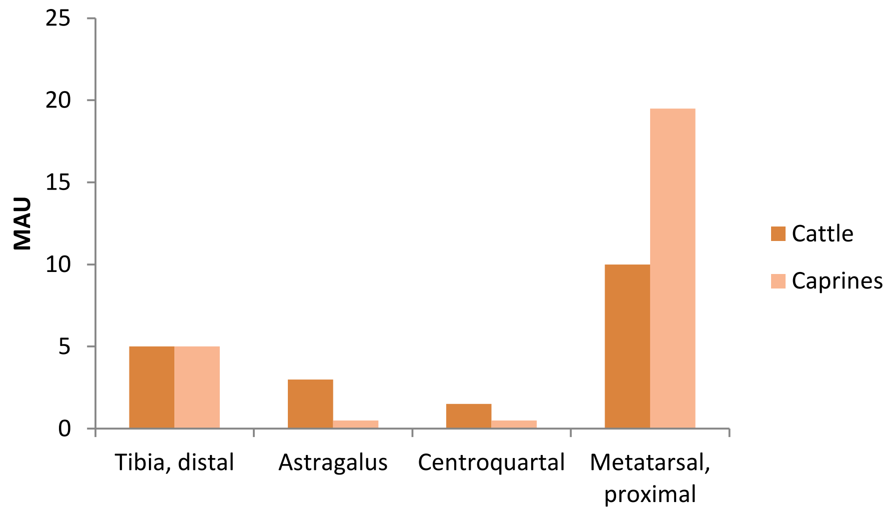

Fig. 6.23 Prague. Frequency of the adjacent bones of the hock joint (MAU)

6.2.4.2 Density

Body part representation of cattle and caprines from Prague was tested against structural density (see section 5.6.2). Due to sample sizes of individual contexts at both sites in Prague being too small for this analysis, the tests were performed only for Staronová and Libeň sites in bulk. In Staronová, the correlations for both cattle and caprines were strong and significant, $\rho = 0.49$, $P = 0.05$. This would suggest that the body part composition of both species is affected by density mediated taphonomic factors. In a similar way as described in the

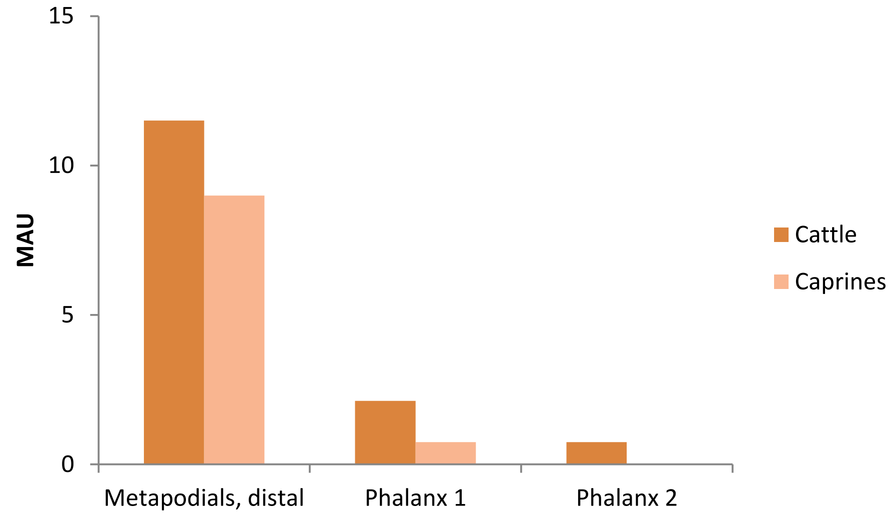

Fig. 6.24 Prague. Frequency of the adjacent bones of the fetlock joint and the foot (MAU)

chapter on Wrocław, this may be partly a result of equifinality. The butchery pattern (see the next chapter) which occurs on the site is characterised by the removal of epiphyses, which are of low density, and leaving shafts which have the highest density, and may affect the correlations. This may be the case for caprines from Staronová, but a little less so in the case of cattle, in which there is little difference between shaft–epiphysis ratios. In Libeň, tests for both taxa were moderate and marginally significant, $\rho = 0.49$, $P = 0.05$, which also suggests that the lower number of low density bones is caused by taphonomic damage. The taphonomy itself cannot, however, explain the underrepresentation of hindlimbs in relation to forelimbs.

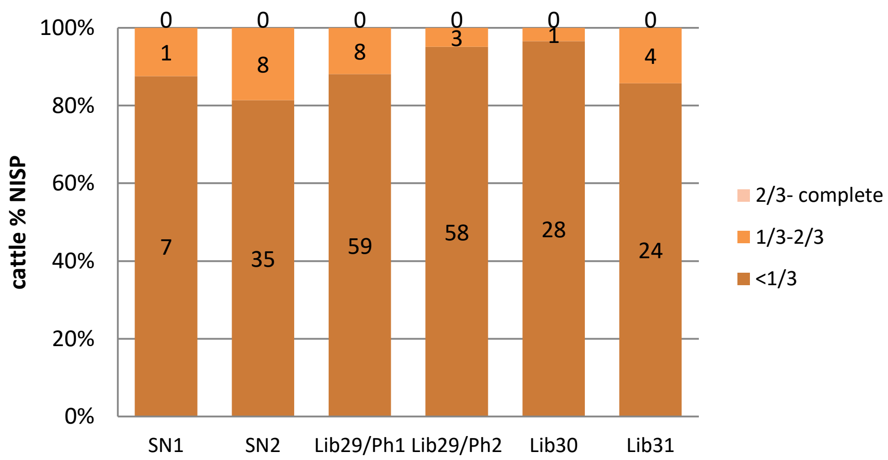

Fig. 6.25 Prague. The intensity of fragmentation of long bones and the skull of cattle

6.2.4.3 Fragmentation and fractures

Fragmentation of long bones from Prague was very severe. Between 80% and 90% of cattle long bones were heavily fragmented and were preserved in less than $\frac{1}{3}$ of the anatomical element (fig. 6.25). Complete or nearly compete specimens (i.e. preserved in more than $\frac{2}{3}$ of the anatomical element) were absent from the assemblage. Fragmentation was less intensive in caprine bones, as evidenced by the higher portion of the middle group (i.e. specimens preserved in more than $\frac{1}{3}$ but less than $\frac{2}{3}$ of the anatomical element) and the presence of some complete bones (fig. 6.26). The intensity of fragmentation in the assemblage from the eighteenth century Libeň (Lib29/Ph2) seems to be smaller than in the houses from the seventeenth century (i.e. Lib29/Ph1, Lib30, Lib31).

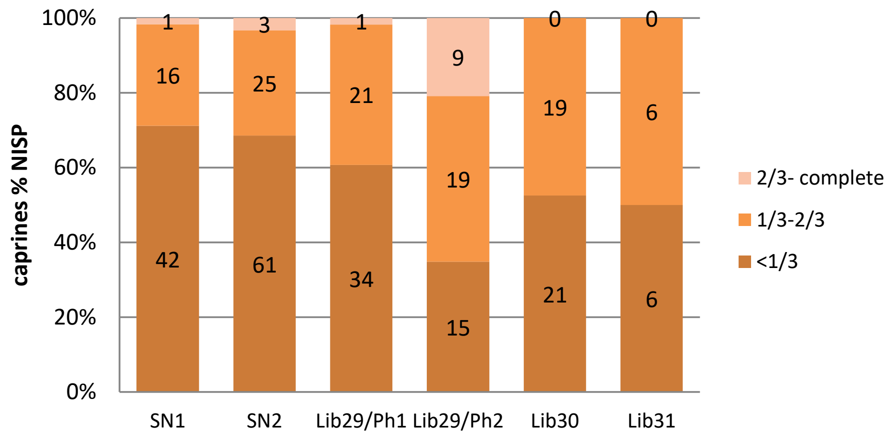

Fig. 6.26 Prague. The intensity of fragmentation of long bones and the skull of caprines

The fracture freshness analysis shows slightly different results for long bones of caprines and cattle (fig. 6.27). Majority of cattle bones from Staronová (i.e. SN1 and SN2) were broken whilst fresh, but most caprine bones were broken dry or mineralised. In Libeň, a vast majority, between 70% and over 90%, of bones of both taxa were broken fresh. Only bones of caprines from the second phase of house 29 (Lib29/Ph2) underwent more intensive postdepositional fragmentation.

6.2.4.4 Gnawing

Dog gnawing was observed on a substantial amount of bones from Staronová synagogue, and on a much smaller number from Libeň (fig. 6.28). Marks were

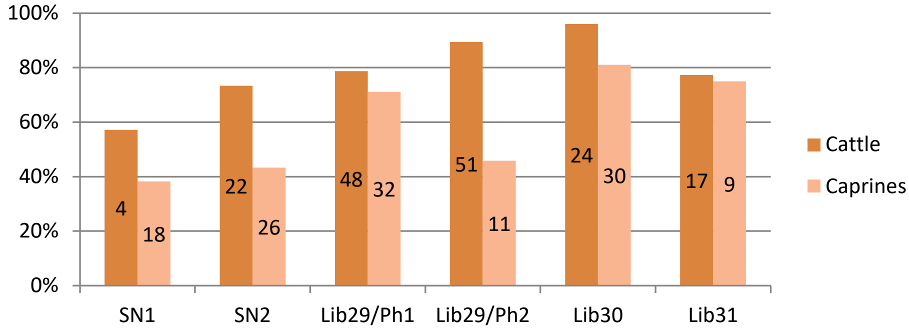

Fig. 6.27 Prague. The incidence of green/fresh fractures of long bones. The values represent the amount of specimens broken when the bone was fresh (NISP), and the percentage is tallied in relation to the total number of specimens of the specific taxon

visible on almost 30% of cattle bones and almost 25% of caprine bones from Staronová, which suggests that dogs had relatively easy access to the discarded bones. Gnawing is present in a small proportion of bones from the assemblages from early seventeenth century Libeň (i.e. Lib29/Ph1, Lib30, Lib31, Lib34), and about 10% from eighteenth century house 29 (Lib29/Ph2). Differences between species seem to be too minute given the small sample size. Amongst other species, the only one pig bone from Staronová was gnawed, and in Lib29/Ph2 a roe deer metatarsal and a juvenile dog radius were both gnawed by carnivores.

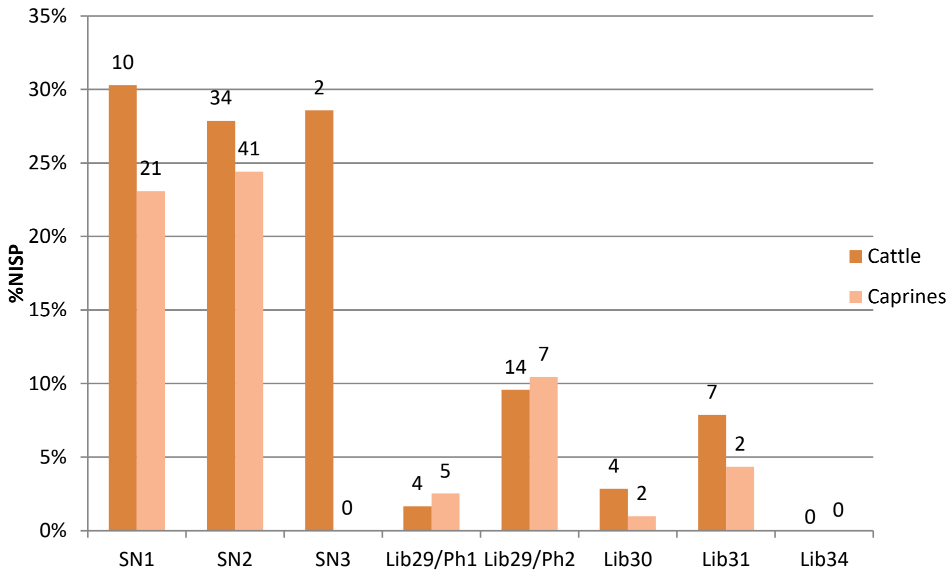

Fig. 6.28 Prague. The incidence of dog gnawing. The values represent the amount of specimens gnawed (NISP), and the percentage is tallied in relation to the total number of specimens of the specific taxon

6.2.4.5 Abiotic factors

Trampling, erosion, and abrasion were present in about 8% of cattle and caprine assemblages from Staronová. In Libeň most assemblages were free of abiotic taphonomy, but this is present on a substantial portion of the assemblage from both phases of house 29 (i.e. Lib29/Ph1 and Lib29/Ph2): 14% of cattle and 6% of caprine assemblages (NISP). Weathering is present on 6% of bones (NISP) in Staronová, with little difference between parts of the synagogue and taxa. In Libeň, however, weathering is present only on a few stray bones. The only pig bone excavated in Staronová is weathered, but other abiotic factors did not occur on other species from both sites in Prague. The results suggest that the taphonomical conditions at Staronová were consistent for all parts and both major taxa, but in Libeň taphonomic history was different for house 29 than for houses 30, 31, and 34.

6.3 Age at slaughter

The following section discusses ageing data based on mandibular teeth, epiphyseal fusion stages, and development of horncores.

6.3.1 Chełm

Age distribution of **cattle** mandibles in the Chełm assemblages suggests late culling of those animals; however, the results suffer from the problem of small sample size (fig. 6.29). In phase 1, most of recorded individuals were killed off in their adulthood, after the 4th year. The phase 2 assemblage seems to have a slightly younger model of mortality. In structure 20, there is very little evidence of deaths before 2nd year of life, and most of animals were culled older. Epiphyseal fusion data (fig. 6.30) largely supports these results; very few remains derive from animals killed before the end of their 2nd year. Phase 1 and structure 20 data shows that the majority of animals survived their 3rd/4th year. In phase 2 the incidence is smaller, but still high.

Chelmer **caprines** were generally culled off much earlier than cattle. Mandibular age data from both phases (fig. 6.31) suggests that the first major culling was happening in their 2nd year (stage D). Afterwards the kill off proceeded in a steady manner till the stage G (4–6y), however in the phase 1 more indi-

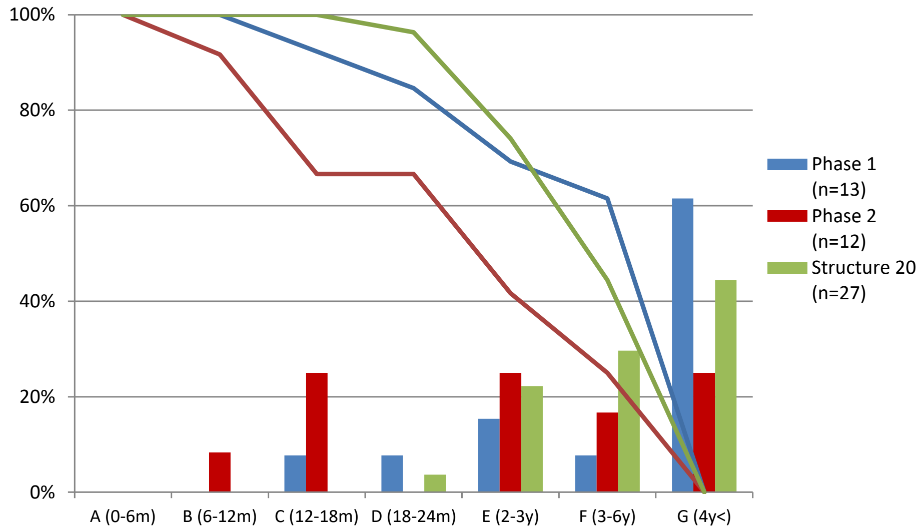

Fig. 6.29 Chełm. Cattle mandibular age stages (MNS). The bars represent the distribution of mandibles across the stages, whilst the lines represent the mortality curves

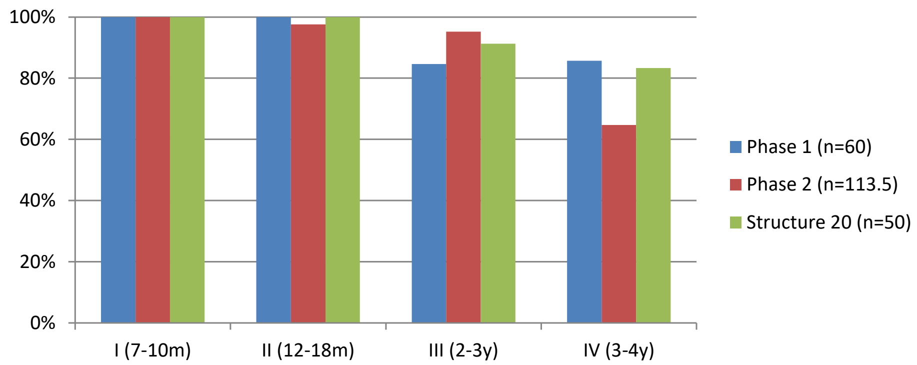

Fig. 6.30 Chełm. Cattle epiphyseal age stages (MAU). The bars represent the percent of fused bones (as opposed to unfused) in each phase (for the methodology see 5.3)

viduals seem to be kept longer, until stage G, whilst in the subsequent phase fewer lived so long. Mandibles from structure 20 present two main culling events, the first in the 2nd year and then in 5th/6th year, with a one individual living until its old age; the assemblage is, however, quite small. The epiphyseal fusion (fig. 6.32) seems to corroborate the mandibular age data, especially in the case of phase 2, but in phase 1 there is a distinct lack of the 2nd year cull. For this phase, over 70% of animals seem to survive their 3rd year and killed later. Although taxonomic differences between the age distribution of sheep and goat are unclear when the phases are analysed separately, the general trend for those species in Chełm suggests that goats were slaughtered earlier than the sheep (fig. 6.33). After the second year cull, which targeted both species,

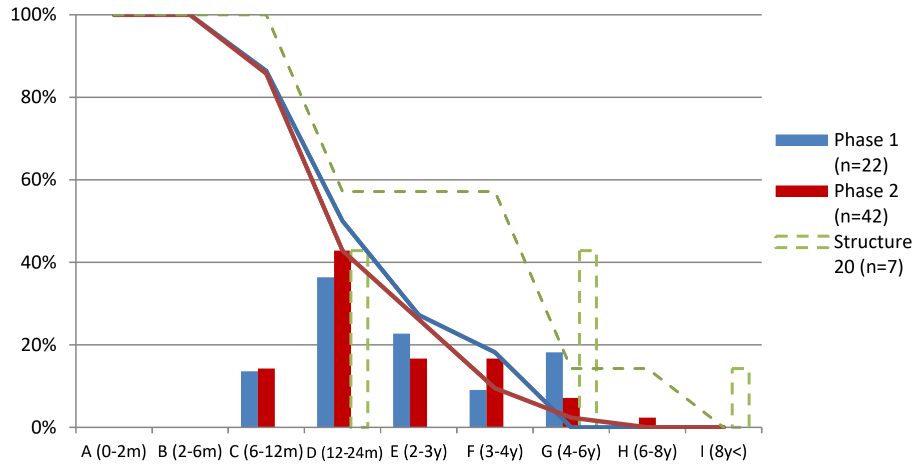

Fig. 6.31 Chełm. Caprine mandibular age stages (MNS). The bars represent the distribution of mandibles across the stages, whilst the lines represent the mortality curves. Assemblages of sample size too small (n<10) for comparisons are marked in dashed outlines

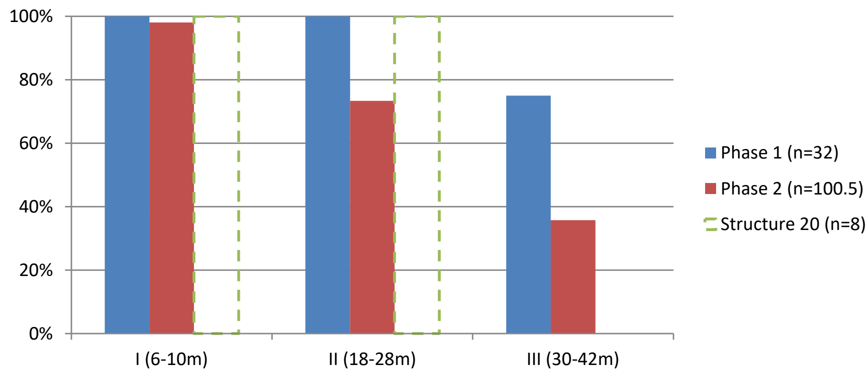

Fig. 6.32 Chełm. Caprine epiphyseal age stages (MAU). The bars represent the percent of fused bones (as opposed to unfused) in each phase (for the methodology see 5.3). Assemblages of sample size too small (n<10) for comparisons are marked in dashed outlines

goats were mostly killed off in the next 2 years (before the end of 4th year) whilst over 20% of sheep were kept until their late adulthood.

Ageing data for **pig** was scarce: only four adult mandibles and one sub-adult mandible were recorded.

6.3.2 Wrocław

Despite the relatively large size of the assemblage from Wrocław, bones and teeth which allow age at death estimation were scarce in some contexts; especially in periods A and E. Hence, those assemblages were excluded from the graphs for the sake of clarity.

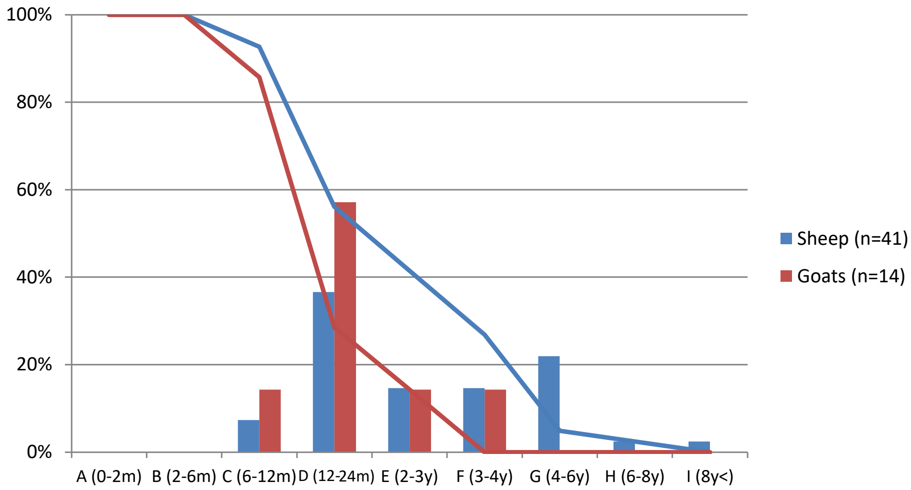

Fig. 6.33 Chełm. Sheep and goat mandibular age stages combined for the whole site (MNS). The bars represent the distribution of mandibles across the stages, whilst the lines represent the mortality curves

Specimens providing data on **cattle** ageing are relatively limited in number at Wrocław.

- In the most represented assemblage, period B, mandibular data suggests that most animals were culled between 1.5 and 3 years of age (fig. 6.34), with a small peak of infant deaths (6–12 m.o.) and the absence of the oldest individuals. This data, however, is not consistent with epiphyseal fusion data (fig. 6.35), which suggest that animals were slaughtered slightly earlier in general, before 1–1.5 year. This discrepancy may be caused by taphonomic factors; but taphonomic loss produces a different bias: against the juvenile bones. Hence, the small sample size for mandibles seems more likely to be the culprit of this discrepancy.
- In period C both mandibular and epiphyseal data suggest that animals were culled after the first year of life and the trend was steady into adulthood.
- Most mandibles in period D derive from animals older than 3 year, whilst the epiphyseal data suggest that most animals were slaughtered after 1.5– 3 year.
- Cattle ageing data for period E is only represented by a small assemblage of epiphyses which imply that a slight majority of individuals were culled in their second or third year but the rest survived into adulthood.

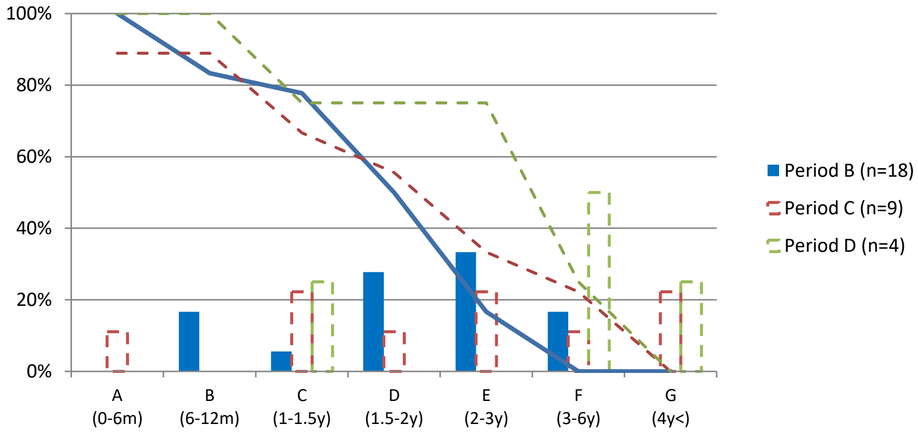

Fig. 6.34 Wrocław. Cattle mandibular age stages (MNS). The bars represent the distribution of mandibles across the stages, whilst the lines represent the mortality curves. Assemblages of sample size too small (n<10) for comparisons are marked in dashed outlines

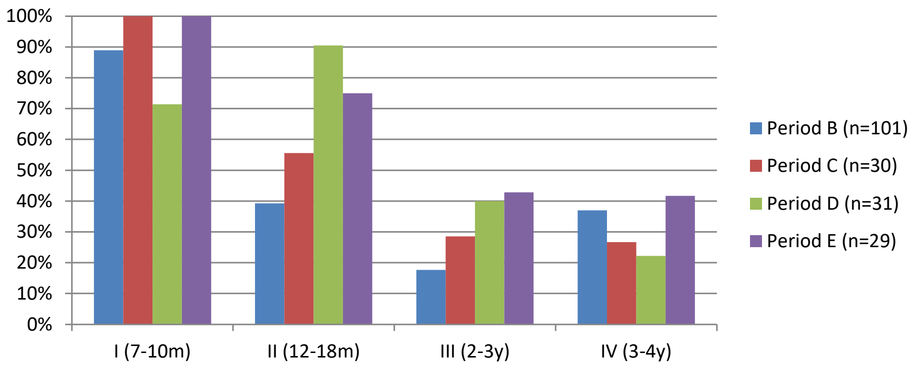

Fig. 6.35 Wrocław. Cattle epiphyseal age stages (MAU). The bars represent the percent of fused bones (as opposed to unfused) in each period (for the methodology see 5.3)

Interesting insights into cattle mortality come from horncores. In three periods with a sufficient amount of specimens present (periods B, C, and E) mortality profiles slightly differ (fig. 6.36). In period B horncores were harvested mostly from young adults (3–7 years old) and adults (7–10 years old). This data is not coherent with epiphyseal ageing for this period and suggests even older age than the mandibles. One explanation is that the limbs brought to the site were preferred young, whilst heads of the older cohort were brought in connection to the horn craftsman's workshop. It needs to be stressed that the systems for ageing of cattle horncores is not precise but rather subjective (Sykes and Symmons, 2007; Salvagno et al., 2017). In the next period, C, a slight shift comparing to the previous period is seen. The majority of cores come from sub-adults (2–3 years old), whilst young adult and adult individuals are much scarcer. In period E, sub-adult and young adult cattle dominate. Horncores

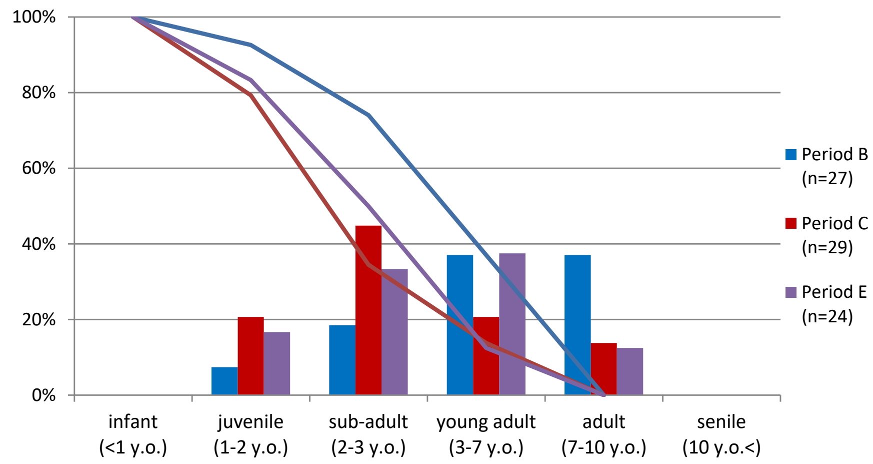

Fig. 6.36 Wrocław. Cattle horn core age stages (Armitage, 1982) for selected assemblages (NRDZ). The bars represent the distribution of horncores in each phase, whilst the lines represent the mortality curves (for the methodology see 5.3)

from periods D and E relatively well correspond with other ageing data for these periods. In all phases, horncores from infant and senile cattle are absent.

Ageing data for **caprines** is generally much more abundant (fig. 6.37; 6.38).

- In period A, epiphyseal data shows low frequencies of bones of animals slaughtered before reaching 28 months of live, and the majority derive from individuals culled after 2.5–3.5 years.
- In period B, the body of mandibular and epiphyseal data is much larger than for the other periods. It shows a coherent pattern in which a small portion of animals were culled before reaching first year (mostly between their 6th and 12th months). The major culling was performed between the 12th and 24th month, presumably even before the eighteenth month. After this, the mortality curve steadily drops down leaving only few animals alive in their 5th–9th year.
- Caprines in the next period, C, seem to be culled later in their life, the major culling happened when animals were 2–3 years old, and then when they were 3–4 years old. A few individuals also reached late adulthood.
- In period D the main culling happened in the second and fourth year of live. A few individuals lived till later age, sometimes reaching late adulthood.

- Data suggests that caprines in period E were slaughtered in their third year with many reaching later ages, but only epiphyseal fusion is available for this period.

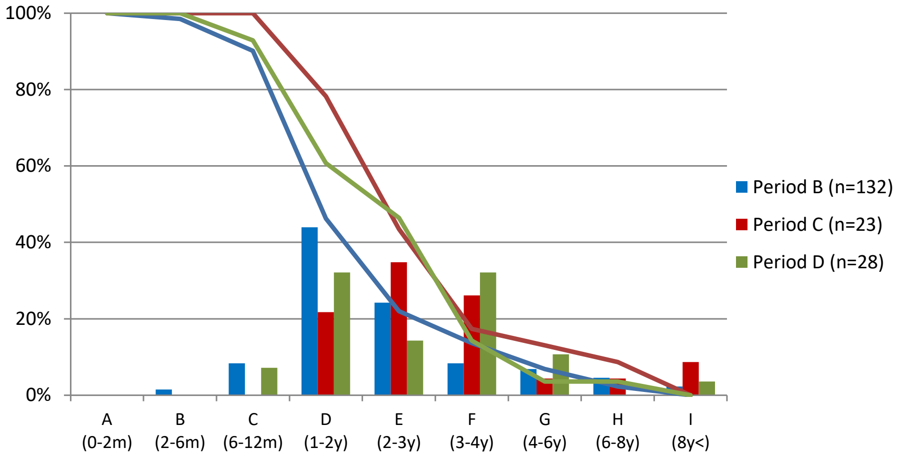

Fig. 6.37 Wrocław. Caprine mandibular age stages (MNS). The bars represent the distribution of mandibles across the stages, whilst the lines represent the mortality curves

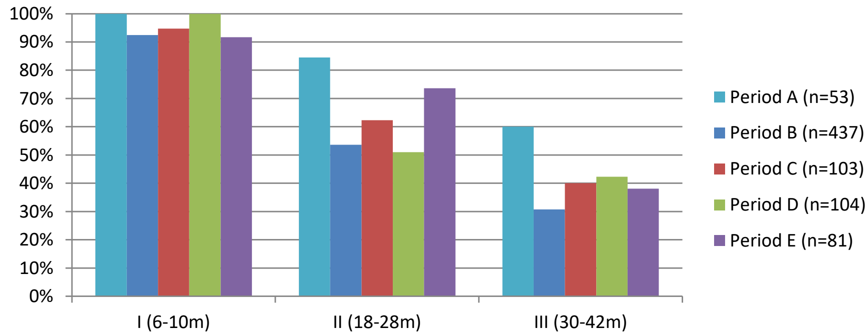

Fig. 6.38 Wrocław. Caprine epiphyseal age stages (MAU). The bars represent the percent of fused bones (as opposed to unfused) in each period (for the methodology see 5.3)

For the whole assemblage from Wrocław, 98 mandibles were identified as sheep and 13 as goat. Although the sample size for goat is small, a cursory analysis does not show obvious differences from the sheep trend. Larger samples of mandibles identified to species are, however, needed to carry out a proper comparison between the two species.

Pig ageing was possible only on a limited number of specimens, but some basic trends can still be seen (fig. 6.39; 6.40). In periods C and D most of pig deaths occurred when animals were juvenile up to subadult, and only a few survived the second year. Culling in period B seems to take place slightly later. The majority of animals were subadult/adult 1 when slaughtered and infant deaths are less common.

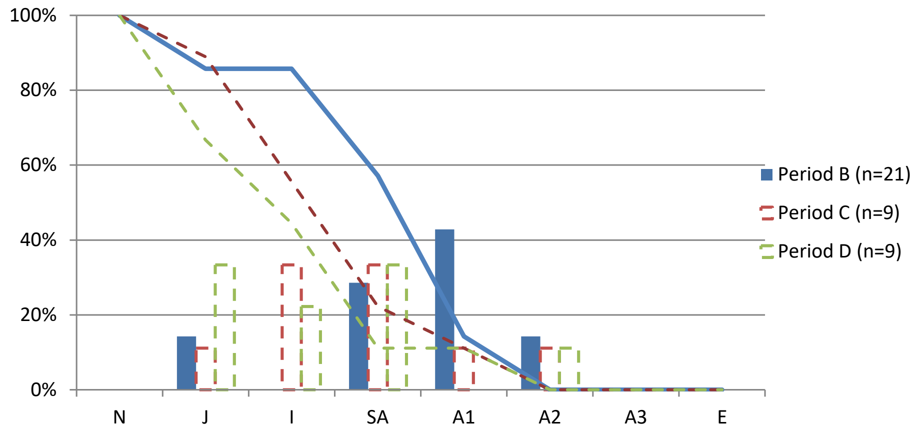

Fig. 6.39 Wrocław. Pig mandibular age stages (MNS). The bars represent the distribution of mandibles across the stages, whilst the lines represent the mortality curves. Assemblages of sample size too small (n<10) for comparisons are marked in dashed outlines

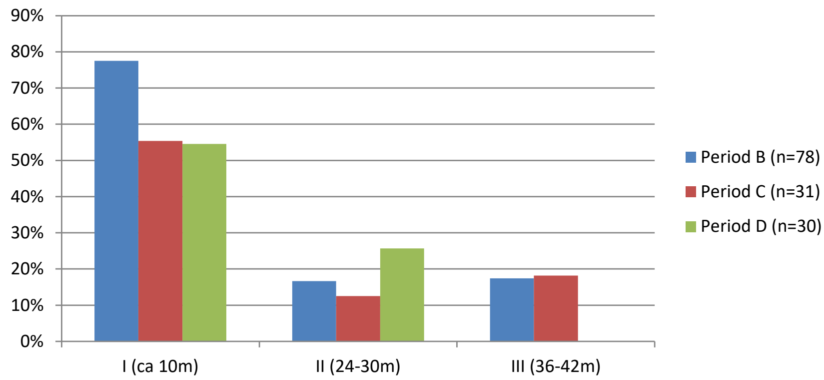

Fig. 6.40 Wrocław. Pig epiphyseal age stages (MAU). The bars represent the percent of fused bones (as opposed to unfused) in each period (for the methodology see 5.3)

6.3.3 Lelów

Despite the large size of the assemblage, mandibles providing ageing data were present in relatively small numbers.

The data for Lelów **cattle** suggests the preference in culling young adult individuals. Infant cattle mortality was very low, as evidenced in the mandibular (fig. 6.41), epiphyseal (fig. 6.42), and horncore (fig. 6.43) data. However, this underrepresentation comparing to other age stages is probably affected by taphonomic destruction of infant bones and teeth. According to mandibular data from period A (fig. 6.41), there is a steady incline in juvenile and sub-adult mortality. The majority of individuals were culled off as young adults or possibly later. Data for period B is scarce but it seems not to contradict this trend. Epiphyseal data (fig. 6.42) does not detect the higher rates of juvenile mortality as evidenced by the mandibular data (i.e. age stage II), possibly due to the taphonomic bias against unfused bones. Approximately 30–40% of animals were slaughtered around their second or third year according to this data. This suggests a relatively old age of cattle slaughtered in Lelów, about 60–70% reaching at least fourth year of life. Epiphyseal data for both periods seems to follow similar trends. Based on the horncore ageing data (fig. 6.43), the majority of animals were slaughtered in their young adult age, which roughly follows the trend evidenced by other methods, and some reached their full adulthood (7–10 y.o.).

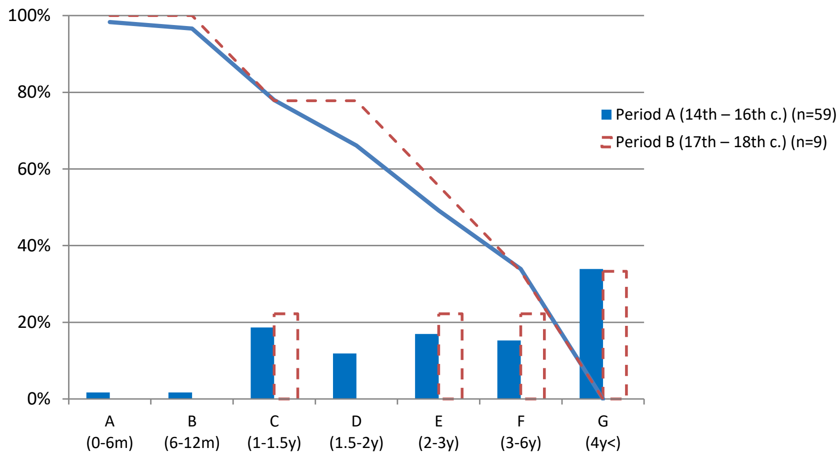

Fig. 6.41 Lelów. Cattle mandibular age stages (MNS). The bars represent the distribution of mandibles across the stages, whilst the lines represent the mortality curves. Assemblages of sample size too small (n<10) for comparisons are marked in dashed outlines

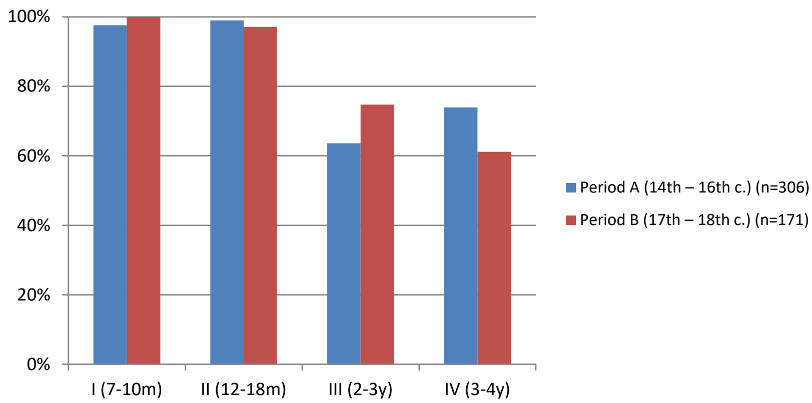

Fig. 6.42 Lelów. Cattle epiphyseal age stages (MAU). The bars represent the percent of fused bones (as opposed to unfused) in each period (for the methodology see 5.3)

In sum, all cattle mortality data from Lelów seem to reflect the practice of utilisation of most of animals for several years before the slaughter. Some juvenile and sub-adult mortality may reflect the need for young meat. Never-

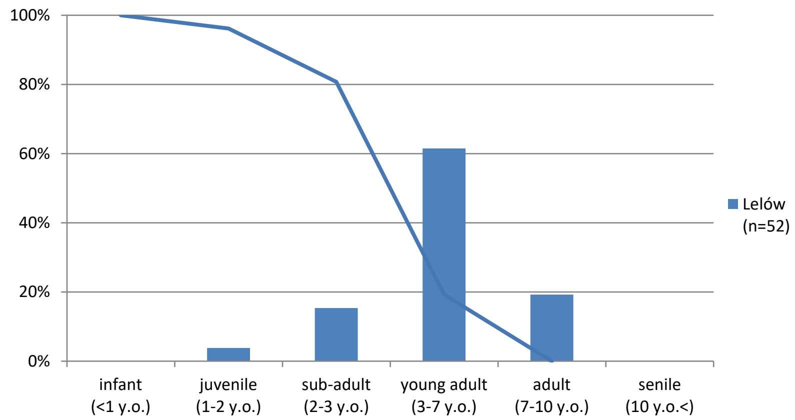

Fig. 6.43 Lelów. Cattle horn core age stages (Armitage, 1982) for selected assemblages (NRDZ). The bars represent the distribution of horncores in each phase, whilst the lines represent the mortality curves (for the methodology see 5.3)

theless, cattle was presumably more valuable as working animals or in dairy production.

Mortality patterns of **caprines** from Lelów suffer from a small sample size; however, they still provide some information. In mandibular data for period A there is an absence of mandibles of animals younger than 1 year, a slight peak in mortality of 1–2 year-olds and a steady distribution of mandibles until the stage H (fig. 6.44). Contrary to that, the epiphyseal data (fig. 6.45) evidences infant mortality in approximately 20%–30% of early fusing bones. Similar mortality is seen for the second stage, whilst the higher mortality in the third stage suggests that a high portion of caprines were slaughtered between stages II and III; that is around their third year. Differences between goat and sheep mortality were intangible due to the small sample size. Each ageing method in this case provides slightly different results, but combined outcomes suggest that caprines were culled at all ages, which would suggest the mixed utilisation of this taxa; the infant (evidenced only in the epiphyseal fusion data) and juvenile deaths suggest meat production, but the presence of much older individuals, up to 8 years suggest that caprines were kept also with a strong aim for dairy and/or wool production.

Pig mortality profile from Lelów is based on a small number of mandibles (fig. 6.46). All the available data suggest a rather short span of the preferred age of slaughtered pigs: sub-adult and young adult. This is the age when is most efficient to slaughter animals for meat.

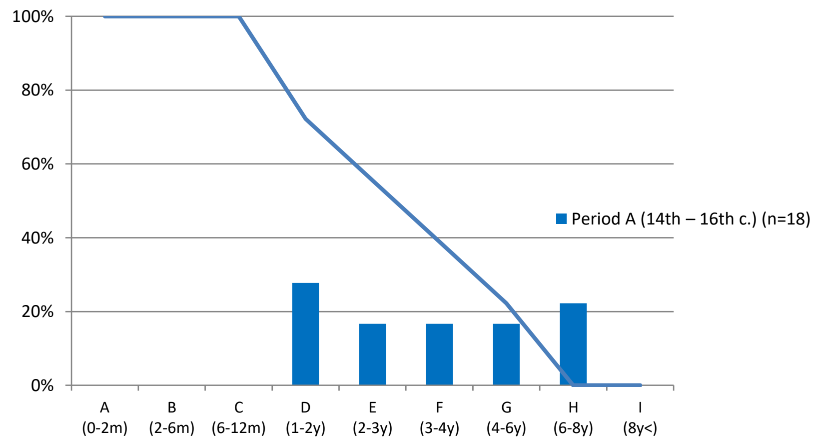

Fig. 6.44 Lelów. Caprine mandibular age stages (MNS). The bars represent the distribution of mandibles across the stages, whilst the lines represent the mortality curves

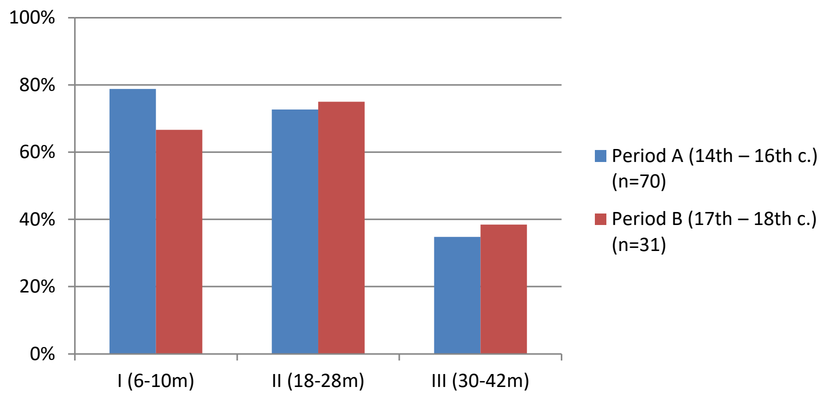

Fig. 6.45 Lelów. Caprine epiphyseal age stages (MAU). The bars represent the percent of fused bones (as opposed to unfused) in each period (for the methodology see 5.3)

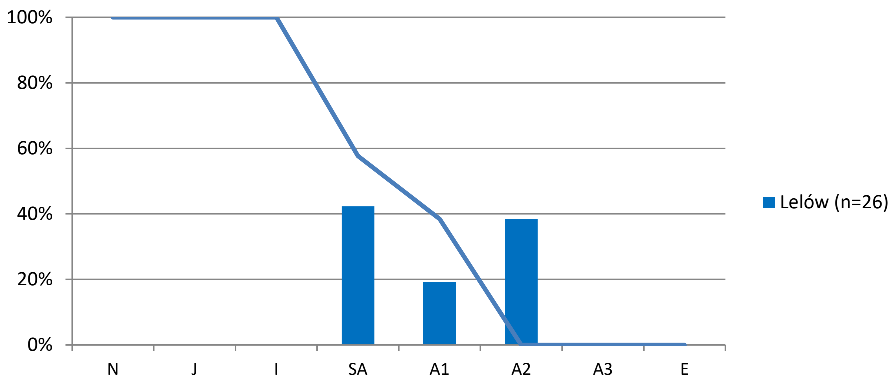

Fig. 6.46 Lelów. Pig mandibular age stages (MNS). The bars represent the distribution of mandibles across the stages, whilst the lines represent the mortality curves

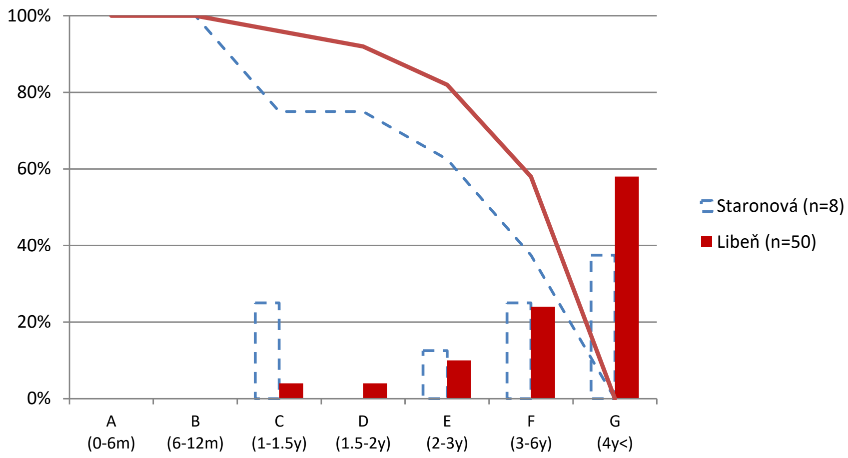

Fig. 6.47 Prague. Cattle mandibular age stages (MNS). The bars represent the distribution of mandibles across the stages, whilst the lines represent the mortality curves. Assemblages of sample size too small (n<10) for comparisons are marked in dashed outlines

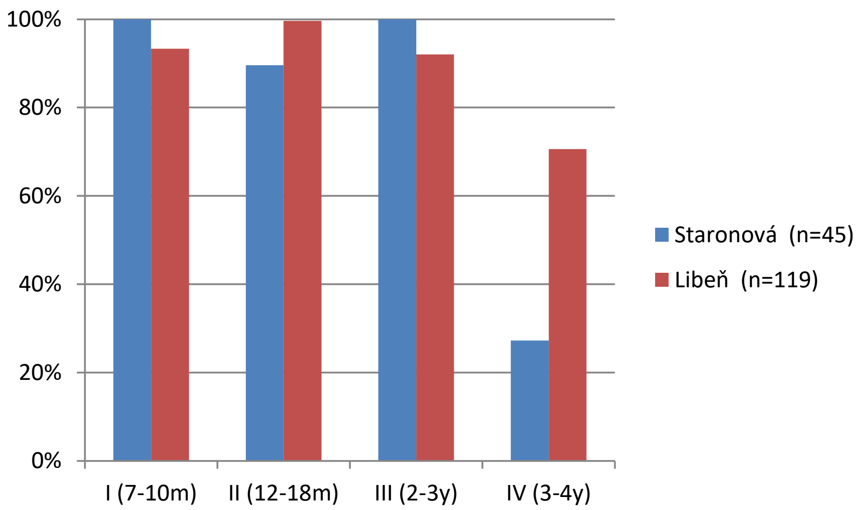

Fig. 6.48 Prague. Cattle epiphyseal age stages (MAU). The bars represent the percent of fused bones (as opposed to unfused) in each period (for the methodology see 5.3

6.3.4 Prague

Most **cattle** present in Libeň were slaughtered as young adults (that is, after at least 4 years) and later (fig. 6.47). Individuals of younger age are rarely represented in the assemblage. Epiphyseal data for Libeň follows the same pattern (fig. 6.48). Few bones derive from animals younger than 3 years, and in approximately 70% of the cases the individual lived beyond the fourth year. The data for Libeň suggests strong preference towards adult cattle, with little presence of individuals slaughtered in the younger age. The absence of the infant

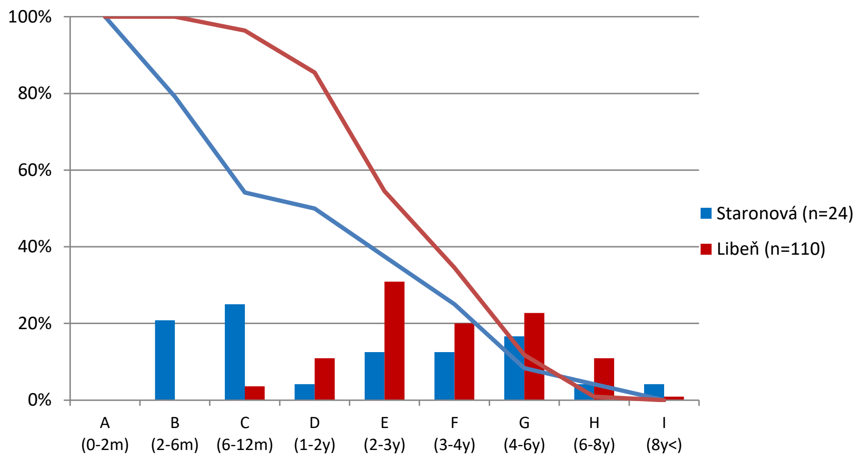

Fig. 6.49 Prague. Caprine mandibular age stages (MNS). The bars represent the distribution of mandibles across the stages, whilst the lines represent the mortality curves

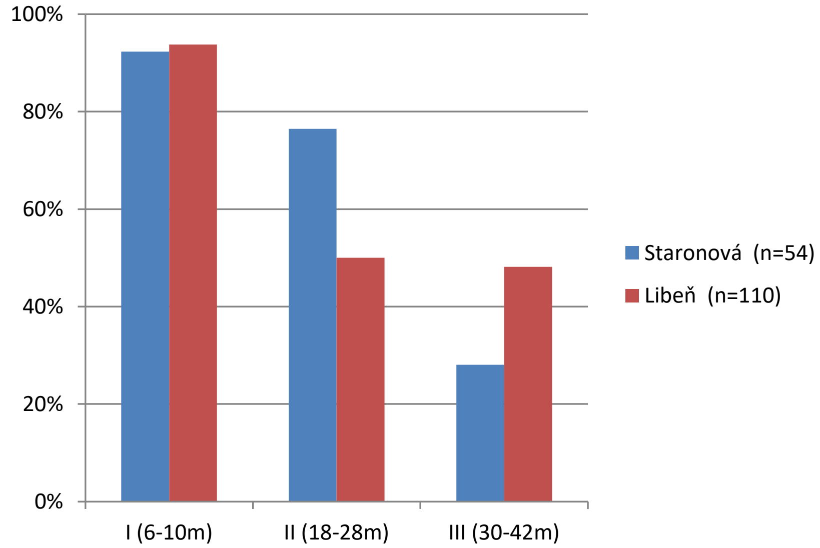

Fig. 6.50 Prague. Caprine epiphyseal age stages (MAU). The bars represent the percent of fused bones (as opposed to unfused) in each period (for the methodology see 5.3)

and juvenile deaths is evident. Although, it may be caused by taphonomic factors acting against fragile bones of the youngest animals. This pattern may be associated with the importance of the village of Libeň in the Prague cattle trade: younger animals could have been exported to the city centre, whilst adult individuals were slaughtered on the spot for local consumption.

Cattle mandibles from Staronová are very few, but most of them come from animals classified as young adults or older — akin to Libeň (fig. 6.47). At Staronová, only a few instances of deaths in epiphyseal age stages I, II, and III were recorded (fig. 6.48). The majority of animals were slaughtered between III and IV stage — that is presumably around the third year of life — and approximately 30%

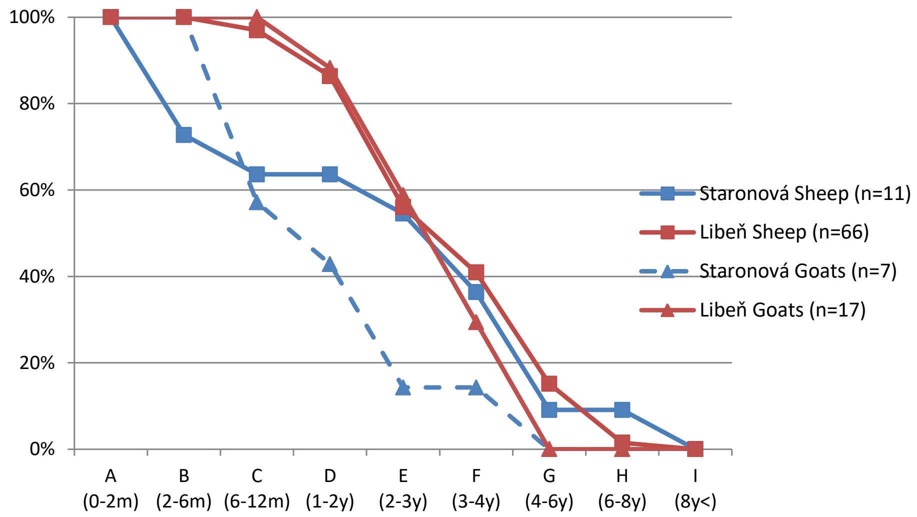

Fig. 6.51 Prague. Sheep and goat mandibular age stages (MNS). The lines represent the mortality curves

reached adulthood. The data suggests that the local inhabitants mostly consumed meat of sub-adult cattle. Nonetheless, the bias against the young ones may be due to taphonomy.

Cattle horncores are very scarce in the assemblage and do not provide a reliable ageing method. These were sole specimens of stage 1 and 2 in Lib29/Ph2, and stage 2 and 3 at Staronová.

The assemblage of mandibles of **caprines** is much more substantial than of cattle. Infant and juvenile deaths are very scarce in the mandible data from Libeň (fig. 6.49). The highest mortality at Libeň is noted in the third year of age and later there was a steady mortality until stages G and H. The epiphyseal fusion data seem to provide similar results (fig. 6.50). It is noteworthy that there is little difference between mortality of sheep and goats, but only a small portion of sheep were slaughtered later in adulthood than goats (fig. 6.51). In sum, the slaughter of sheep and goats at Libeň was carried out rather late in the life of those animals, mostly in the third year, and up to the sixth year. The seeming preference towards the older individuals may be explained by the importance of live animal exploitation: for milk, as well as for wool in the case of sheep. However, the lack of the younglings in the assemblage may also be caused by exporting them for the consumption in the city centre of Prague, like in cattle; or simply due to the taphonomical bias. Compared to Libeň, caprines from Staronová display a slightly different pattern. A substantial infant and juvenile mortality is attested at Staronová; but otherwise, the majority of animals were much older. The epiphyseal data does not show the pick in juvenile mortality (fig. 6.50), although poor preservation of unfused epiphyses may be to blame. Mortality profiles for sheep and goat differ, but the sample is rather small. Sheep seem to display a pattern of higher juvenile morality than goat, but this lack of juvenile goat mandibles is due to the general paucity of the data for this species. In general, goats seem to be slaughtered much earlier than sheep. Given that the bulk of meat in Staronová, which is in the very centre of a large city, came from local import, this data suggests that a substantial part of meat was from young sheep, and the remaining part was mutton from older animals, presumably kept for milk or wool. Goat meat seems to come from younger animals. This may mean that they were not as popular dairy species; it is also possible that the meat of older goats was not imported as much.

Other species from Prague did not provide any suitable ageing data.

6.4 Animal pathologies

Palaeopathological changes are present on a rather small number of bones, a total number of 101 cases (MNS).

A large fraction of the lesions was evidenced on metapodials of cattle and caprines (table 6.21). Some conditions, such as exostosis and lipping, were also noticed on epiphyses. These changes in the joints of the metapodials may have a differential aetiology. They are often related to exploitation of the animals for traction, but may also be a result of poor nutrition, breed, or simply old age (Bartosiewicz et al., 1997, p.62–72). In fact, the majority of the pathological changes happened to bones of adult individuals. A few specimens show signs of spavin; a condition in which tarsals fuse to metatarsals with extensive exostosis (Baker and Brothwell, 1980, p.117–118). This condition may be seen in draught cattle but may also be hereditary.

On the epiphyses of other long bones of cattle and caprine exostosis is present, and a few cattle long bone epiphyses were ivory-like appearance, as a result of eburnation. These lesions may possibly be associated with osteoarthritis.

Changes of the long bone shaft recorded in the assemblage are partly caused by trauma and mistreatment of the animals. A smooth-in-appearance swelling of the bone called ossified haematoma was recorded in a few cases; it results from a blunt impact (Baker and Brothwell, 1980, p.83). Also, different levels of

Table 6.21 The incidence of pathological changes on cattle and caprine bones Minimum Number of Sections (MNS)

Pathologies in caprines		Chełm	Lelów	Wrocław	Prague
Metapodials and tarsals	Distal exostosis	1	1	1	
	Proximal exostosis	1		2	1
	Exostosis (shaft)			6	1
	Rickets				1
	Ossified haematoma			2	1
Other bones and teeth	Tooth malformation		1	1	1
	Abnormal tooth wear				3
	Antemortem tooth loss				1
	Exostosis (epiphyses)	2			
	Exostosis (shaft)	1		3	
	Exostosis (horncore basis)		3		
	Ossified haematoma			1	
	Depressions (shaft)				1
Total		**5**	**5**	**16**	**10**
Percent of the assemblage (MNS)		**0.8%**	**1.1%**	**0.6%**	**1.5%**

Pathologies in cattle		Chełm	Lelów	Wrocław	Prague
Metapodials and tarsals	Proximal exostosis	2		5	
	Distal exostosis	1			
	Lipping	1	2	1	
	Spavin	2		1	
	Depressions (shaft)		2		
	Ossified haematoma		1		
Other bones and teeth	Tooth malformation	2	1		1
	Abnormal tooth wear				3
	Periodontal inflammation		1		1
	Abscess (oral)	2			
	Exostosis (epiphyses)	1	2		1
	Eburnation	2		1	
	Depressions (shaft)		1		1
	Ossified haematoma	1			1
	Large occipital perforations	1			1
Total		**15**	**10**	**8**	**9**
Percent of the assemblage (MNS)		**1.8%**	**0.6%**	**1.1%**	**1.9%**

exostosis were seen on several metapodial shafts at Wrocław — including a few juveniles — located mostly on the posterior aspect of the shaft. A probable cause of these changes is prolonged environmental stress and inflammation, possibly due to hobbling of the animal's legs. However, the precise aetiology would need to be determined using more specialised tools, such as radiology. Other lesions observed on the shaft were shallow depressions found on cattle metapodials from Lelów. These presumably are a result of inflammation (Baker and Brothwell, 1980). Another interesting case is a caprine metatarsal from Prague Libeň that is arched; it is a sign of rickets, a disease caused by the deficiency of phosphorus relative to calcium and a lack of vitamin D in the individual's diet (Baker and Brothwell, 1980, p.49).

A few cases of cattle skulls had perforations in their occipitals. The aetiology of these changes is not clearly understood, they are presumably hereditary (Manaseryan et al., 1999). Initially it was thought they started occurring after the domestication in draught cattle (see Brothwell et al., 1996), but the evidence from other species, including wisent (Manaseryan et al., 1999) and pig (Fabiš and Thomas, 2011), contradicts the previous interpretation.

A number of goat crania from Lelów had exostosis at the basis of the horncore. These lesions may result from tethering. Several mandibles and maxillae of cattle and caprines were affected by pathological conditions (table 6.21). A few molars were deformed. These malformations include reduced cusps or missing third cusps of the third molar. Malformations of teeth may result from stress during the juvenile years (Baker and Brothwell, 1980, p.137–141). Another set of molars of caprines and cattle from Prague had severe abnormal wear. The animals presumably fed on hard grass and foliage from bushes. A few individuals of cattle displayed signs of periodontal inflammation (Baker and Brothwell, 1980, p.153–154). This condition may lead to production of abscess, also seen in cattle from Chełm.

In horse, eleven cases of pathological changes were observed. Four were found on maxillae and mandibles from Wrocław and Chełm (periodontal inflammation and abnormal tooth wear) and two on pelves from Wrocław and Chełm (exostosis on the acetabulum). Further findings are lipping on two phalanges from Chełm, an ossified haematoma on a metatarsal from Lelów, spavin on a metatarsal from Chełm and a portion of the lumbar spinal column fused together from Lelów. In pig, only two cases of pathological changes were present at Chełm and Wrocław. Both were tibiae and fibulae fused together, possibly as a result of hobbling. Finally, healed fractures and an ossified haematoma were observed on two dog humeri and a cat femur.

In sum, bone pathologies present in the assemblage are scarce but they make an interesting case study of animal exploitation and healthcare. The evidence shows that a number of the animals were mistreated by humans. Malformation and abnormal wear of teeth and rickets suggest that some animals were underfed or fed fodder of insufficient nutritional quality. This is especially the case in Prague. At Lelów and Wrocław, exostoses on shafts of metapodials and horncores imply the existence of the practice of tethering and hobbling of sheep and goats. Ossified haematomas and healed fractures on caprine, cattle, horse, dog, and cat bones may constitute evidence of violence towards the animals. Lastly, lesions in cattle feet, especially at Chełm and Wrocław, may suggest that some animals consumed in those towns had previously been used as drought animals.

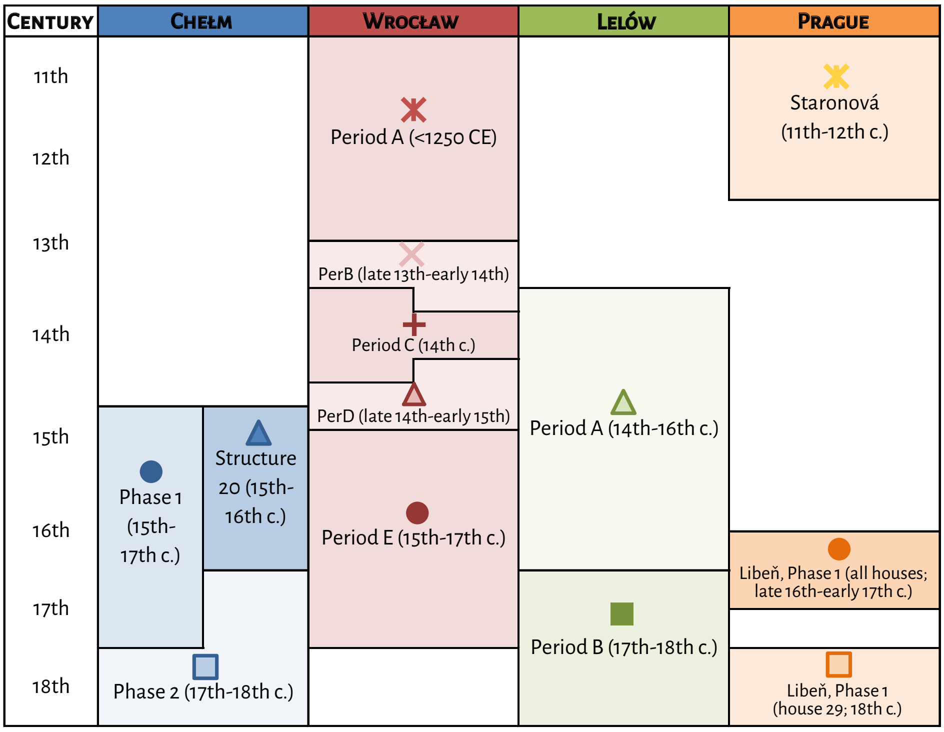

Fig. 6.52 The key for dating and colour- and symbol-coding used in biometry charts for particular analysed contexts

6.5 Body size and sex ratio

The biometrical study discussed in this section plays an important role: it provides data on sex distribution of species, changes in size of the livestock, the presence of different morphotypes and correlation between the sites. In this section I will focus only on the measurements present in larger numbers (usually more than 10 for each context) and those strands of analysis which are potentially more informative. I have also excluded unfused bones.

For the reader's convenience, figure 6.52 repeats the general dating of archaeological contexts and introduces symbols and colour-coding consistently used throughout the following section.

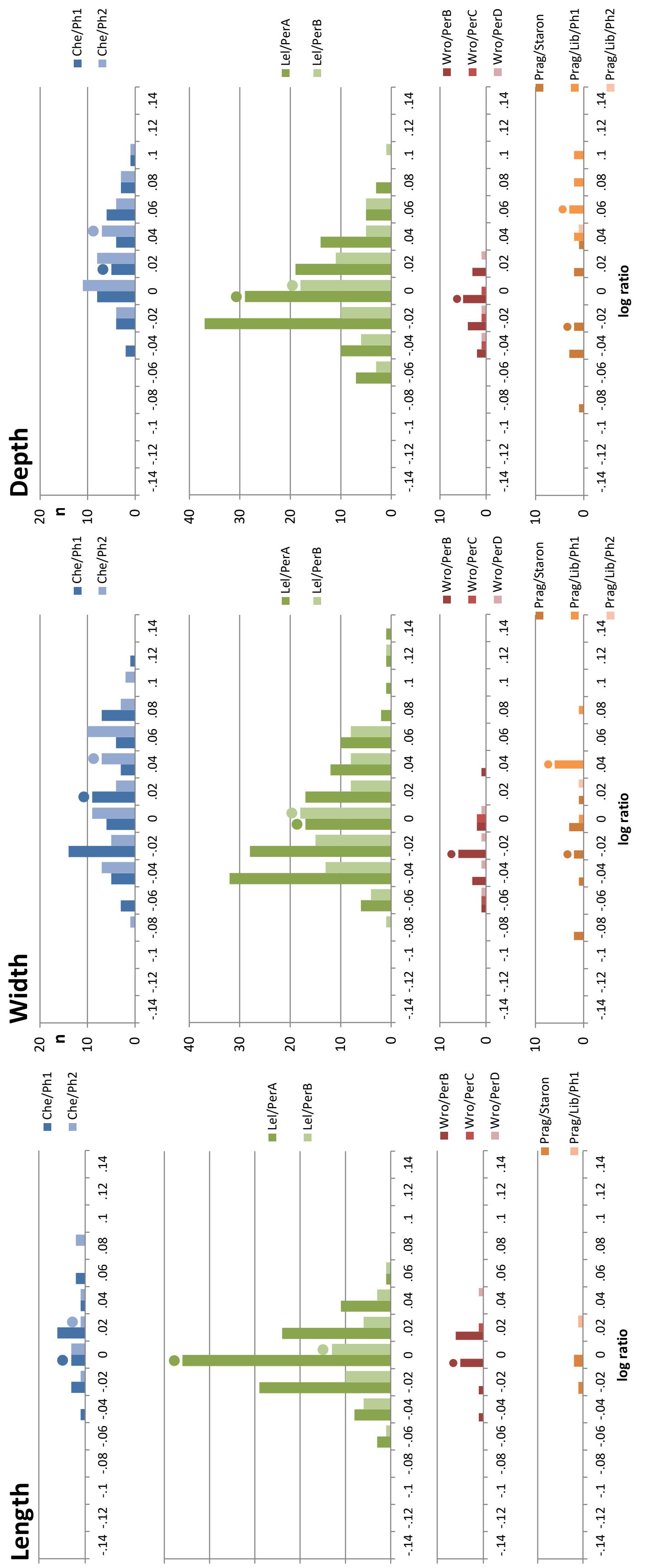

Fig. 6.53 Log ratios for cattle postcranial bones. Dots mark sites' mean. The methodology is described in section 5.4

6.5.1 Morphological sexing

Unfortunately, sex determination based on morphological traits such as the shape of ruminant pelvis or pig canines. These cannot be used for quantitative analysis in most of the analysed assemblages due to the paucity of data. Only a small number of animal bones was useful for this analysis.

Chełm Sexing of pelves was possible only for two individuals of cattle, and two caprines — all of which females. Also, two horse mandibles and two pig mandibles were recognised as male. Lelów.

Wrocław Out of 33 caprine pelves, 21 were female and only 12 male. Four cattle pelves were present — all female. Also, a canine of a male horse was present. As for pig canines, 24 belonged to males and only 2 to females; a discrepancy likely caused by the recovery bias.

Lelów Sex was recognised on two caprine pelves; one was male and the second female. Only one cattle pelvis was sexed, and it is a female. As for pig canines, sexing was possible in 33 cases: 26 males and 7 females. The ratio may be heavily affected by the recovery bias due to the large size difference between male and female canines. For horse, out of four cases of crania or mandibles 3 are males and one a female.

Prague One cattle and one caprine pelves were found at Staronová, a bovine bull and a caprine ewe.

6.5.2 Cattle biometry

Measurements were taken on 975 cattle bones and teeth recovered at the analysed sites.

6.5.2.1 General size of cattle

The general trends in size of cattle bones are expressed by log ratios; the methodology for this analysis is described in section 5.4. Values of log ratios for postcranial elements were broken down into lengths (proximal–distal aspect), widths (mediolateral aspect), and depths (anteroposterior aspect) (fig. 6.53). The lengths of bones were rather rare in most contexts, and the existing data displays little difference between sites. It is worth noting that there are two unusually large bones from Chełm (at .08 value); bones this size are not evidenced at other sites. Widths and depths are more diverse. The oldest specimens which come from Prague Staronová (11th–12th c.) have the smallest widths and depths. The size does not simply increase with time. Specimens from Wrocław, periods B to D (late 13th–early 15th c.) seem to follow the same pattern as at close-by Lelów in period A (14th–16th c.). The assemblage from Lelów period A has similar bone measurements to the assemblage from period B (17th–18th c.). There is a sharp difference in the distribution of the measurements: the period A distribution is skewed right, whilst the period B has a normal distribution. This difference is present only for widths and depths, not lengths, suggesting that, compared to period B, in period A at Lelów there is a bias towards individuals of slender limbs, possibly females or castrates. Specimens from Chełm are wider and deeper than at Lelów, despite similar chronology (phase 1, 15th–17th c.; phase 2, 17th–18th c.). The difference exists in overall distribution and in the means. Both phases at Chełm also slightly differ: animals in later times generally have wider bones. The presence of the above-mentioned unusually large individuals may suggest that in phase 2 at Chełm animals had limbs more robust, and generally larger than a couple centuries earlier. The widest and deepest limb bones were recorded at Prague Libeň, which also is one of the youngest analysed sites (16th–18th c.). This population probably was the largest with the most robust limbs, and serves a good example of the large increase in size between the medieval (i.e. above-mentioned Staronová) and modern age cattle.

To have further insights into cattle size patterns I used dental biometry. Tooth measurements are resilient to environmental change, very little dependant on age, and probably only slightly affected by sex (Degerbøl, 1963; Albarella, 2002). Hence, they constitute a good tool in the research of population changes. The measurements of the width of mandibular M3 are presented in figure 6.54. The evidence suggests similarities between the populations from Chełm, Wrocław and Prague Staronová. Putting this into perspective, this size roughly correspondents to size of British late medieval cattle at Launceston Castle, which are small in the overall British regional context (Albarella and Davis, 1994a, 1996; Albarella, 1997a). The assemblage from Lelów, in period A (14th–16th century) has similar measurements, albeit much more spread out, suggesting greater diversity in the sizes of cattle. An increase in the mean of the width of teeth is noted in period B at Lelów (17th–18th c.), but the sample is small and fits in the range of the previous period. A similar size shift on a more substantial scale is expressed in the difference in between the individuals from Prague Staronová (11th–12th c.), whose molars were not as wide as those of cattle at Prague–Libeň several centuries later (16th–18th c.). This is a clear example of the increase in size between medieval and modern age cattle, similar to the increase which was evidenced for the above-mentioned Launceston Castle in the post-medieval times. Here it was probably caused by the introduction of a new population of cattle with different body type characteristics. As for Chełm, the dental data usefully complement the data from postcranial bones. The Chełm cattle, despite having more robust limbs than at Lelów, had narrower teeth. What is more, the apparent increase of size and robustness of cattle in phase 2 at Chełm does not go together with the increase of dental width. This may indicate that the improvement of cattle was local and recent, and did not affect the teeth, which tend to be more conservative. Another possibility is that

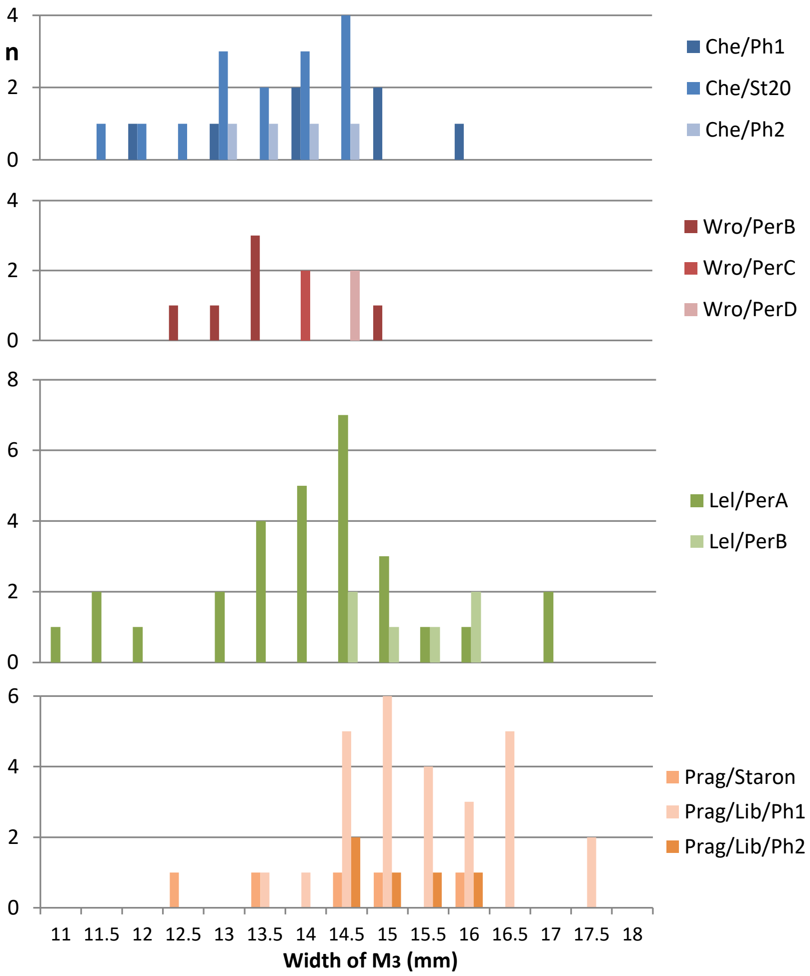

Fig. 6.54 Width of cattle third molar (key as in fig. 6.52)

the apparent size increase evidenced in bones is, in fact, caused by different sex ratios, with males being more abundant in the latter period.

6.5.2.2 Horncores

The size and shape of cattle horncores may be dependent on age, sex, and morphotypes of cattle in the past. To minimise the impact of age on the size of horncores, I utilised Armitage (1982) system of ageing based on the porosity of the bone and tried to exclude horncores that were not fully grown — that is age stages 1 and 2 — leaving only young adults and adults (3–10 years old). Unfortunately, this system is not precise and is rather subjective (cf. Sykes and Symmons, 2007; Salvagno et al., 2017). This means that some not-fully-grown horncores potentially made their way into the analysis.

Horncores represent a good indication of sex dimorphism. It was suggested that males' horncores differ from females' in shape. The latter being more circular, the former oval, and the castrates would have mixed characteristics, but longer and slenderer horns (Armitage and Clutton-Brock, 1976). In fact, visual examination of the shape was proven not to be reliable when it comes to sexing, and the analysis should be based on the measurements of the base of the core (Sykes and Symmons, 2007). Comparisons between the greatest and smallest diameter and the circumference of the base proved to provide viable results; although not without an area of overlap (Sykes and Symmons, 2007). The invaluable sexing reference data collected by Sykes and Symmons (2007) have, unfortunately, little applicability to the studied assemblages. On figure 6.55 red dashed lines mark the ranges of measurements for males, females, and the overlap area defined by Sykes and Symmons (2007). The measurements from the researched sites are smaller, which is hardly surprising given that the reference was based on long-horn nineteenth/twentieth century cattle. The local medieval and early modern cattle was a much smaller, short-horn cattle, commonly referred to as *Bos taurus brachyceros* (Lasota-Moskalewska, 1997b, p.158–159; Makowiecki, 2009, 2018). Hence, as a reference I used a large assemblage of horncores from the medieval–early modern sites in Poznań. This was measured and sexed by Makowiecki (2016c, p.255–258) (fig. 6.55).

The overall size (length and width) of horncores (fig. 6.56) shows that cattle from Wrocław, and the majority of cattle horncores from Lelów form a consistent cluster. Their size is similar to that of horncores from Poznań during the Middle Ages and early modern times (13th–16th century) (Makowiecki,

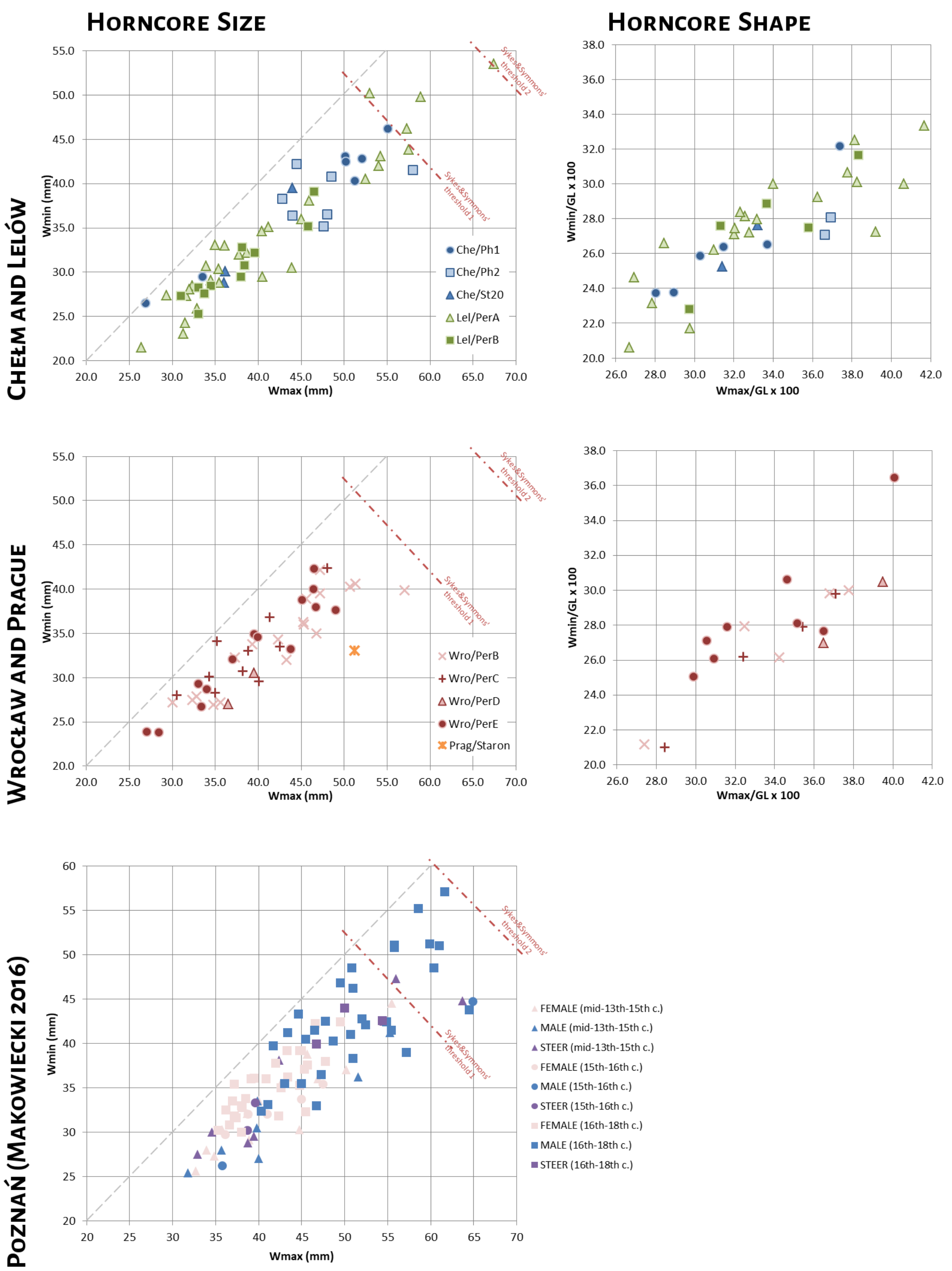

Fig. 6.55 Size of and shape of cattle horncores from the analysed sites (upper four graphs) and from the literature (Poznań: Makowiecki, 2016c). The upper four charts include only horncores from young adult and adult individuals (stages 3 and 4; 3–10 years old). The red dashed lines mark thresholds between the sexes determined by Sykes and Symmons (2007). Wmin — smallest diameter of the base of the horncore; Wmax — greatest diameter; GL — greatest length on the outer curvature. The key for the sites as in 6.52.

2016c). The assemblage from Chełm differs, as most cattle have larger horncores, whose range is similar to the latest period at Poznań (16th–18th century). Two large horncores from Lelów also fall into this range.

When the size of the base (maximum and minimum breath) is considered, the assemblages from Lelów and Chełm (fig. 6.55, topmost figures) are roughly bimodal. The juxtaposition with the reference from Poznań (the bottom graph) shows that these two groups may represent females and males. Horncores from Lelów were mostly in the smaller-size group, and also rather slender (see the upper-left graph), suggesting the predominance of females. A tail towards upper-left corner on the graph marks the presence of males, but some individuals have much larger horns. These were possibly from a different 'breed'. In Poznań, animals of horns this size have appeared in the latest period (Makowiecki, 2016c); but interestingly, these were present in Lelów earlier, in phase 1 (14th–16th c.). Chełm cattle, on the other hand, were mostly in the group of larger measurements, with a few in the smaller group. The bimodality is also visible, but the large-sized group is more abundant, suggesting the predominance of males with horns generally much longer (see fig. 6.56) than at the other sites. Most of Chełm horncores were long and rather slender, presumably meaning that most of these males were steers. Horncores from Wrocław (fig. 6.55, the middle graphs) are less variable than at Chełm, Lelów and Poznań. In general, there is little difference between phases (fig. 6.55). Sex groups are not so clearly distinguished, but in juxtaposition with other sites it appears that a bias towards females is present in periods C and D, and a more balanced ratio in periods E and B. Trends are not so evident from the shape of the horncores: the differences are small except of a few odd very robust and very slender individuals. As for Prague, only one horncore was present — it was presumably a male of different proportions than at the other sites.

In sum, the data suggests that most of the variability in shape and size of horncores is caused by sexual dimorphism. Cattle at Wrocław seem to make up a population fairly consistent in horn size, metrically similar to the late medieval reference, with a slight bias towards females. Lelów cattle are more diverse in horn size and shape, suggesting a mixing of populations: most animals are of a similar type to those from Wrocław and Poznań, but some from period A have much larger horncores. The bias towards smaller horns suggests a strong predominance of females. Lastly, Chełm cattle seem to be of a different kind with larger, although not bulkier, horns; it is similar in size to the population from

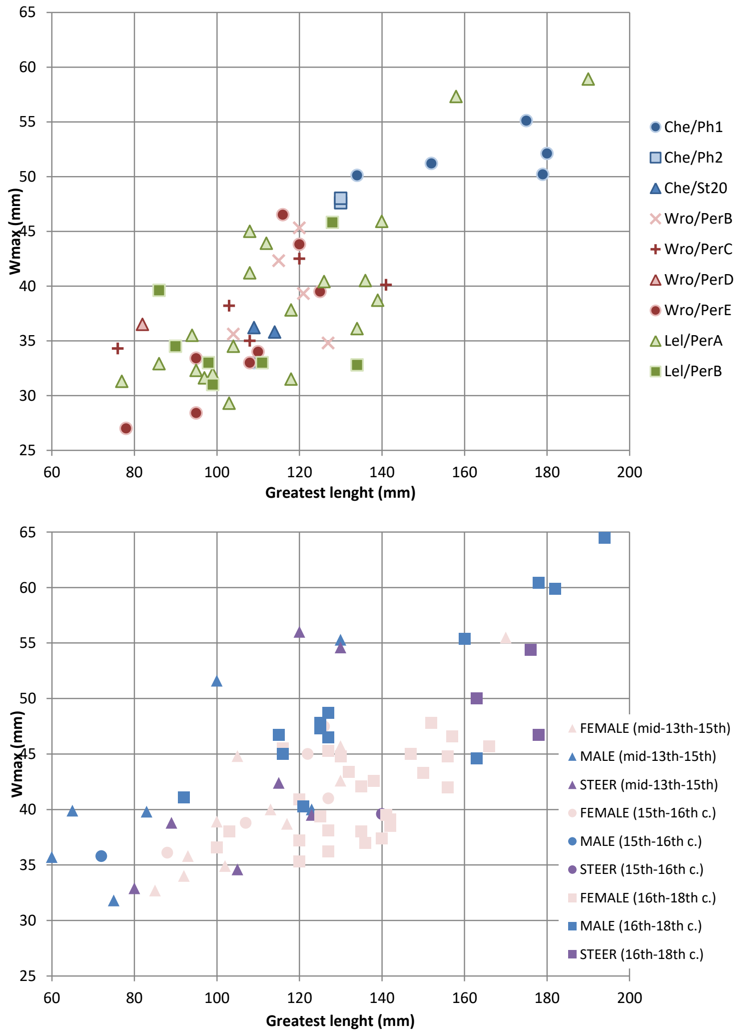

Fig. 6.56 Size of cattle horncores (the greatest diameter, and the greatest length) from the analysed sites (upper graph) compared to size of horncores of determined sex from Poznań (lower graph; from Makowiecki, 2016c). The key for the sites as in figure 6.52

the early modern age cattle from the reference. Males seem to predominate, but these presumably are mostly steers.

6.5.2.3 Metapodials and astragali

The size and shape of metapodials — metacarpals little more so than metatarsals — can be successfully used for sexing (Grigson, 1982, and references therein). Metapodials have a tendency to be short and slender in females, short and wide in males, and long and slender in castrates. However, it has also been demonstrated that another factor influencing the size and shape of metapodials is the morphotype, or 'breed', of the animal (e.g Albarella, 1997a).

The assemblage from Lelów had an unusually large portion of unbroken cattle metapodials: the greatest length was taken on 60 metacarpals and 74 metatarsals. Unfortunately, other sites yielded much scarcer data: only 11 bones at Chełm and one at Wrocław. Potentially, the studied assemblage was shaped by both sex dimorphism [1] and the presence of different morphotypes.

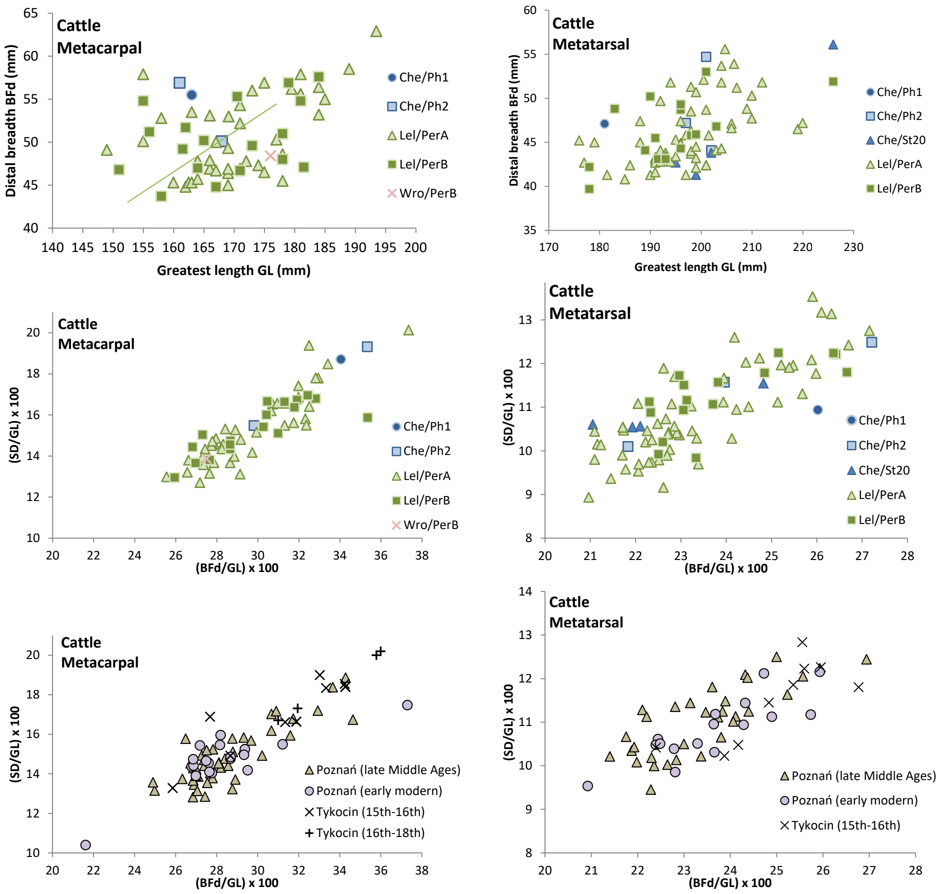

Fig. 6.57 Size and shape of cattle metacarpals (on the left-hand side graphs) and metatarsals (right-hand side graphs). The first row of graphs show size and the second row show shape in the analysed assemblages. The third row of graphs show size of metapodials from the reference sites: Tykocin Castle — from Gręzak (2015, tables 12–21), and collective data from several sites at Poznań from Makowiecki (2016c, p.262–263 and 270–271). The key for the sites as in 6.52.

When the size of metapodials is considered there are little differences between the sites (fig. 6.57, uppermost graphs). Metacarpals seem to split into groups which differ mostly in breadth, which is seen roughly for all contexts. Metatarsals do not have clear clusters, but the size range from period A at Lelów is much larger than for period B. The latter group seems to generally be missing the largest individuals, which are present in the former group.

[1] even polymorphism, if steers are considered (cf. Albarella, 2002)

The shape of metapodials seems to be more patterned than their size (fig. 6.57, graphs in the middle). Metacarpals are very proportionate in the shape of the shaft and distal epiphysis and the trend is very linear. Two main clusters are present for Lelów. The group of the slender ones is more abundant than the group of the robust ones in period A, whilst the opposite seems to hold true for period B. What is more, the group from period A seems to be more spread out. Similar clusters are present in the reference data (fig. 6.57, bottom graphs) from Poznań (Makowiecki, 2016c) and Tykocin Castle (Gręzak, 2015), albeit bones in the cluster of more robust specimens are much more abundant than at those sites. Specimens from Chełm are much scarcer, and whilst they potentially also cluster into two groups, both would be more robust than their counterparts from Lelów. Taken into the consideration that the measurements of metacarpals tend to be sex-dependant, these two clusters may represent the sexes: the slender for females and the robust for males.

To pursue this further, I have compared the shape of the shaft against the length of metapodials (fig. 6.58, upper two graphs). I used the site of Tum in Central Poland less than 200 kilometres from Lelów as a reference. The data here is abundant and neatly aligns into clusters which were interpreted as bulls, cows, and steers (Makowiecki, 2014). I applied ranges of those clusters from Tum in the background of the data from the sites under scrutiny (the coloured shades) to determine whether similar clusters are present on the plot. The measurements of metapodials from Tum are generally of a comparable size to the studied assemblage. My data does not display clusters so well defined, but metacarpals from Lelów plotted on figure 6.58 for period A would mostly represent cows, about twice as numerous as the steers and almost four times as numerous as the bulls. In period B, on the other hand, the proportion of three groups would be almost balanced. The data for metatarsals seems to differ: the steers' cluster is less well-defined, and bulls seem to be more abundant than suggested by the metacarpal graph. Metatarsals tend to be less sex-dependant than metacarpals, and, as it was mentioned above, may also reflect 'breeds'. To support this analysis with even further evidence, I used the index $(4.7 \times BFd) - GL$, which was able to successfully differentiate between sexes of Portuguese cattle (Davis et al., 2018). This method (fig. 6.58, bottom graph) shows bimodality of the assemblage, and, comparing to the previous method, suggests more balanced ratio between females and males, with a slight preference towards the former.

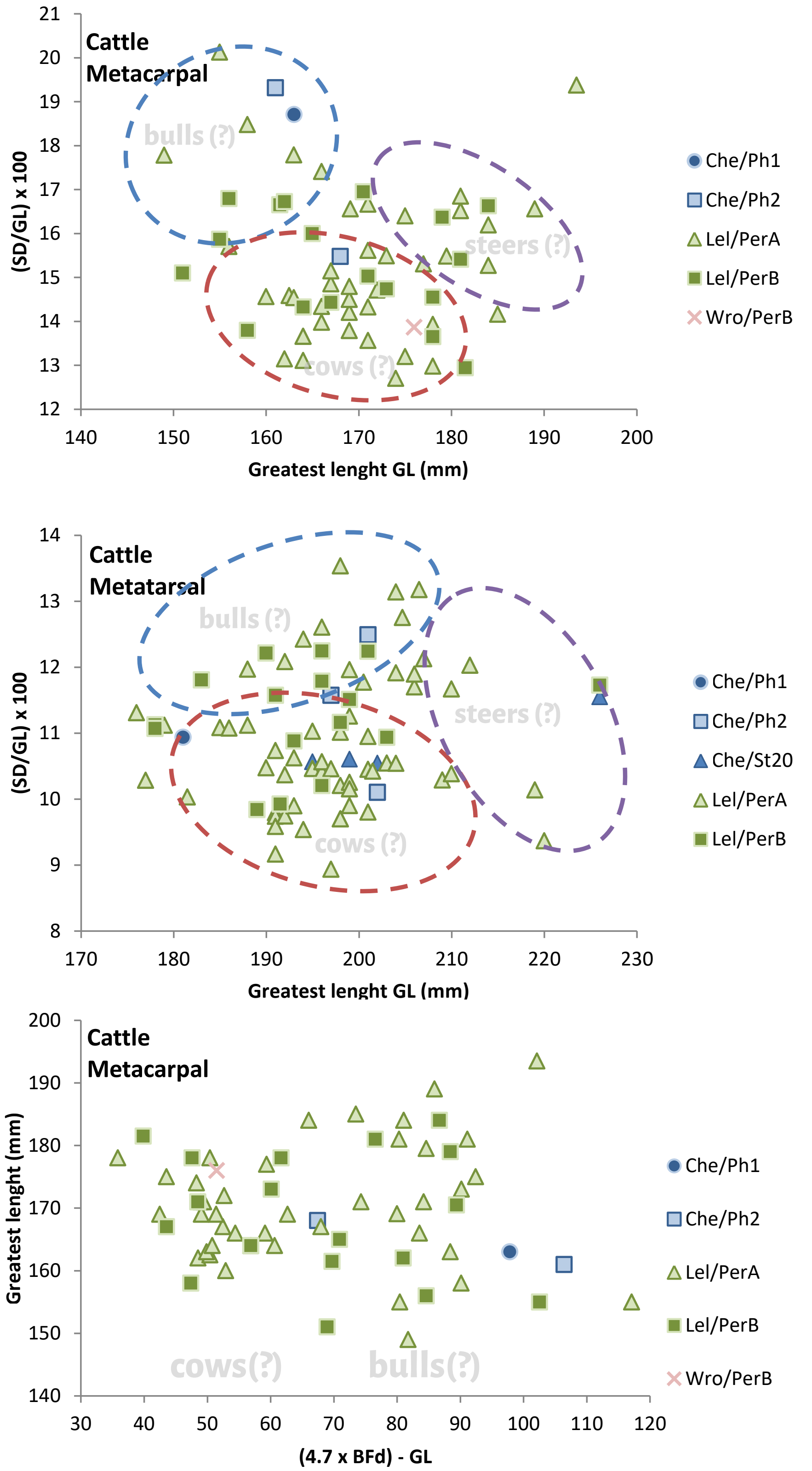

Fig. 6.58 Cattle metapodials; sex determination. Areas enclosed in dash lines on the upper two graphs mark ranges of measurements for particular sexes based on Makowiecki (2014). The third graph is based on Davis et al. (2018)

Let us return to the metatarsal plot on fig. 6.57. The shape of metatarsals shows very different trends than for metacarpals. The shaft and distal epiphysis are not as proportional as for metacarpals, which results in a larger spread. The plot does roughly split into two clusters, but they are not nearly as well defined as for metacarpals. The slender group dominate over the robust at every site and period.

There is a general trend seen: metatarsals from period A at Lelów have a larger spread of shapes. Also, specimens from period B at Lelów tend to have broader shafts (i.e. larger $SD \div GL \times 100$ values) than bones from Lelów, period A. This difference between the two periods at Lelów is subtle, but may suggest increasing robustness of bones over time. An analogous discrepancy, albeit much more pronounced, was evidenced at Launceston Castle Albarella (1997a). The difference there was due to the presence of different 'breeds' of cattle; possibly for Lelów this means also an improvement or some changes in the morphotypes of the population. Moreover, there is a difference between the shapes of metatarsals from Poznań, in the Western Poland (Makowiecki, 2016c), and Tykocin, in the North–Eastern Poland (Gręzak, 2015). This difference is reflected in the shape of the distal epiphyses, not so much in shafts, with Tykocin metatarsals being more robust. This is possibly a difference in morphotypes of cattle. Unsurprisingly, the Lelów cattle are more similar to Poznań, which is closer geographically than Tykocin.

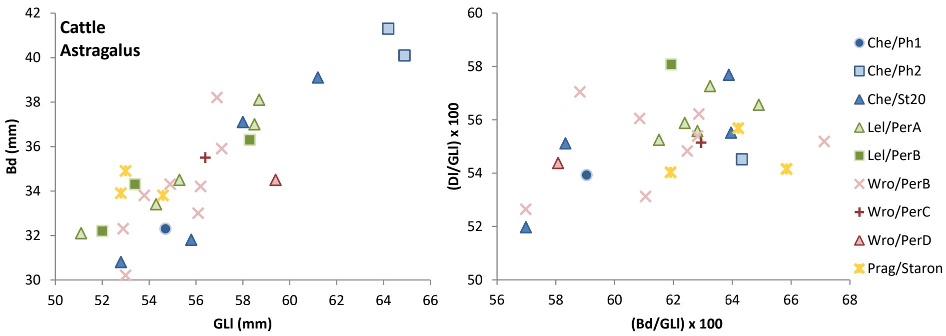

Fig. 6.59 Size and shape of cattle astragalus. The key for the sites as in 6.52

As for the astragali, no substantial changes in size are evident for most of the periods at the studied sites (fig. 6.59). The size range roughly corresponds to size of cattle astragali from medieval and late medieval Britain, and is smaller than from post-medieval Cornwall (Albarella and Davis, 1994a, 1996). The measurements are clustered, with a possible bimodal distribution at Lelów and structure 20 at Chełm. At Staronová they line up with the smaller cluster from other sites; and Wrocław shows a unified distribution. These differences are, however, rather minute. Only some measurements from phase 2 at Chełm seem to stand out, being much larger than at other sites. Slight bimodality is also outlined for the shape of astragali, but only in Bd/GLl plane for the measurements from Chełm, and Wrocław.

6.5.3 Caprine biometry

Measurements were taken from a total of 1557 bones of sheep and goat. The measurements of teeth, astragali, and goat metapodials were too few to show meaningful differences between contexts. Therefore, they will not be discussed.

6.5.3.1 General size

The general patterns of size of sheep and goat are presented through log ratios (fig. 6.60). The standard for this analysis was taken from Shetland sheep (Davis 1996b). A total of 881 measurements or limb bones are included in the analysis, 67% of which are sheep, 20% are goat and 13% are sheep/goat. Samples for Chełm, Lelów, and Prague are not divided into phases due to the paucity of the data. There is little difference between lengths of bones at different sites, but all are generally longer than the Shetland sheep standard. This is expected, given that the standard is determined from females: a population of mixed sexes will move up the mean. The widths and depths generally have a similar range as the standard but some differences between contexts emerge. Populations from Lelów and Prague seem to be similar in the width and depth of bones. Although the one from Prague is slightly skewed on the right, which may suggest a larger number of males. The Chełm population has wider and deeper limbs, with a larger range of sizes. At Wrocław, it is possible to trace some changes throughout time. Starting with period A (before 1250 ce) there is a decline in size of caprines in the fourteenth century (period C, and partly B and D). There seems to be an improvement from the fifteenth century to the early modern era (period E). Caprines in this period were larger and more robust.

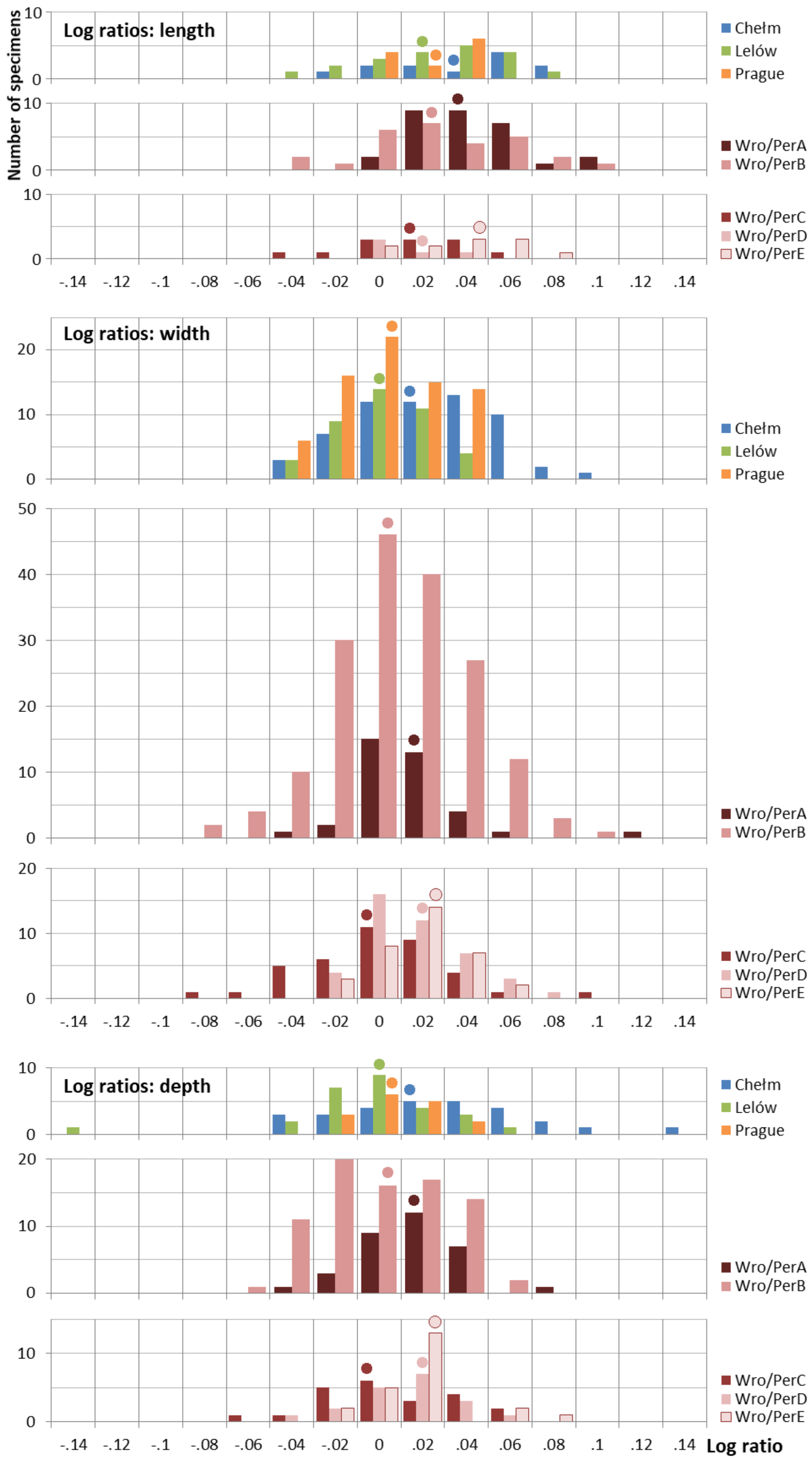

Fig. 6.60 Log ratios for caprine postcranial bones. Dots mark sites' mean. The methodology is described in 5.4. The standard is based on Davis (1996, table 2)

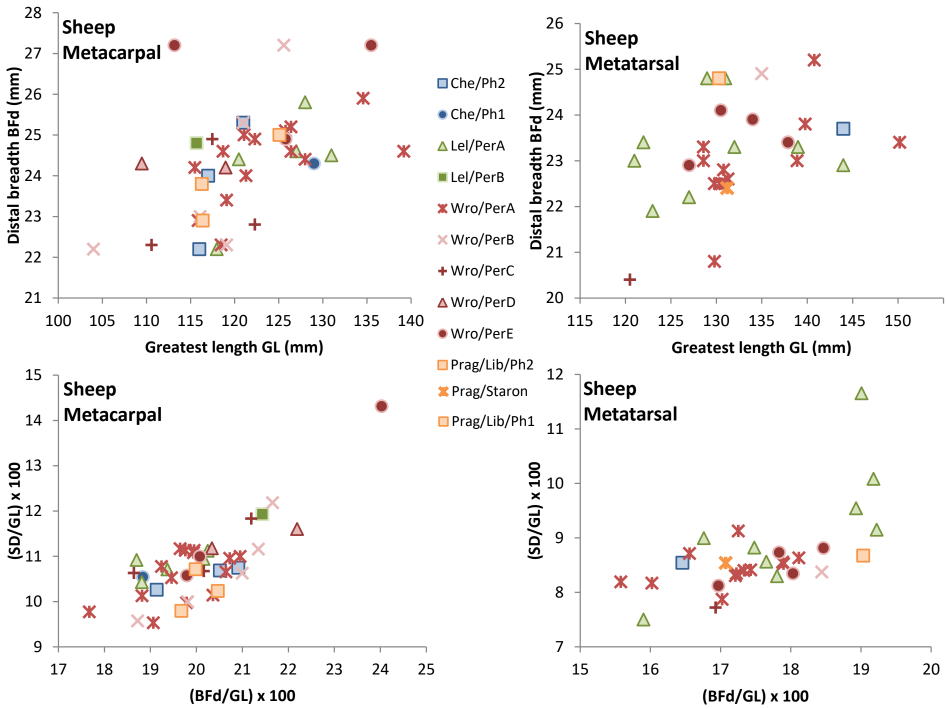

Fig. 6.61 Size and shape of sheep metapodials. The key for the sites as in 6.52

6.5.3.2 Sheep metapodials

No distinct patterns are present in the size and shape of sheep metapodials (fig. 6.61), but the sample is not large. However, some observations can still be made. Large and robust individuals are present in period E at Wrocław, which is consistent with the evidence obtained by the log ratio analysis. Metatarsals from Lelów display a potential sex-related bimodality in shape: the presence of the group of more robust specimens on the right-hand side probably represent the males. Their absence from the metacarpal plot probably due to small sample size.

6.5.3.3 Sheep horncores

Sex distinction of sheep horncores is possible on morphological basis. In rams, horns are D–shaped, or even ∆–shaped in section, with rounded anterior edge and broader posterior edge; in ewes, horns have sharp keel-shaped edges and are flattened medio-laterally (Clutton-Brock et al., 1990; Salvagno, 2015, p.45). Female horncores tend to be also less robust and shorter. I applied these morphological criteria to horncores from the analysed sites. Figure 6.62 shows size difference between horncores identified as having female characteristics and those with male characteristics. The measurements, especially the widths of the base of the horncore, show a clear bimodality. This is presumably associated to sexual dimorphism. The morphological characteristics of the sexes generally correspond with the size groups. Several specimens of the larger size were identified as female based on their morphology. Given the very clear bimodality of the measurements, these seem to be males with a slightly unusual shape.

There is no evidence of size and shape differences between sites and contexts (fig. 6.63). The bimodality is clearly seen, and is most provably caused by sexual dimorphism. The cluster of presumable male specimens is much larger than the female one in all contexts which yielded more substantial findings — that is at Lelów and Chełm. This may suggest a rather large overrepresentation of males compared to females at those sites. This may not, however, be a proxy for the whole ovine population of those sites. Horns, when used as craft material,

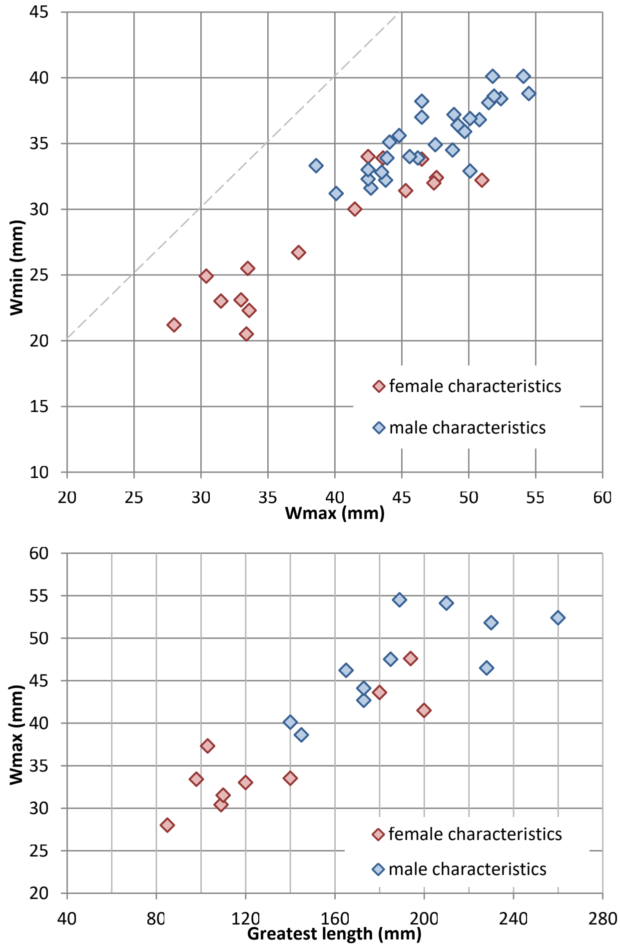

Fig. 6.62 Size of sheep horncores from the analysed sites divided into sex groups determined on the morphological basis

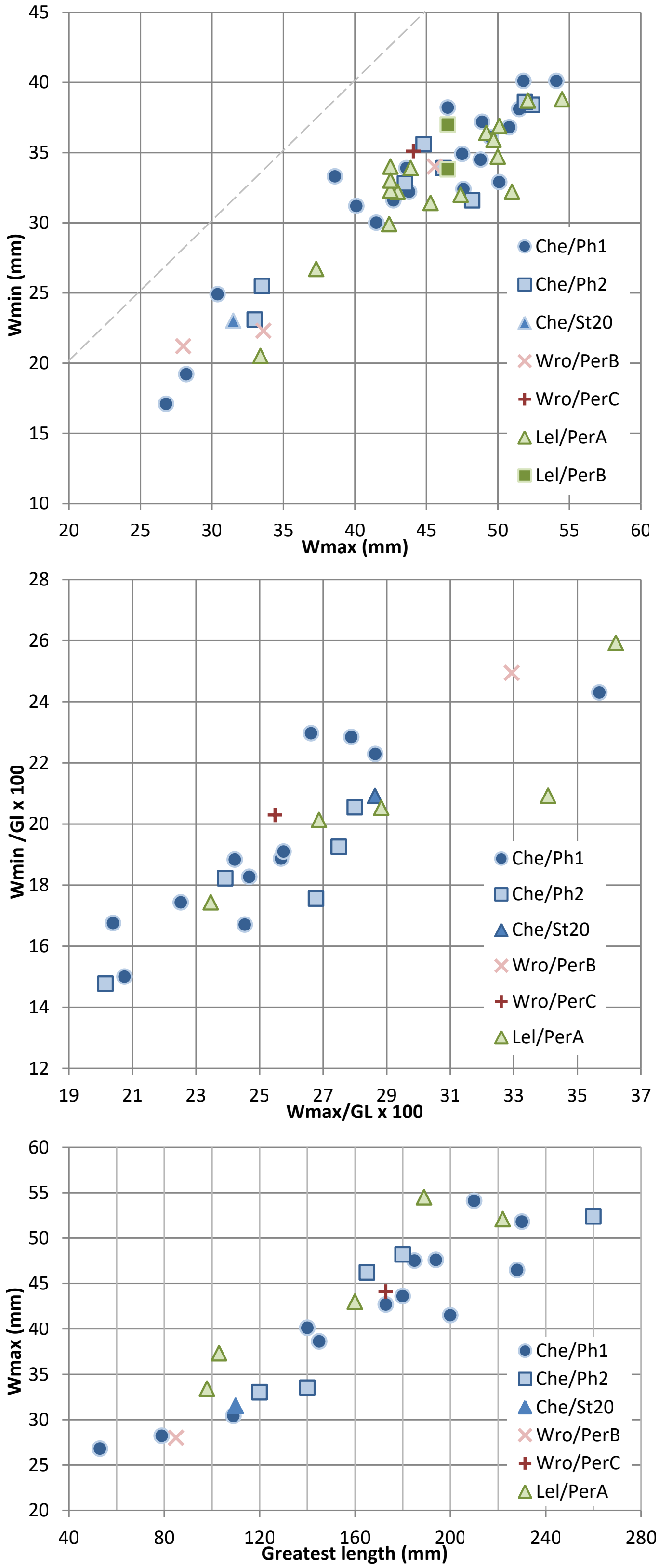

Fig. 6.63 Size and shape of sheep horncores from the analysed sites. The key for the sites as in 6.52

are preferred to be larger and consequently derive mostly from males. Another explanation is that ewes on the researched sites were polled naturally. The presence of horns in rams only is a characteristic for an old, rather primitive, Polish breed called the Heath sheep (Pol. *Wrzosówka*), and for the common Polish Merino breed, which was bred in Poland as early as in the eighteenth century (Załuska and Załuska, 1985, p.339).

6.5.3.4 Goat horncores

The size and shape of goat horncore depends, among other things, on sex (Lasota-Moskalewska et al., 1991). Some of the morphological features argued to be sex dependant are: the presence of the frontal tuber in males, the cross-section of the base of the core (D–shaped, or similar to a rounded triangle in females, and ellipsoidal-shaped in males), and twisting in the overall shape (Kobryń et al., 1991). In many modern breeds only males have twisted horns, whilst the females have scimitar-shaped horns (Porter et al., 2016, p.351). This feature was also evidenced in the medieval goats. Kobryń et al. (1991) noted that in their assemblage, with some exceptions, the females had scimitar shape of the horncore. Meanwhile, both shapes were recorded in males, although the twisted form was twice as frequent as the scimitar-shaped. There was no difference between the measurements of the circumference of twisted and scimitar horncores, but the scimitar ones tend to be a little shorter (Kobryń et al., 1991). There was a clear sexual dimorphism in the size of the base of the horncore with males being larger than females with a very little area of the overlap. The overlap was, however, larger for the length of the horncore of males and females.

In the analysed assemblages 267 goat horncores were measured, and in this number the length of the outer margin was recorded for as many as 170 specimens (fig. 6.64). There seems to be a clear difference between male and female goats present (fig. 6.65). The bimodality is seen in the measurements of the base of the horncore, which largely line up with morphological identifications of the shape of the cross-section (D–shaped for females and ellipsoidal for males). The length has great areas of overlapping between sexes. Twisting seems to be found mainly in males, although a number of specimens of the D–shaped section and female dimensions possessed twisted appearance. In general, this method seems to be reasonably reliable for sexing in this particular case.

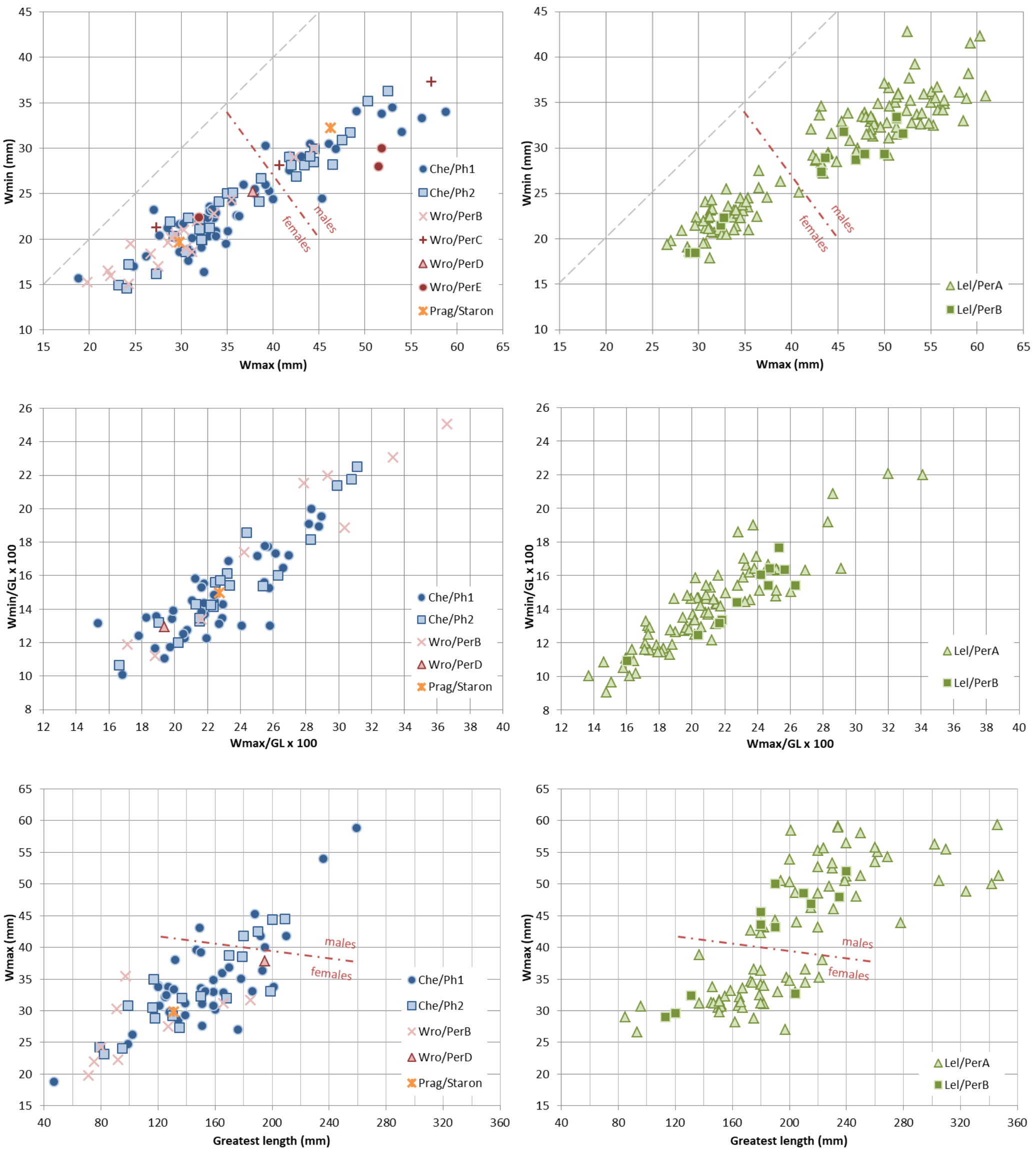

Fig. 6.64 Size and shape of goat horncores from the analysed sites. The key for the sites as in figure 6.52

The study of measurements of goat horncores unravels some patterns (fig. 6.64). Clear bimodality of data is present for all the sites, when widths are considered (uppermost graphs). Both lengths and width measurements show that the population from Lelów has the largest horncores. In Lelów, period A displays a wider spread of the measurements than period B. Specimens from Chełm, in general, are smaller and rarely reach the size of the Lelów population. The specimens from Wrocław, especially in period B, were the smallest. The cohorts from particular sites also differ in the shape of the horncore (fig. 6.64, the middle graphs). The Lelów horncores are slenderer than those from Chełm; the Wrocław specimens are the most robust. The combination of data of size

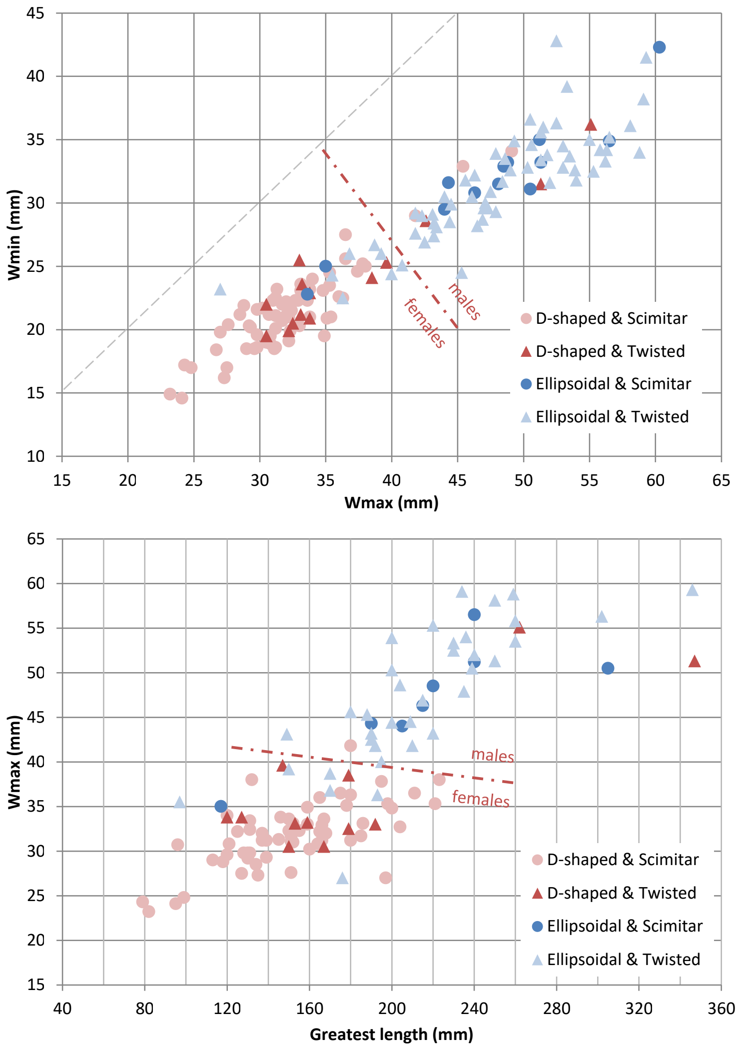

Fig. 6.65 Size of goat horncores from the analysed sites divided into sex groups determined on the morphological basis

and shape suggests that some of the differences between the sites may be caused by age. Short and robust horncores are typical for individuals whose horns are still growing, whilst long and slender horncores are more typical of adults. If this is indeed case, it would follow that the Wrocław goats would be culled the youngest, and Lelów the oldest. However, if that would be the principal reason behind the size change, the bimodality would not be as clear it is. Hence, the evidence suggests that populations from Lelów and Chełm differ, with Lelów having a population of larger but slender horns and Chełm a population of smaller and more robust horns.

Lasota-Moskalewska et al. (1991) and Swieżynski et al. (1992) remark the presence of two forms, smaller and larger goats, in assemblages in Poland and surrounding areas. They differ in withers height, and, possibly, in the horncore length, but the latter was not directly evidenced (Kobryń et al., 1991). Consequently, it is not clear whether the two forms evidenced in Lelów and Chełm correspond with two forms distinguished in the above-mentioned papers. What is more, it is clear that the presence of scimitar or twisted horncores is indicative of sexual dimorphism. This trait is not ubiquitous for all breeds. Only some modern goat breeds are characterised by a twisted shape of horns in males and scimitar in females, one of which is the Carpathian breed known to be locally present in the nineteenth century (Sikora and Kawęcka, 2015, p.6).

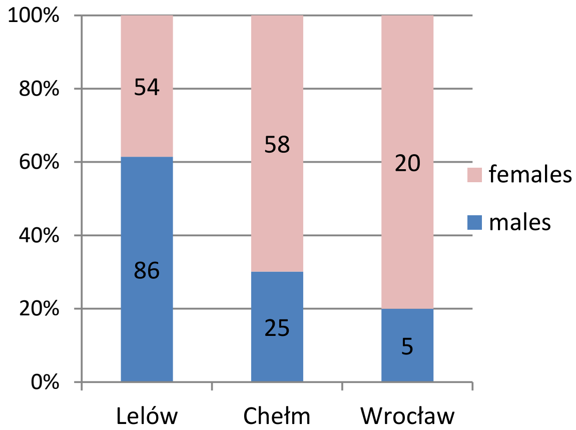

Fig. 6.66 Sex ratio of goats based on the widths of horncore base (see fig. 6.65)

Another difference is the sex ratio at different sites (fig. 6.66). At Lelów, males predominate, constituting approximately 60% of the assemblage. At Chełm they only make up 30% of the goats, and at Wrocław 20%. The difference may be caused by different reasons behind goat breeding. Males may be desired in the meat-oriented economy due to their larger size, whereas females would prevail in milk-oriented economy.

6.5.4 Pig biometry

Measurements for pig are scarce due to the overall paucity of the bones of this animal. Measurable material was recorded only at Chełm (mainly from phase 2), Lelów (mainly from period A), and Wrocław (mainly from period B). To detect the presence of wild boars I used measurements of the third molar. This is the most commonly used element in this kind of distinction (Albarella, 2002). The widths of molars were evidenced to display the smallest age and sex variability therefore are one of the best indicators of domestication (Payne and Bull 1988). In the analysed assemblage, a cluster of measurements of width (WA) of the third molar show the presence of a group of domestic pigs (fig. 6.67). No significant differences occur between the sites (paired–samples t–tests, $p > 0.05$). A presence of a sole individual of the wild boar is evidenced for period B at Wrocław.

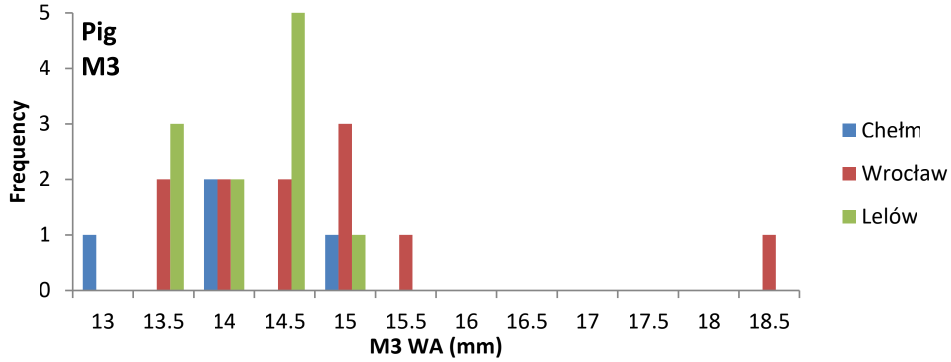

Fig. 6.67 Width of pig third molar (key as in figure 6.52)

The postcranial skeleton, especially the forelimbs, may show much more sex and age variability in pig (Payne and Bull, 1988). The measurements of distal humerus width (BT) against the diameter of trochlear constriction (HTC) reveal a slight difference between the populations of Lelów and Wrocław (fig. 6.68). The sample size is small, and this discrepancy is not statistically significant (paired–samples t–test). A single specimen from period C at Wrocław has much larger size and presumably derives from the wild boar.

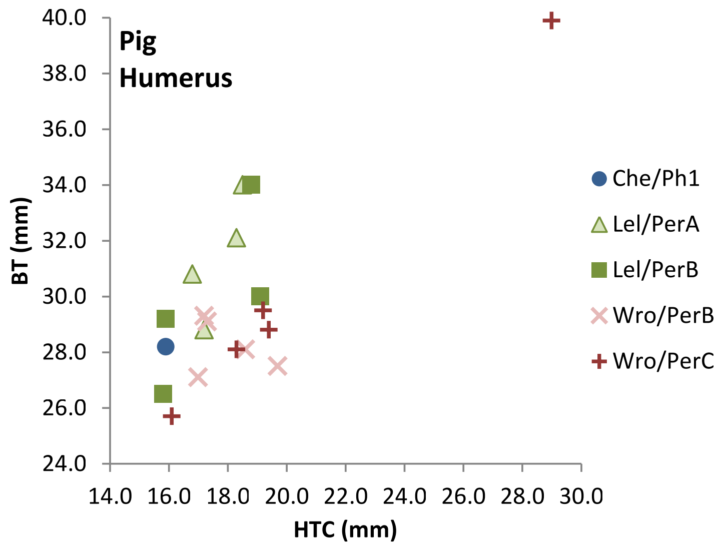

Fig. 6.68 Pig distal humerus measurements (key as in figure 6.52)

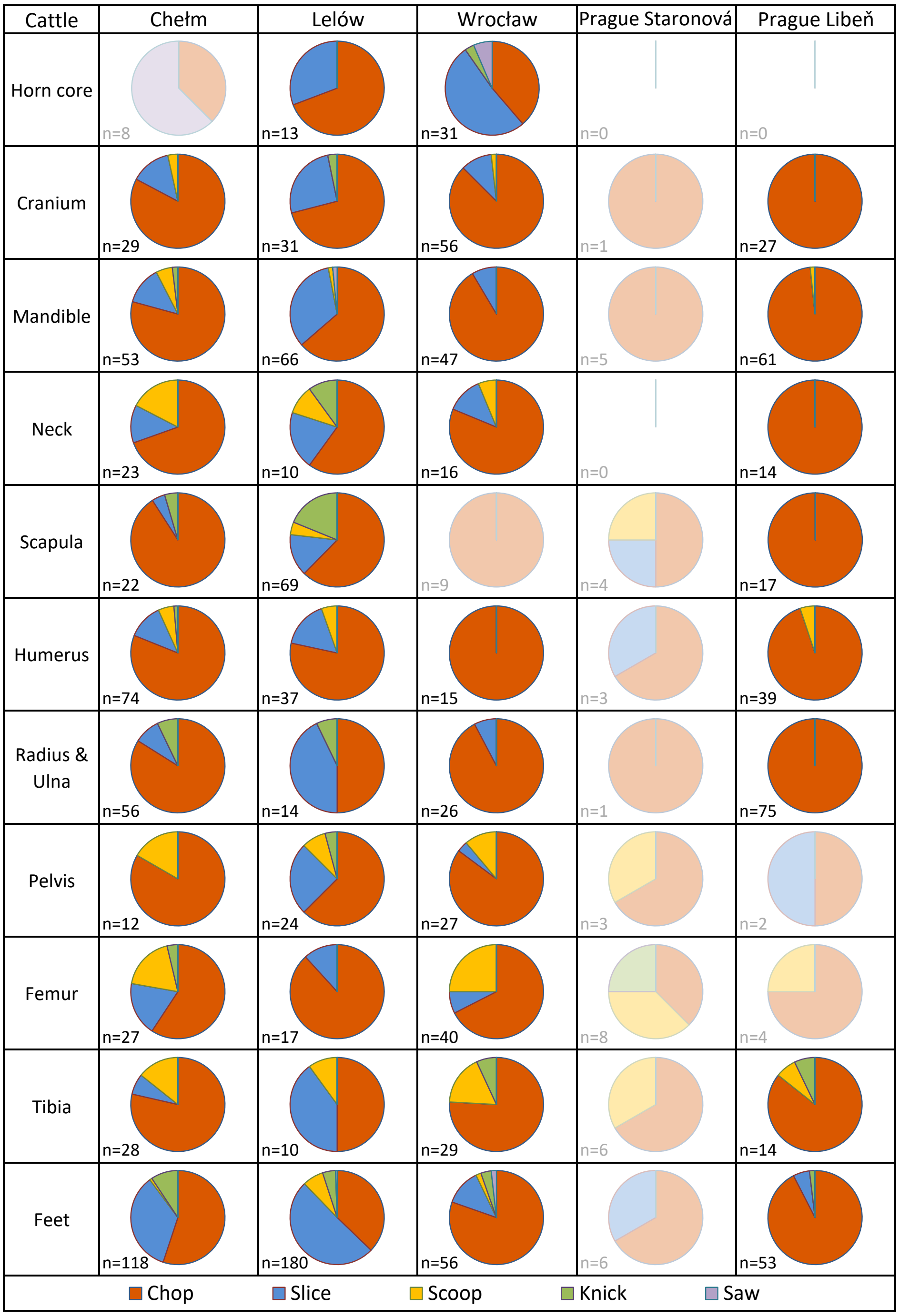

Fig. 6.69 Incidence of different type of butchery marks on cattle. The methodology of quantification is described in section 5.6.3

6.6 Butchery and meat processing

In the following section I will describe butchery patterns inferred from marks on bones from the studied sites with the main focus on two kosher taxa — cattle and caprines — predominant in the analyses assemblages. I decided that the distinction between butchery of sheep and goat, despite its possible relevance, will not be presented here due to the paucity of data for those species when discussed separately. What is more, the species share a relatively similar body type, which makes the presence of substantial differences in the way those two species were butchered rather unlikely. In this section I will commonly refer to the *porging pattern*, which will be described in detail in the next chapter.

Assemblages from some archaeological contexts discussed in this section were too small to meaningfully represent data. I have set the threshold to 10 bones, and smaller assemblages will generally not be discussed. These are being shown in the figures in faded out colour.

6.6.1 Cattle butchery

Butchery marks are relatively common at the studied sites. In a style typical for the late historic urban butchery, processing of cattle carcass heavily depended on chopping tools which in turn left a significant predominance of chopping marks comparing to other types of marks (fig. 6.69). The most common butchery activity recorded on bones was splitting/breaking of bones with a chopping tool; a result of the late stages of carcass processing, such as division of meat cuts, pot-sizing, or marrow extraction. Specific patterns of butchery are present on cattle bones from different sites (fig. 6.70). These will be described in detail below.

6.6.1.1 Chełm

On cattle bones from Chełm, butchery marks can be seen on 44% of the specimens (fig. 6.71). They are most commonly present on the upper sections of hindlimbs (ca. 60–70% of bones, depending on the context) and forelimbs (ca. 60–80%), but are less common on cranial skeleton and feet (ca. 30–40%). The majority of the modifications were made by chopping tools, while the use of cutting implements generally constitutes up to a one-fourth of the butchery marks (fig. 6.69). The exceptions to this are feet, with a significant portion of slicing and knick marks, and bones of the hindlimb and neck which had a larger incidence of scraping/scoop marks. In both phases the general pattern of cattle butchery activities is similar: splitting/pot-sizing of bones predominates and disarticulation is also common (fig. 6.71). In general, phases 1 and 2 seem to

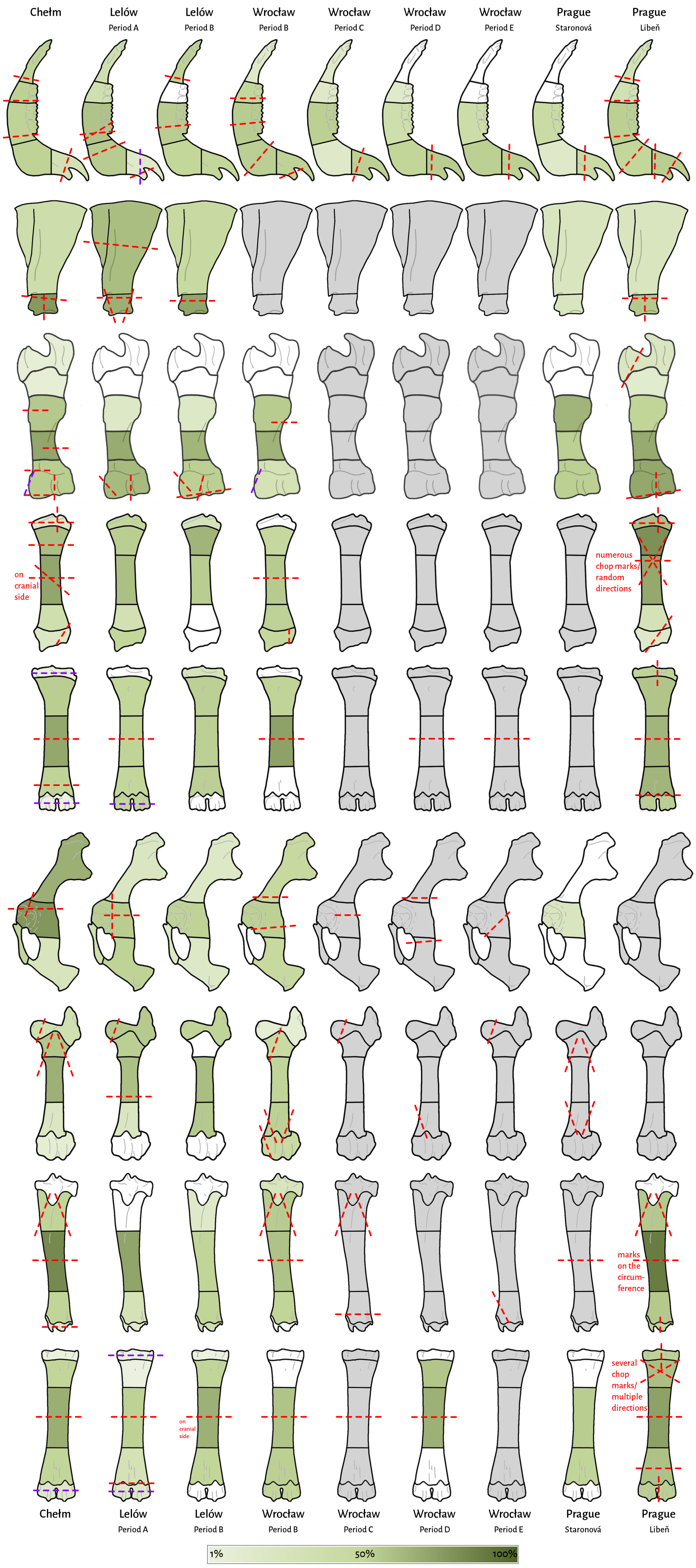

Fig. 6.70 Cattle. Distribution of fresh-bone fractures (shades of green), patterns of chop marks (red dashed lines), and patterns of slice marks connected to disarticulation (purple dashed lines). The first is a percent of specimens of particular zone which were broken while fresh (% of total NISP); white represents the absence of fractures and the darker colour means more fractures in the assemblage (assemblages with fewer than 10 specimens marked in grey). Patterns of chop and slice marks are indicated by dashed lines recorded when marks of similar characteristics (location and direction) occurred on a substantial portion of the assemblage (at least several instances)

show little differences in butchery, but the patterns at structure 20 differ from those two assemblages (fig. 6.71).

Skinning and horn removal. The most conspicuous difference between the two phases at Chełm is the presence of traces of the initial stage of butchery. Skinning and horn removal is more copious on bovine heads and feet in phase 2 than in phase 1 (fig. 6.71). Traces of horn removal were present on horncores from phase 2, all of them were sawn off the cranium, indicating the importance of horn sheaths for horn-working. The evidence of this kind of practice was absent from phase 1. What is more, skinning, although present on skulls in both phases, was common on feet from phase 2 but absent in phase 1 (fig. 6.71). This suggests that the initial stage of butchery had slightly changed with time; possibly with more attention given in phase 2 to careful harvesting of the skin and horn, which could have left more marks on bones.

Disarticulation of the carcass left frequent traces on forelimbs and feet, and to a lesser extent, heads and hindlimbs (fig. 6.71). The difference between phases 1 and 2 is small, but disarticulation in structure 20 is much more common on forelimbs and less frequent on hindlimbs than in the other two assemblages (fig. 6.71). However, the proportions may be affected by the smaller size of the structure 20 assemblage. Disarticulation by chopping was a few times more frequent than by cutting on upper limb bones (see hatching patterns on the red — disarticulation — part of the chart on fig. 6.71). Chopping through elbow and hip joints left a common pattern on bones (see fig. 6.70). In contrast, knives seem to have been used more frequently to remove heads, and are reflected by a pattern of cutting apart the carpal and the fetlock joints (fig. 6.70).

Filleting was sporadically present on mandibles, cervicals, and upper limb bones (fig. 6.71). Notably, rather few knife marks were left on the scapula (fig. 6.69) — a bone which often receives much attention by the butchers. The scarcity of those marks suggests that boning was mostly performed in a way which did not nick the bone.

Porging has been recorded in both phases on femora and tibiae (fig. 6.71). This includes the pattern of removed epiphyses (see fig. 6.70) and the increased number of scraping/scoop marks (fig. 6.69). Signs of porging were absent in structure 20.

Bone breaking. The most common butchery activity reflected in cattle bones from Chełm was the splitting of bones. Many long bones (except femora) were

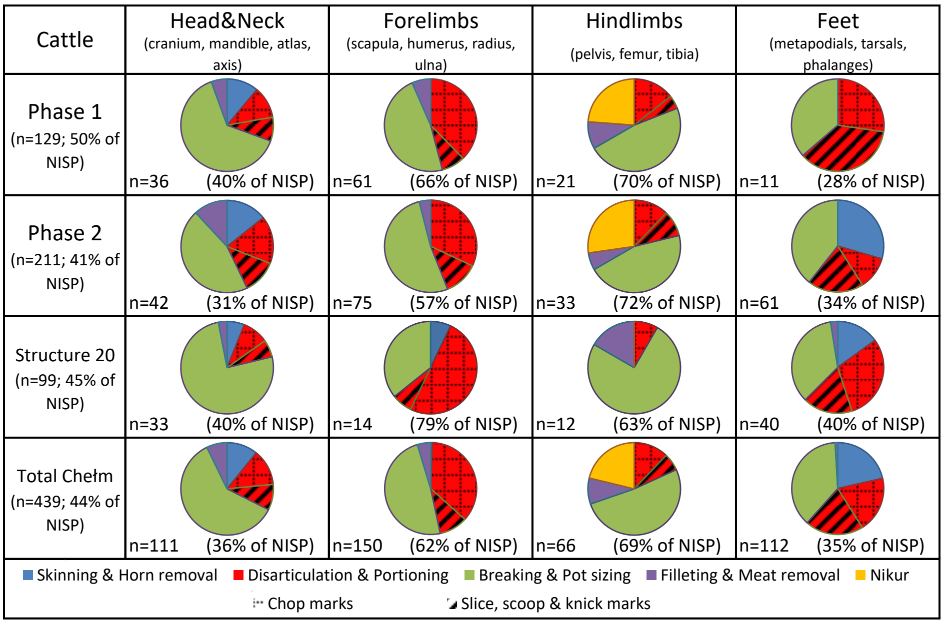

Fig. 6.71 Chełm. Incidence of different types of butchery activities on cattle bones. Activities are represented by different colours. Additionally, for disarticulation, cross hatching indicates disarticulation done by chopping, and diagonal hatching by cutting. The methodology of quantification is described in section 5.6.3

commonly split in a crosswise direction to divide the cuts, as well as harvest marrow (fig. 6.70). This action left a pattern of chop marks and increased frequency of fragmentation on the mid-shaft. Additionally, long bones of the forelimb and mandibles were often split into segments, or pot-sized. Sometimes, even more intense processing ensued: many radii, humeri, scapulae and crania — notably, not the bones of hindlimbs — were chopped in random directions into small pieces (fig. 6.70). These traces suggest the practice of extracting grease from those bones (Rixson, 1989), possibly for soup (Mensch, 1974). Femora generally had traces of epiphyses removed during porging and were not chopped transversely or pot-sized.

6.6.1.2 Wrocław

Butchery marks were recorded on 38% of cattle bones from Wrocław (fig. 6.72). They are present commonly on the upper section of hindlimbs (on ca. 60–70 % of the bones, depending on the context), and forelimbs (40–60%), while feet have generally a lower incidence of marks (ca. 30%) (fig. 6.72). The head region shows substantial differences between periods; it is commonly butchered in period B but the incidence decreases in the later periods. The majority of recorded marks are chop marks, constituting about three-fourths of all recorded marks

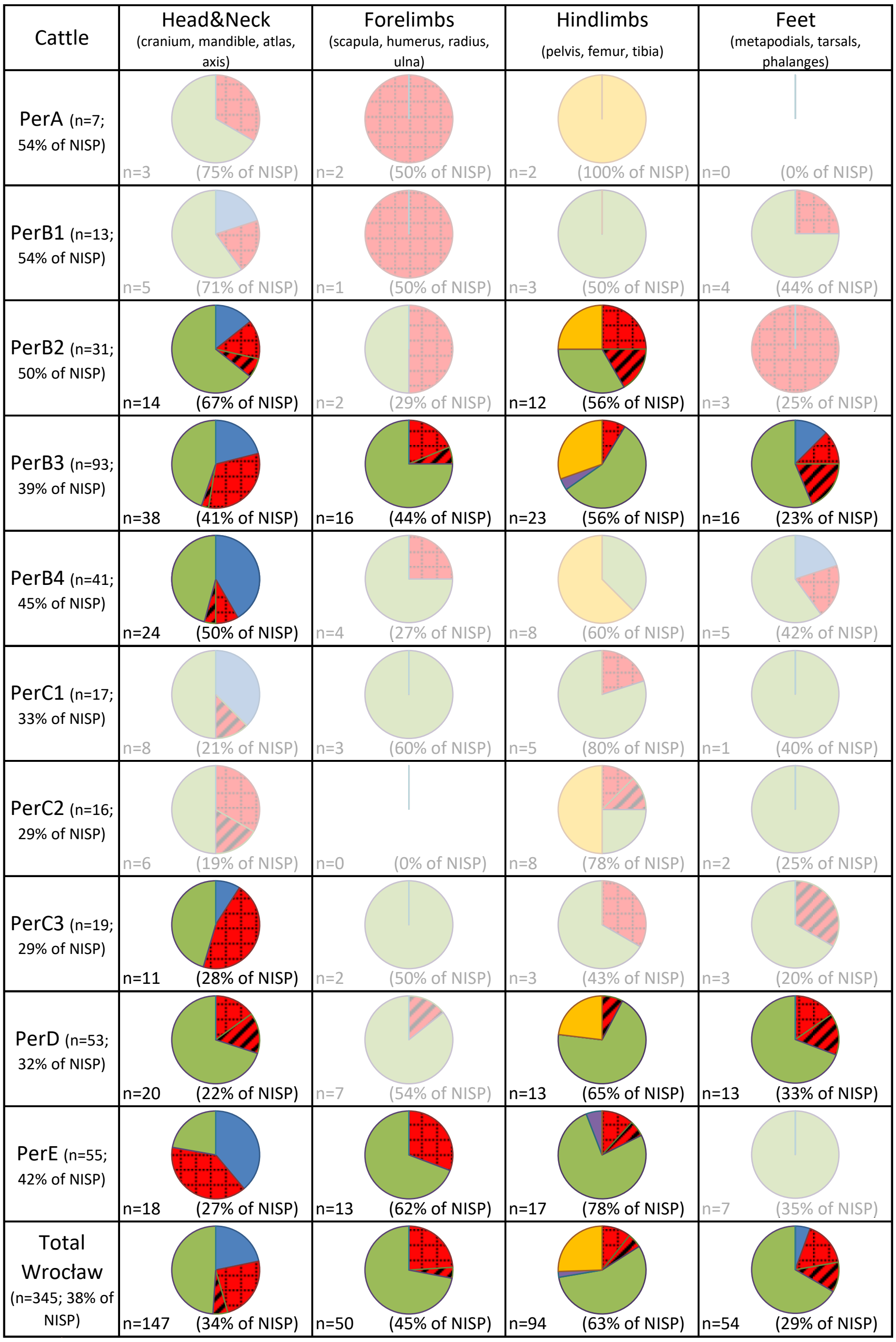

Fig. 6.72 Wrocław. Incidence of different types of butchery activities on cattle bones. Activities are represented by different colours. Additionally, for disarticulation, cross hatching indicates disarticulation done by chopping, and diagonal hatching by cutting. Assemblages with insufficient data (n<10) are faded for the sake of data presentation. The methodology of quantification is described in section 5.6.3

on all body part, with an exemption of horncores, showing a predominance of cutting (fig. 6.69). The predominant activity reflected in butchery marks was splitting/pot-sizing (fig. 6.72), and disarticulation/jointing in much lesser extent. Marks left by filleting are generally absent on cattle bones.

Skinning and horn removal. In general, horn removal and traces of skinning are common on bones from period B. Many horncores bore slicing marks on the base of the horn left by butchers trying to cut off horn sheaths (fig. 6.73). This activity may be associated with horn working and it is predominately present in period B: the back buildings (B3) and sanitary area (B4) (fig. 6.72). In period C this activity is much less common, and absent altogether in period D. In period E some skulls bore skinning marks, but no traces of horn collection were visible.

Fig. 6.73 Wrocław, period E. Picture of a bovine horncore with slicing marks on the circumference of the base

Disarticulation. Traces of disarticulation are present on bones of all periods, but no evident patterns emerge (fig. 6.72). Hindlimbs seem to display these marks less commonly than other body parts, but the difference is small. In most cases, disarticulation was done with a chopping tool. These marks were mostly randomly located, but some rather usual patterns of disarticulation occurred (fig. 6.70). The feet were disarticulated with a cutting action more commonly than other parts of the carcass.

Filleting is rare, and present only on a few bones of the hindlimbs (fig. 6.72).

Porging is present on approximately one-fourth of cases of butchered cattle bones in all periods, except the youngest one — period E — where it is present in very few cases. This is shown in a pattern of removing of epiphyses of femora and tibiae (fig. 6.70), and the increase of numbers of scraping/scoop marks (fig. 6.69).

Bone breaking was common on cattle bones. The majority of bones were split only in one or a few places; the assemblage largely lacks bones intensively chopped into small pieces. For periods A, C, D and E data is rather scarce, but in period B, many bones (with the exception of femora) were split in a crosswise direction to divide the cuts and facilitate the processing of marrow (fig. 6.70). This is reflected in a specific pattern of chop marks, where one or few blows were delivered transversely to the mid-portion of the shaft. The long bones of forelimbs and feet were split, but rarely had the epiphyses chopped off, unlike the femora and tibiae on which this was frequently recorded as a result of porging. Mandibles in period B display a pattern of chopping into segments, but it is not seen in other periods, where mandibles were broken in different ways (fig. 6.70).

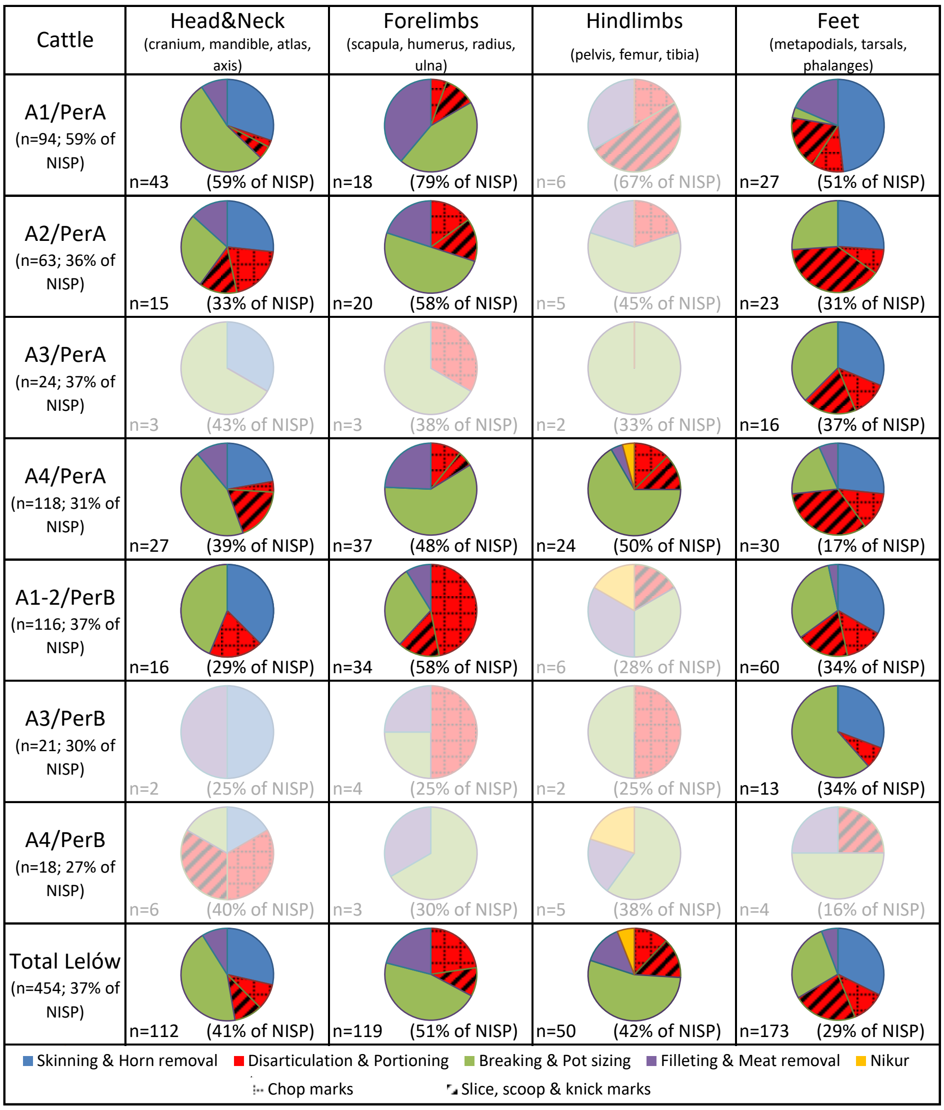

Fig. 6.74 Lelów. Incidence of different types of butchery activities on cattle bones. Activities are represented by different colours. Additionally, for disarticulation, cross hatching indicates disarticulation done by chopping, and diagonal hatching by cutting. Assemblages with insufficient data (n<10) are faded for the sake of data presentation. The methodology of quantification is described in section 5.6.3

6.6.1.3 Lelów

Thirty-seven percent of cattle bones at Lelów had butchery marks (fig. 6.74). They were present on the fore– and hindlimbs and the head regions in about 40–50% of cases, and a little less so on the feet (ca. 30%). Most marks were chop marks. Slice marks and other marks indicating the use of knives, were more frequent than at the other analysed sites and constituted between a third up to two-thirds of instances, depending on the location (fig. 6.69). In general, cutting was represented by slice marks, but scoop and knick marks prevail on the first cervicals and scapulae. Notably, slice marks are a dominant type of marks on feet bones, outnumbering chopping marks. Among all butchery activities, bone splitting was predominant as was the case at the other sites. Disarticulation and filleting are commonly present, on the head and feet skinning was common (fig. 6.74).

Skinning and horn removal constitute a substantial portion of the marks on heads and feet in all contexts, but their frequencies vary (fig. 6.74). On skulls, the chopping of horncores is the most common feature.

Disarticulation. In period A, the disarticulation of the head region and forelimbs was more commonly conducted with the aid of knives than cleavers (fig. 6.74). The disarticulating slicing marks were usually on rather random locations on the epiphyses and a repeated and consistent pattern was seen only for mandible — which was cut off the cranium in several instances — and metapodials — which display traces of cutting through the hock joint and the fetlocks (fig. 6.70). Disarticulating chopping marks in period A form a pattern on shoulder, elbow and hip joints. For instance, the repeated action of dividing of chuck into smaller cuts is demonstrated by the chopping of scapulae in a crosswise direction (fig. 6.75); marks on this location were redundant across several specimens (fig. 6.70). In period B, feet were usually also cut off with the aid of knives; conversely, and in contrast to period A, the disarticulation of head and forelimb regions was done mostly with chopping tools (fig. 6.74).

Filleting and meat removal is seen on a substantial portion of forelimbs and mandibles in period A, but is much less frequent in period B (fig. 6.74). A clear example of this activity is present on the dorsal aspect of the scapula, which bears repetitive cases of slicing on the infraspinatus fossa and the spinous process. What is more, the spinous process was also often removed with a chopping tool during the meat removal (fig. 6.75) (cf. Rixson, 1989).

Fig. 6.75 Lelów. Picture of cattle scapulae with spinous processes removed. The second specimen was also chopped through in a crosswise direction

Fig. 6.76 Lelów. Picture of cattle scapulae chopped vertically through the glenoid fossa

Porging is rather rare. It was recorded on solitary instances of hindlimb bones in both periods.

Bone breaking. In period A, some body parts show repetitive patterns of pot-sizing — such as mandibles, and maxillae — or splitting of bone in a cross-wise direction mid-shaft for marrow — such as femora and some metapodials (fig. 6.70). What is more, a number of scapulae had their glenoid cavities repeatedly axially chopped through (fig. 6.76). In phase B, metapodials were broken more frequently than in period A, but no consistent patterns of repetitive chop marks were found (fig. 6.70).

6.6.1.4 Prague

Butchery marks were found on 40% of the assemblage of cattle bones from Prague (fig. 6.77). They were very common on the upper limb bones (ca. 60–79%) and much rarer on head and feet. Almost all marks on bones from Libeň were made with chopping tools (fig. 6.69). At Staronová, the assemblage is inadequate in size. It seems that cutting tools were used more often than at Libeň. From all documented butchery activities, at Libeň, bone splitting is much more pronounced in numbers than at other discussed sites, but disarticulation is less frequent (fig. 6.77). Little differences are present between contexts at Libeň. The small assemblage from Staronová seems to be more diverse, and disarticulation is relatively more frequent than at Libeň.

Skinning and horn removal: examples of the initial stage of carcass processing are rare at Prague (fig. 6.77). These activities left no marks on cattle skulls, and very few skinning marks on feet.

Disarticulation at Libeň is seen on a relatively consistent portion of bones across all body parts but hindlimbs, while the data from Staronová is very limited (fig. 6.77). A different pattern is displayed on hindlimbs, where disarticulation was largely absent; mostly due to the underrepresentation of epiphyses of femora and tibiae, removed during porging. The evidence suggests that disarticulation was predominately performed with chopping tools; knives were sporadically used, most notably on feet. Repetitive disarticulation patterns of chopping marks were recorded for mandibles and all joints of the forelimb (fig. 6.70).

Filleting was almost absent. The boning had to been performed in a way which left few marks on bones.

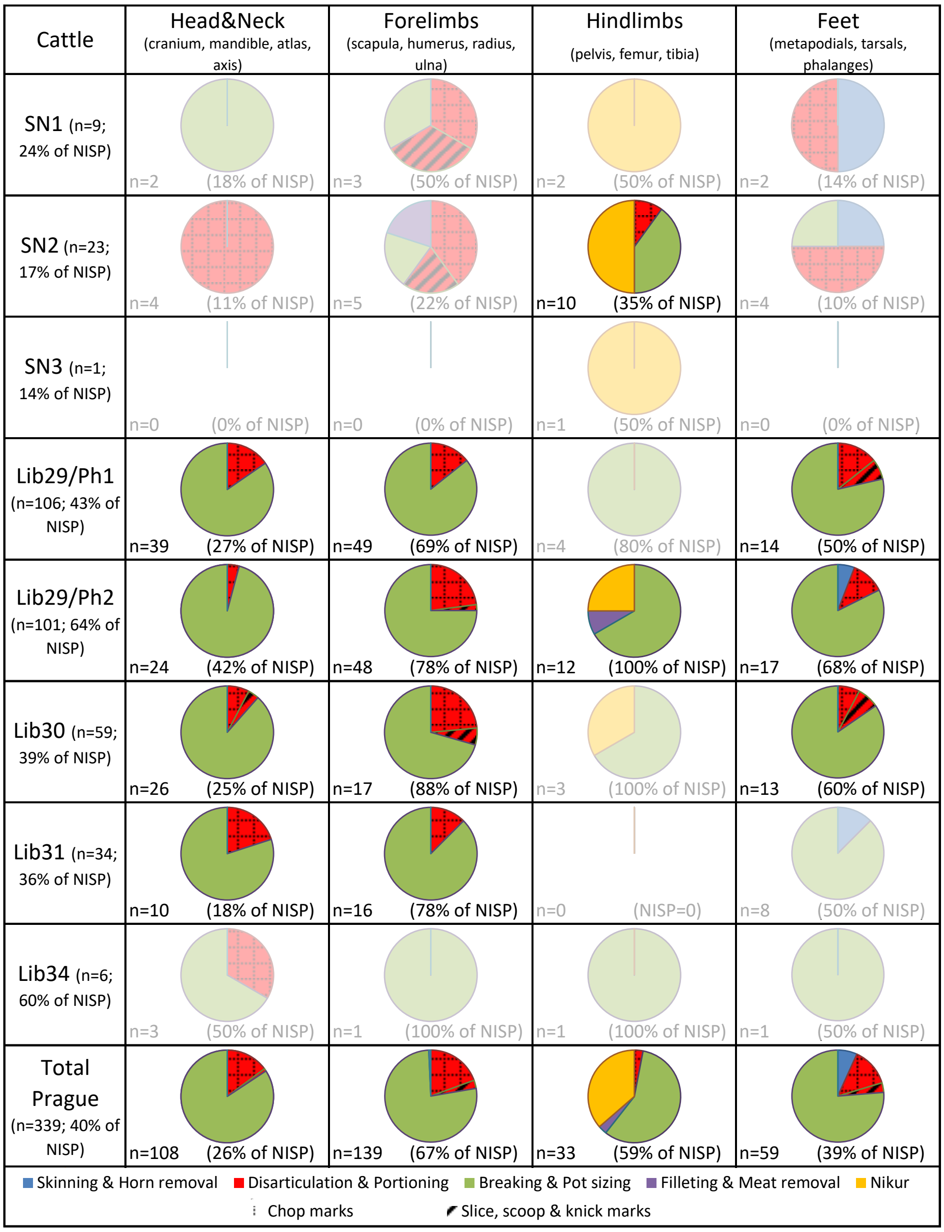

Fig. 6.77 Prague. Incidence of different types of butchery activities on cattle bones. Activities are represented by different colours. Additionally, for disarticulation, cross hatching indicates disarticulation done by chopping, and diagonal hatching by cutting. Assemblages with insufficient data (n<10) are faded for the sake of data presentation. The methodology of quantification is described in section 5.6.3

Porging is present on a substantial portion of bones from Staronová and in several instances at Libeň (fig. 6.77). The pattern includes chopped off epiphyses of femora and tibiae (fig. 6.70) and scraping/scoop marks on bones of hindlimbs (fig. 6.69).

Bone breaking. In a manner akin to other sites, bone splitting is a dominant type of butchering activity present on cattle bones from Prague (fig. 6.77). At

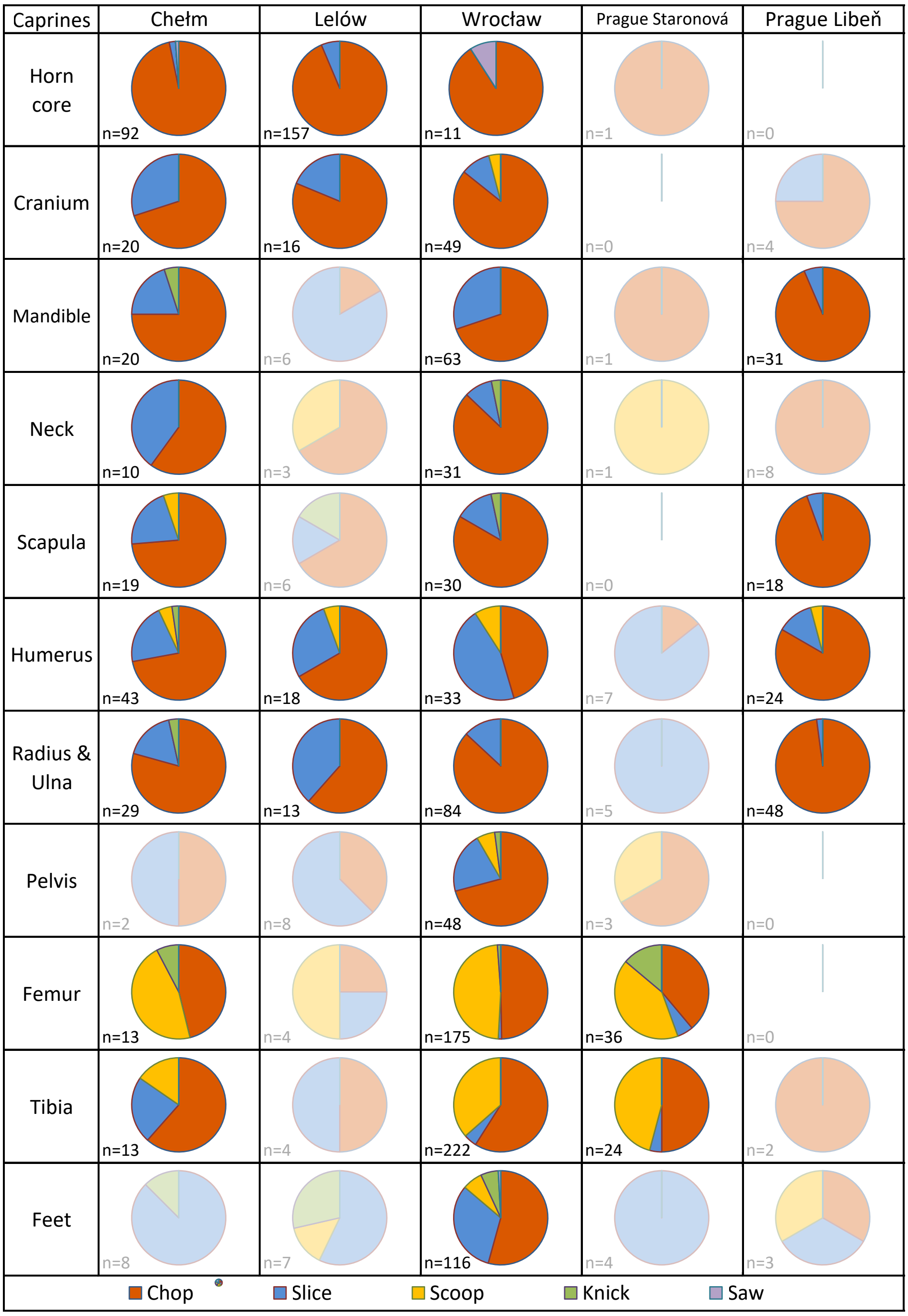

Fig. 6.78 Incidence of different type of butchery marks on caprines. The methodology of quantification is described in section 5.6.3

Libeň, many tibiae and metapodials were split in a crosswise direction in their mid-shaft, which would enable marrow extraction (fig. 6.70). Also metapodials, along with mandibles, display a pattern of pot-sizing. There are traces of intensive processing of bones from Libeň. These include many instances of forelimb and metapodial bones chopped axially through their epiphyses, and repeated chopping of random direction of proximal radii and metatarsals, which left the specimens fractured into small pieces. This practice may be associated with bone grease extraction (Rixson, 1989); or simply soup making (Mensch, 1974). The assemblage from Staronová, on the other hand, shows no clear patterns except the removal of epiphyses of femora during porging and splitting tibiae mid-shaft.

6.6.2 Caprine butchery

Butchery marks on caprine bones are common, but their incidence of occurrence is more variable between sites than in the case of cattle. As for cattle, most of the butchery was done with the aid of a chopping tool, but the evidence of knife usage is more abundant than for cattle (fig. 6.78). The most common butchery activity recorded on bones is breaking/ splitting of bones with a chopping tool, a result of the late stages of carcass processing, such as the division of meat cuts, pot-sizing, and marrow extraction. The specific patterns recorded on the caprine bones will be discussed in detail in the following section (fig. 6.79)

6.6.2.1 Chełm

At Chełm, butchery marks on caprine bones occur with a similar frequency to cattle (ca. 40%) (fig. 6.80). In general, butchery marks are more frequent on head and neck region from phase 1 than in phase 2, while the opposite is true for forelimbs. The majority of marks are chopping marks (fig. 6.78). Scraping/scoop marks are generally rare, except on hindlimbs, where they are associated with porging. On the head region, horn removal is the most frequent activity; for the forelimbs it is bone splitting, whilst for the hindlimbs it is porging.

Skinning and horn removal. Horncores in both phases were commonly chopped off from skulls (fig. 6.80). Skinning is rare and was present only on a few metapodials from phase 2.

Disarticulation was recorded on some mandibles from phase 2 and forelimbs (fig. 6.80). Disarticulation was performed with the aid of both chopping tools and knives. Notably, this butchery activity is rare on hind limbs due to the underrepresentation of epiphyses, often removed during porging.

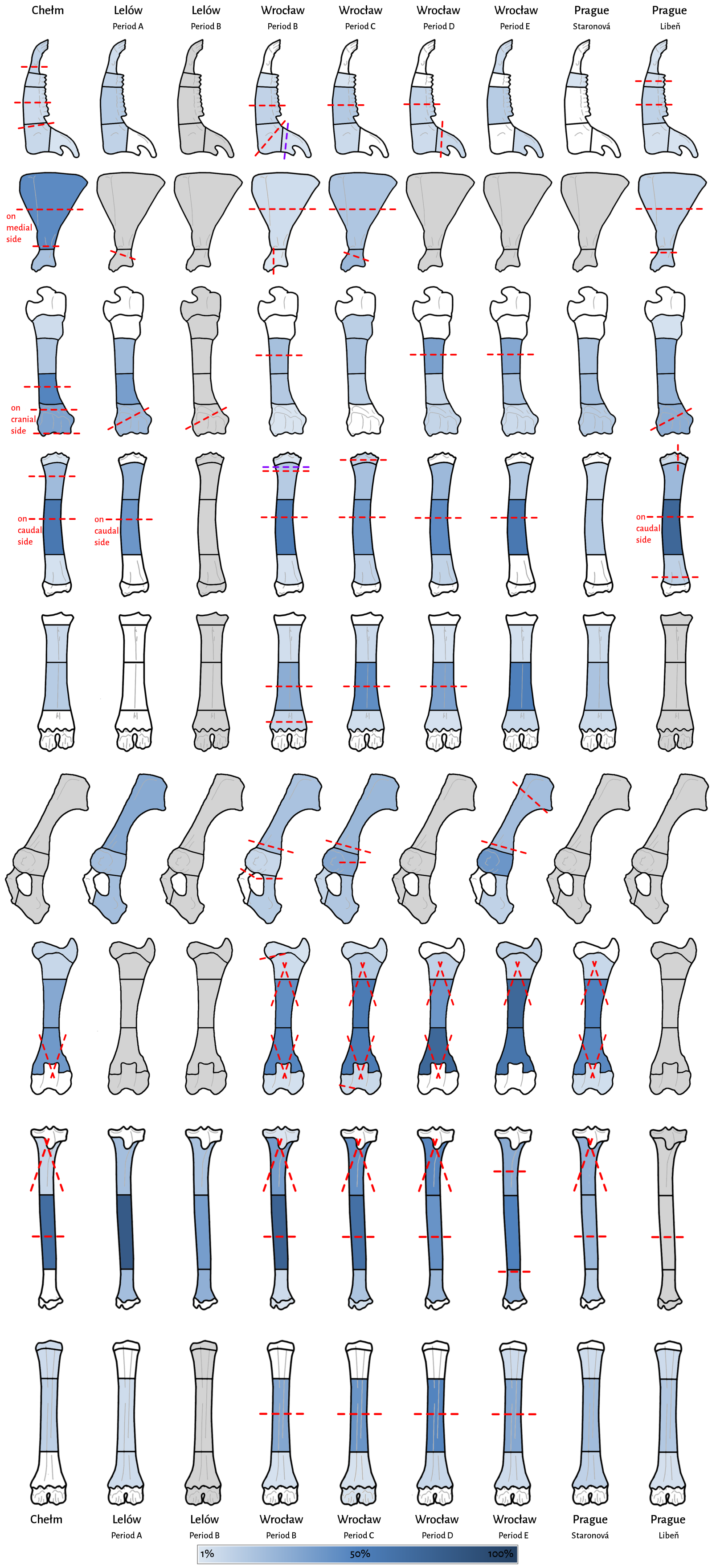

Fig. 6.79 Caprines. Distribution of fresh-bone fractures (shades of blue), patterns of chop marks (red dashed lines), and patterns of slice marks connected to disarticulation (purple dashed lines). The first is a percent of specimens of particular zone which were broken while fresh (% of total NISP); white represents the absence of fractures and the darker colour means more fractures in the assemblage (assemblages with fewer than 10 specimens marked in grey). Patterns of chop and slice marks are indicated by dashed lines recorded when marks of similar characteristics (location and direction) occurred on a substantial portion of the assemblage (at least several instances)

Filleting seems to be more often present in phase 1. Mandibles and upper forelimb bones also provide some signs of filleting, which left mostly slice marks and a few scoop/knick marks (fig. 6.80).

Porging. Hindquarters have evidence of porging, which often left many scraping/scoop marks on femora and tibiae (fig. 6.78), and a pattern of removed epiphyses of those elements (fig. 6.79). Porging is more common in phase 2 than phase 1, and on femora rather than tibiae, but was absent in structure 20 (fig. 6.80).

Bone breaking. Many caprine bones from Chełm were split in a crosswise direction to facilitate marrow extraction; this is reflected in the increased fragmentation and repetitive patterns of chopping in the middle of the shaft of humeri, radii, and tibiae (fig. 6.79). Some remains, such as mandibles, scapulae, and radii also show a pattern of pot-sizing: cuts were divided into smaller sections. Femora and tibiae often have their epiphyses removed by chops with an acute angle during porging, whereas the removing of the epiphyses of humeri and radii left marks perpendicular to the long axis of the bone. What is noteworthy, metapodials were fractured much less frequently than other long bones and do not display any consistent pattern of breakage.

6.6.2.2 Wrocław

Approximately 33% of the assemblage of caprine bones from Wrocław bore butchery marks (fig. 6.81). The frequency of cut marks on upper parts of hindquarters is significantly larger (60–80%) than on forequarters (30–40%), and head regions and feet (20–40%). Chop marks were the most frequent type of marks (fig. 6.78), and are a result of splitting of bones and disarticulation (fig. 6.81). Slicing is frequent on humeri, feet bones and mandibles and scraping/scoop marks, associated with porging, are common on femora and tibiae (fig. 6.81).

Skinning and horn removal. Horncores of both caprine species were chopped off, more rarely sawn off, from the cranium, at the lateral aspect of the base (fig. 6.81). This practice is present in most periods. Skinning marks are rare on the skull. On feet skinning is often present in period B, whilst in later periods the incidence declines.

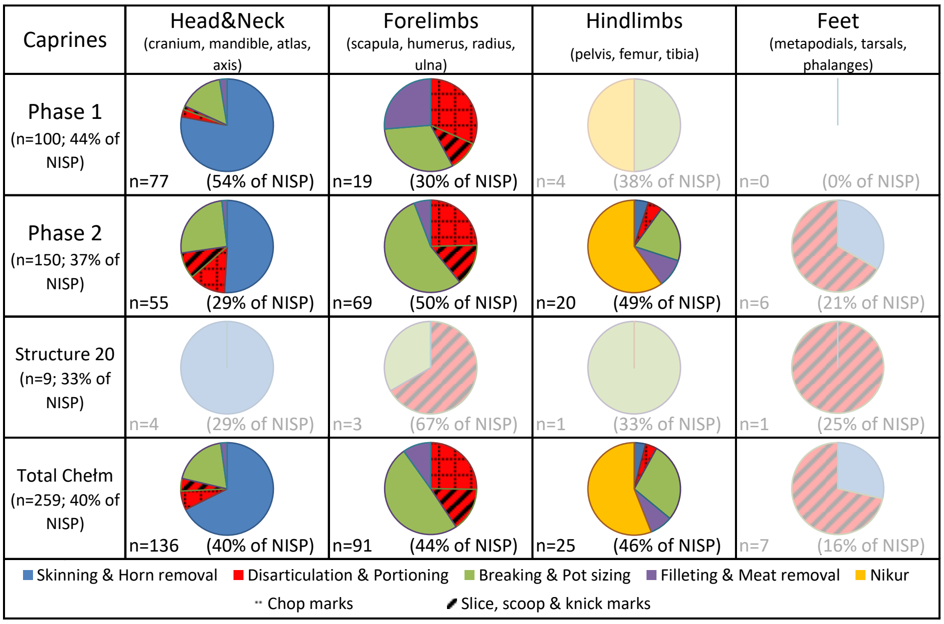

Fig. 6.80 Chełm. Incidence of different types of butchery activities on caprine bones. Incidence of different types of butchery activities. Activities are represented by different colours. Additionally, for disarticulation, cross hatching indicates disarticulation done by chopping, and diagonal hatching by cutting. Assemblages with insufficient data (n<10) are faded for the sake of data presentation. The methodology of quantification is described in section 5.6.3

Disarticulation. Traces of disarticulation were present mainly on bones from the head region, forelimbs, and feet (fig. 6.81). On the head and neck region, most of the disarticulation was carried out using chopping tools — such as the division of the neck in the crosswise direction. Cutting was often found on occipital condyles and left a repetitive pattern of cuts near the articular process of the mandible in period B (fig. 6.79). Also the feet were usually cut off with the aid of a knife (fig. 6.81). Forelimbs show traces of disarticulation carried out with chopping tools and knives. Clear patterns of these actions are present in periods B and C: chopping of the shoulder joint and chopping and cutting of elbow. Hindlimbs rarely show traces of disarticulation (fig. 6.81), presumably due to underrepresentation of the epiphyses commonly removed during porging (fig. 6.79). There are some traces of chopping through the hip joint in period B.

Filleting is uncommon. Notably, it is present in higher proportions on the head region and forelimbs in area B2 when juxtaposed with other areas in this period (fig. 6.81). The assemblage is not particularly large, which probably affected the proportions.

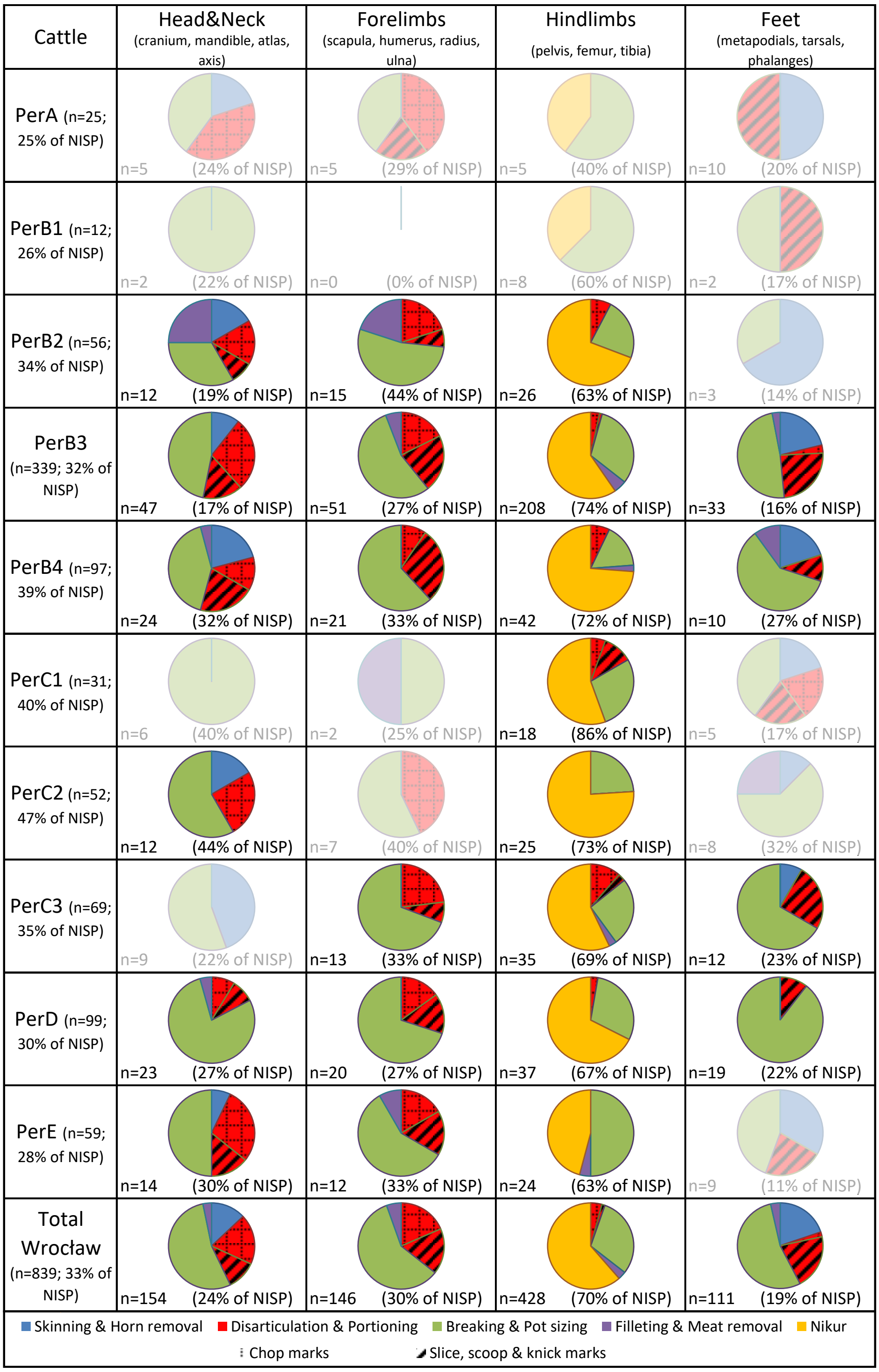

Fig. 6.81 Wrocław. Incidence of different types of butchery activities on caprine bones. Activities are represented by different colours. Additionally, for disarticulation, cross hatching indicates disarticulation done by chopping, and diagonal hatching by cutting. Assemblages with insufficient data (n<10) are faded for the sake of data presentation. The methodology of quantification is described in section 5.6.3

Porging is by far the most common butchery activity recorded on bones of the hindlimb (fig. 6.78). It was performed with chopping tools and knives — mostly scraping/scoop marks — and both occur in large numbers in most periods (fig. 6.78). A typical porging pattern of removing epiphyses of femora and tibiae is attested in most periods (fig. 6.79). Tibiae from period E rarely display the porging pattern. Instead, the epiphyses were commonly chopped off in the crosswise direction.

Bone breaking. At Wrocław, splitting and pot sizing of caprine bones was very common (fig. 6.81). In general, the basic pattern of bone splitting has not changed across the periods. Most remains were split mid-shaft, as shown by the high incidence of fresh fractures in this part of the shaft and by a consistent pattern of crosswise chop marks (fig. 6.79). Marks of pot-sizing were present on many remains, but they seem more common on forelimbs in periods B and C. In period E, the predominant pattern of splitting the tibia was different than in other periods, when porging pattern predominates. The epiphyses were not chopped at an acute angle to the long axis of the bone and with their shafts split crosswise as in other periods. Instead, the shaft was chopped at the right angle near the epiphyses.

6.6.2.3 Lelów

Bones of the appendicular skeleton of the caprines, especially the hindlimbs and feet, are rare at the site; hence the overall numbers of butchery marks are low for most contexts, but the percentage is high: 59% bore butchery marks (fig. 6.82). Marks are common on the head region (60–80%), and less frequent on the limb bones (ca. 50% on forelimbs and 30% on hindlimbs). As was the case on other sites, chop marks dominate in the assemblage (fig. 6.78). Caprine bones from Lelów reflect different butchery actions depending on the anatomical region: disarticulation is the most common cause of marks on forelimbs, while filleting and bone splitting dominates on hindlimbs (fig. 6.82). A very large assemblage of parts of skulls had traces of the removal of horncores.

Skinning and horn removal. The most pronounced feature of the assemblage from Lelów is a set of goat horncores from period A1, which were predominately chopped off the skull with one or a few blows to the lateral side of the base of the horncore (fig. 6.82). Similar activity is present in two other contexts. Skinning was rare.

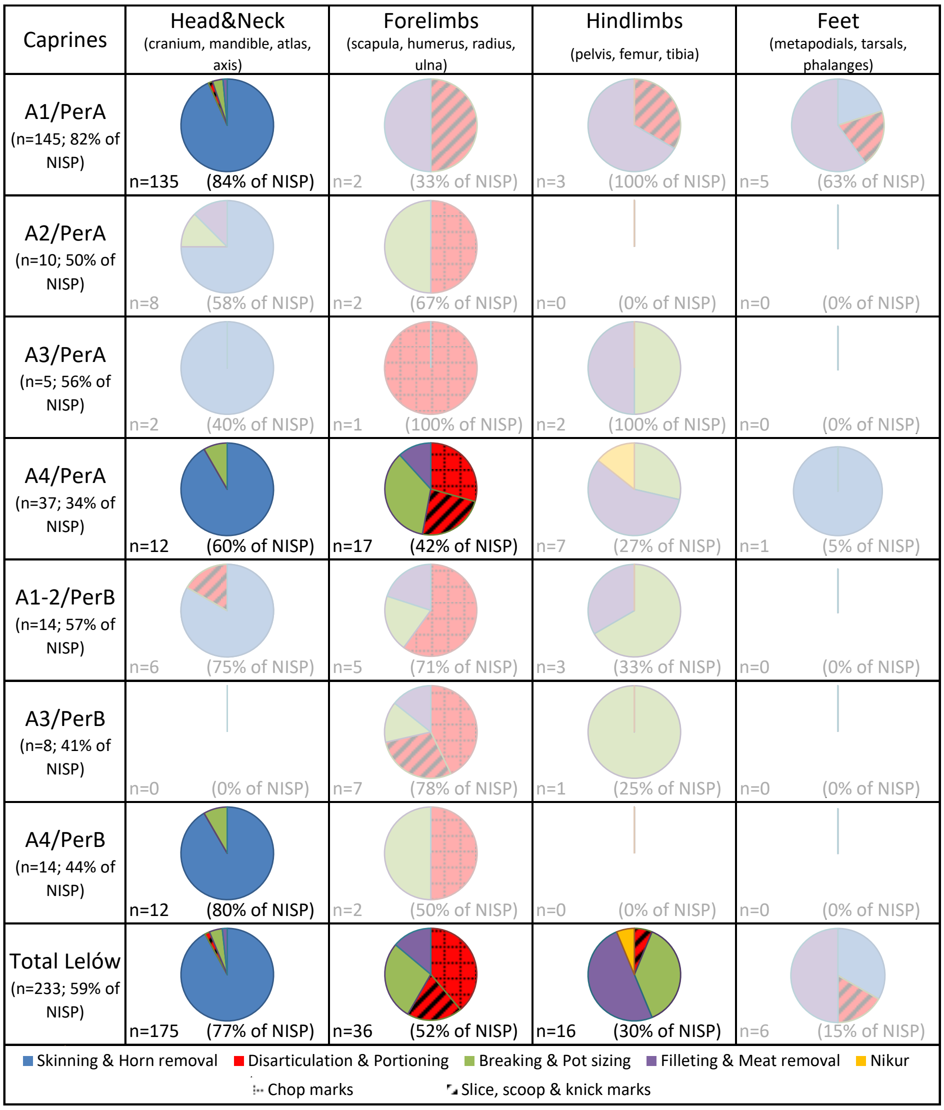

Fig. 6.82 Lelów. Incidence of different types of butchery activities on caprine bones. Activities are represented by different colours. Additionally, for disarticulation, cross hatching indicates disarticulation done by chopping, and diagonal hatching by cutting. Assemblages with insufficient data (n<10) are faded for the sake of data presentation. The methodology of quantification is described in section 5.6.3

Disarticulation was present mostly on forelimbs; it was performed with both knives and chopping tools.

Filleting, on the other hand, predominates on the hindlimbs.

Porging was recorded on a solitary instance of femur from period A.

Bone breaking. Traces of the splitting of bones for marrow or pot-sizing are less common for Lelów caprines than at the other sites (fig. 6.82). Although most long bones were often broken mid-shaft, a consistent pattern of chopping was recorded only on radii (fig. 6.79). It is noteworthy that metapodials were rarely fractured while fresh.

6.6.2.4 Prague

Butchery marks are slightly less frequent on caprine bones from Prague than on the other sites; they were recorded on 22% of bones (fig. 6.83). Marks were most commonly found on hind- and forelimbs (40–60%), and much less on on the head region (ca. 10%). In Libeň, the vast majority of marks were left by chopping tools; knives seem to rarely nick the bone (fig. 6.78). A different situation is reflected in bones from Staronová Synagogue, where scraping/scoop marks are as common as chop marks. At Libeň, the majority of marks were left during the splitting of bones, and some while disarticulating. At Staronová, porging is the most common activity, but only hindlimbs were abundant enough for the analysis.

Skinning and horn removal were represented by solitary cases from both sites at Prague (fig. 6.83).

Disarticulation is mostly seen on forelimbs and the read region. In Libeň this activity was mostly done with a chopping tool, whilst in Staronová the knife dominates; the assemblage is small though.

Filleting is present only on solitary instances of forelimb bones from Staronová.

Porging was common from Staronová, but it is absent at Libeň (fig. 6.83). At Staronová it is connected to the increased number of scraping/scoop marks on femora and tibiae (fig. 6.78), and a pattern of removal of the epiphyses of those remains (fig. 6.79).

Bone breaking. The general pattern of bone splitting for Staronová and Libeň is different. At Staronová, long bones and mandibles were not commonly fractured while fresh, except for femora and tibiae — frequently removed epiphyses during porging (fig. 6.79). In contrast, at Libeň, forelimb bones were more commonly split, showing higher incidences of fractures and a pattern of crosswise splitting on scapulae and radii. Notably tibiae from both sites were often split transversely in mid-shaft.

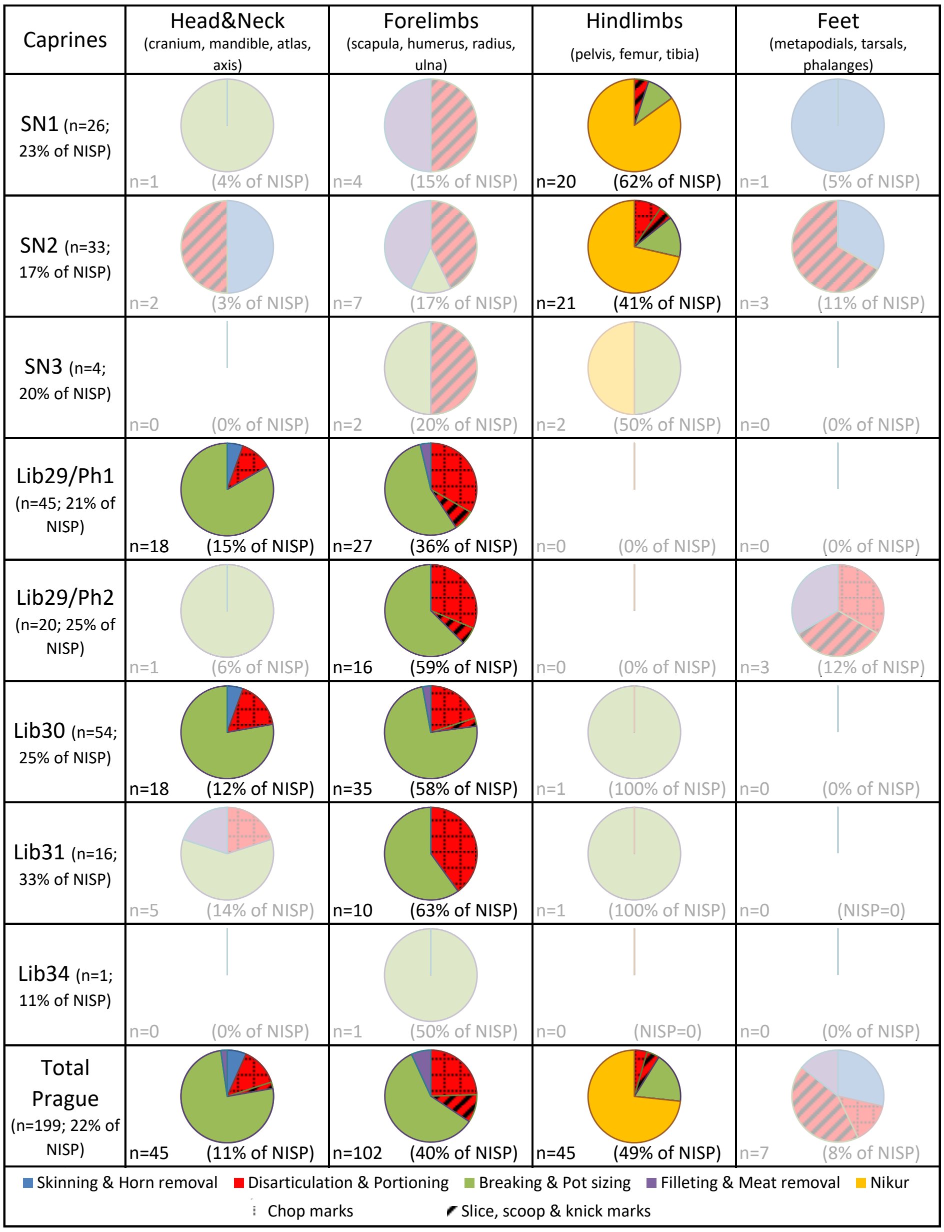

Fig. 6.83 Prague. Incidence of different types of butchery activities on caprine bones. Incidence of different types of butchery activities. Activities are represented by different colours. Additionally, for disarticulation, cross hatching indicates disarticulation done by chopping, and diagonal hatching by cutting. Assemblages with insufficient data (n<10) are faded for the sake of data presentation. The methodology of quantification is described in section 5.6.3

6.6.3 Butchery marks on bones of other species

Bones of species other than cattle and caprines are not frequently present in most contexts at the discussed sites. That being so, butchery marks are generally low in numbers.

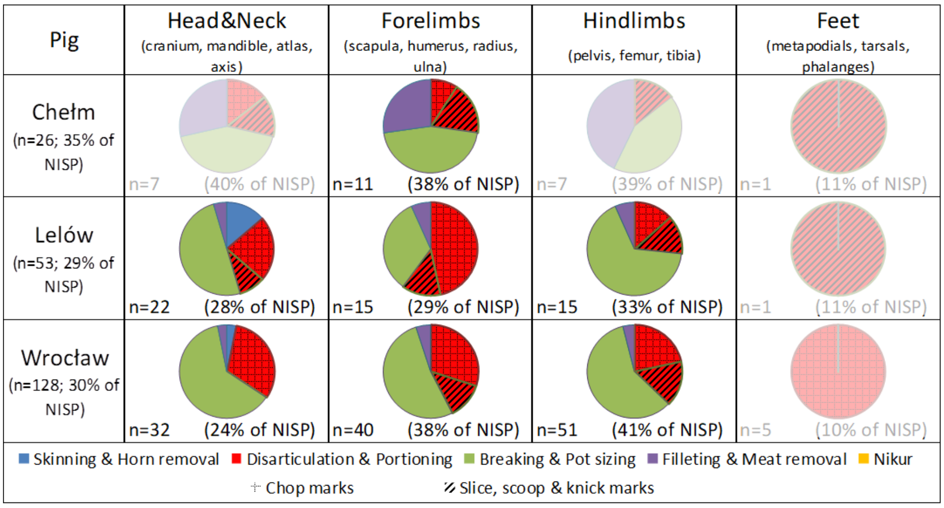

Fig. 6.84 Incidence of different types of butchery activities on pig bones. Activities are represented by different colours. Additionally, for disarticulation, cross hatching indicates disarticulation done by chopping, and diagonal hatching by cutting. Assemblages with insufficient data (n<10) are faded for the sake of data presentation. The methodology of quantification is described in section 5.6.3

Chełm. The average incidence of butchery marks on pig bones is somewhat smaller than for the ruminant taxa (35%) (fig. 6.84). Due to the paucity of the data no repetitive pattern of butchery on particular parts of the carcass was registered for the pig. However, marks were recorded on all body parts with the lowest proportion for the feet. Most recorded marks were produced during splitting bones for marrow. Another common activity was disarticulation — which was carried out predominantly with knives — and filleting, which left slicing and knick marks (fig. 6.84; 6.85). Butchery was noted on two horse bones: a skinned metatarsal from phase 1 and a skull from structure 20, resulting from decapitation. These marks do not represent direct evidence of the consumption of horse meat, but merely of the utilisation of some of the horse body parts. A fox mandible from phase 1 also had skinning marks.

Wrocław. Bones with cut marks make up approximately 30% of the pig bone assemblage (fig. 6.84). They are more frequently present on the upper parts of the limbs, and rarely on the feet. The basic butchery pattern for most parts of the carcass looks alike (fig. 6.84). The main purpose behind the butchery marks was the splitting of bones for marrow and pot-sizing. This was reflected in chopping marks in crosswise direction, delivered to the middle of the long bone shaft. Another common butchery activity was disarticulation, which was also mostly carried out with a blow of a chopping tool to the articular surface, but slicing of joints is also present (fig. 6.84; 6.85). No specific patterns of location

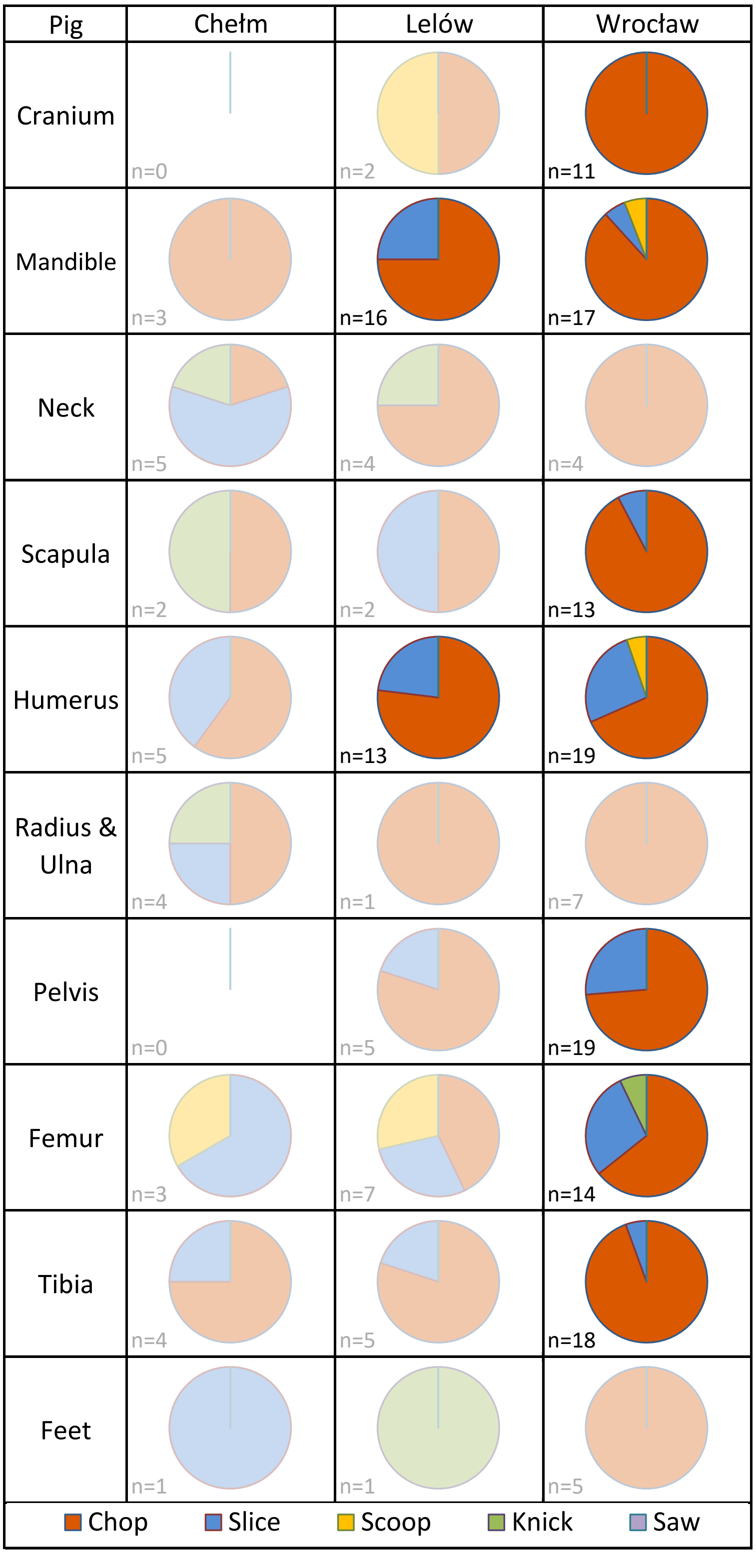

Fig. 6.85 Incidence of different type of butchery marks on pig. The methodology of quantification is described in section 5.6.3

were recorded. Filleting rarely occurred, but it left some slicing and scoop and knick marks. In the case of horse bones, approximately 19% (NISP n=22) bore cut marks. In the assemblages from periods A, D, and E, only a few horse bones were butchered — in these cases chopping marks were left after decapitation and splitting of long bones for marrow. In period C, chopping was present on a few metapodials and a phalanx and a tibia of the horse, suggesting that marrow of this species was utilised. The body of data of horse butchering is the largest in the case of period B, mostly in areas B3 and B4. Butchery is present on most parts of the skeleton and indicates skinning and disarticulation of the carcass, and subsequent splitting of bones for marrow — a clear signs of the utilisation of horse flesh, possibly for consumption. This conclusion stands in contrast to the previous analysis of the assemblage, which assumed no evidence for horse consumption were present (Socha et al. 1999, 154). Butchery was recorded on a few roe deer bones. In period A, these were a skinned cranium and a mandible, detached from the cranium. In period B, at the production area B2 and the back-buildings area B3, two radii were split mid-shaft, presumably for marrow. Similar marks were found on a metacarpal from period D. A hare pelvis with several chopping marks through the ischium was recorded for period A — these marks indicate that animals of this species were consumed (fig. 6.86). Another interesting specimen was recorded in the back-building area in period B (PerB3): an ulna of cat was repeatedly sliced in a crosswise direction in the middle of the shaft (fig. 6.87). Skinning of cats was not an uncommon practice in the past (Fairnell, 2003). Even so, this location is shielded by several muscles, and it seems rather unlikely than a large number of cut marks would be left by mere skinning of the animal. On the other hand, there is more than one way to skin a cat. Nonetheless, the specimen seems to be an evidence of further processing of the cat carcass.

Fig. 6.86 Wrocław, period A. Picture of a pelvis of the hare with chopping and knick marks on the dorsal aspect of ischium

Fig. 6.87 Wrocław, period B3. Picture of an ulna of the cat with slicing marks on the caudal aspect

In sum, the evidence of butchery on bones of non-kosher species at Wrocław, such as pig, horse, roe deer, hare, and even cat, certainly indicates that at least some of those animals were processed for intended consumption.

Lelów. Butchery marks occurred on 29% of pig bones; less frequently than in the case of ruminants (fig. 6.84). They were found on skulls and upper parts of the limbs and are rare on feet. In most cases bones were chopped, either to split the bone for marrow or pot-size or to disarticulate a joint (fig. 6.85). Cutting the joints apart is less frequent than chopping them for the head region and forelimb, but the opposite holds true for the hindlimb. Also skinning was present on a few skulls and filleting was recorded in several instances. Seventeen horse bones with butchery marks were found in period A. They represent all parts of the skeleton, and all types of butchery activities were present, from skinning to filleting and bone splitting. They were mostly found in areas A1 and A4, but solitary instances were present in areas A2 and A3. Also in period B horse was butchered. In areas A1–2 and A4 five horse bones, all of upper parts of fore– and hindlimbs were cut and chopped during disarticulation, filleting, and bone splitting. A red deer mandible was found at area A1 in period A. The mandible was chopped through vertically through the ramus and molars. This may be an evidence of splitting of the bone with the purpose of extracting grease (Rixson, 1989).

Prague. No butchery marks are present on bones other than cattle and caprines, except for four fragments of red deer antler. The specimens were present in area SN1 at Staronová synagogue. They were all sawn and presumably constitute bone-working refuse.

6.6.4 Patterns of burning

Burning is a direct evidence of the heat or fire affecting the bone. It may be a trace of a culinary practice, such as roasting or grilling; this practice will often leave bones only partially scorched or charred. However, not all meat heating will leave burning marks: cooking in liquids is proven to be elusive. What is more, burning may also may be caused by non-culinary activities, such as burning rubbish, or diagenetic factors, such as the proximity of fire to artefacts embedded in the underlying sediment.

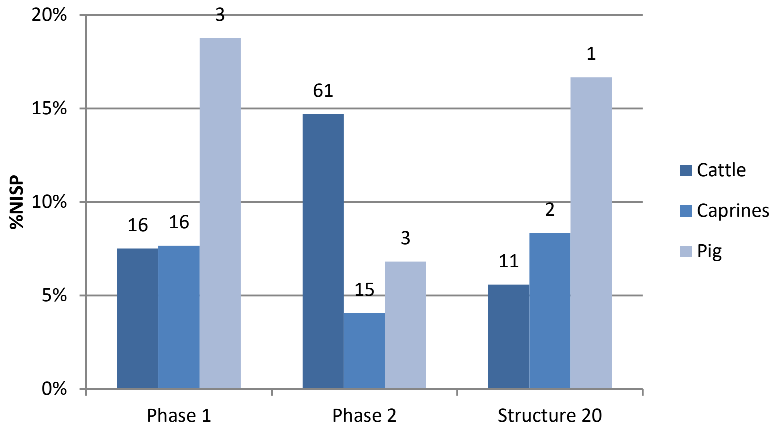

Fig. 6.88 Chełm. Incidence of burnt bones. Numbers indicate the amount of specimens burnt (NISP)

6.6.4.1 Chełm

Burning is not common on bones from Chełm. Only between 4% and 8% of ruminant bones have evidence of burning (fig. 6.88). The exception here is the cattle bones assemblage from phase 2, where burning was recorded on over 14% of bones. The majority of burnt bones in all assemblages (ca. 90%) are scorched — the extent of burning was only superficial on the bone. These may be associated with culinary practices. Only several bones in each assemblage (phase 1 n=2, phase 2 n=6, structure 20 n=2) are carbonised, often over the whole bone, thus suggesting little connection to the food heating practice. Calcined bones were only observed on two cattle bones from phase 1. Burning on pig bones is present(fig. 6.88), but the sample is rather small. Burning on bones of species other than domestic artiodactyls was recorded only in a solitary instance of a horse bone from phase 1 which was burnt post-deposition.

Burning is located predominately on shafts of the humerus and radius of cattle and caprines, and on shafts of metapodials of cattle (table 6.22). Epiphyses of long bones were burnt rarely. The upper parts of hindlimbs show little evidence of burning. Different patterns of burning are present for cattle bones in phase 1 (15th–17th c.) and phase 2 (17th–18th c.) (table 6.23). In phase 1, only upper parts of the forelimb and mandibles were burnt; whereas in phase 2 burning is present on many metapodials and a few hindlimb bones.

Table 6.22 Chełm. Incidence of burning on main anatomical portions. The quantity (#) is the number of remains (MNS) which are burnt; the incidence in the percent out of total MNS for the body part/portion. Calcined bones excluded

Chełm	Cattle		Caprines		Pig	
	#	%MNS	#	%MNS	#	%MNS
Mandible	7	10%	5	6%	1	20%
Scapula	3	10%	2	9%	0	0%
Forelimbs - ends	6	6%	5	6%	0	0%
Forelimbs - shafts	24	28%	15	16%	4	24%
Pelvis	0	0%	1	17%	-	-
Hindlimbs - ends	0	0%	1	4%	1	7%
Hindlimbs - shafts	3	9%	2	6%	1	7%
Metapodials - ends	22	12%	0	0%	0	0%
Metapodials - shafts	34	30%	0	0%	0	0%
Phalanges & tarsals	2	3%	0	0%	0	0%
Total	101	14%	31	7%	7	9%

Burning pattern from Chełm suggests that the majority of meat was heated in a way which did not leave traces on bones; it was presumably deboned beforehand. The evidence suggests that grilling whole chunks of meat on bone was not practised — this activity would leave more carbonising marks on ends of long bones. The increased frequency of burning on shafts is presumably associated with heating of defleshed bones in preparation of roasted marrow, which was later extracted by smashing the mid-shaft.

The interesting finding concerns the underrepresentation of burning on hindlimbs compared to forelimbs. This may be caused by differential processing of hind parts of the carcass, which underwent porging. They were very rarely processed with direct fire, but possibly used for cooking.

Table 6.23 Chełm. Incidence of burning on main anatomical portions for cattle in phases 1 and 2. The quantity (#) is the number of remains (MNS) which are burnt; the incidence in the percent out of total MNS for the body part/portion. Calcined bones excluded

Chełm - cattle	Phase 1		Phase 2	
	#	%MNS	#	%MNS
Mandible	2	10%	4	15%
Scapula	1	14%	2	9%
Forelimbs - ends	4	10%	2	4%
Forelimbs - shafts	7	17%	16	40%
Pelvis	0	0%	0	0%
Hindlimbs - ends	0	0%	0	0%
Hindlimbs - shafts	0	0%	3	18%
Metapodials - ends	0	0%	20	22%
Metapodials - shafts	0	0%	24	39%
Phalanges & tarsals	0	0%	2	5%
Total	14	8%	73	20%

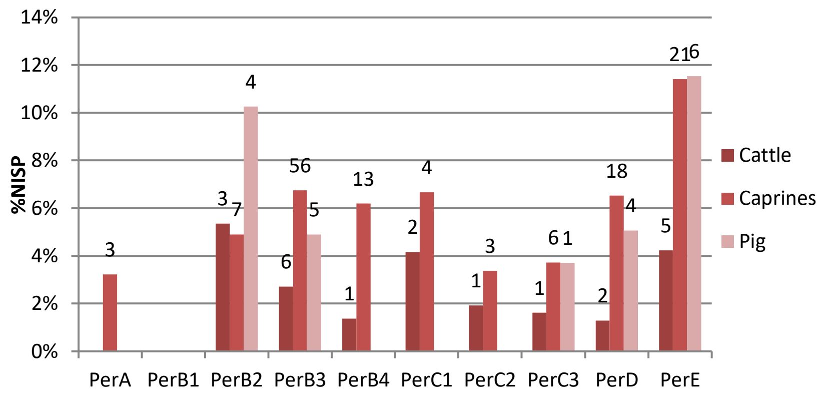

Fig. 6.89 Wrocław. Incidence of burnt bones. Numbers indicate the amount of specimens burnt (NISP)

6.6.4.2 Wrocław

Burning is present of approximately 5% (NISP n=176) of bones from Więzienna 11 (fig. 6.89). The majority of burnt bones were indirectly affected by the high temperature which resulted in scorching (ca. 96%). Only a few bones in some of the periods are carbonised (B3 n=4; B4 n=1; C2 n=1; E n=1), which is presumably connected to post-depositional or accidental burning. Burning on horse bones was present only on solitary instances of bones in B3, B4, and E, and each of those cases was represented by a carbonised bone, presumably burnt accidentality. Interestingly, a cat humerus from PerD was scorched on part of the shaft; however, it is unlikely whether this represents a culinary practice. There are some differences between periods/areas worth noting. Firstly, the main house (zone 1) in periods B and C have different incidences of burning than the back of the residential lot. In B there was no burning in the main building (i.e. PerB1), whilst in C zones C2 and C3 show lower abundance of burning than the main building. Secondly, period A is characterised by very low frequency of burning, whilst periods E has the highest incidence of burnt bones.

Burning is present mostly on the long bone shafts (table 6.24). In cattle and caprines, forelimb shafts are burnt somewhat more frequently than the hindlimb shafts. In caprines, the pattern of burning is much more common on shafts of metapodials than on the upper parts of the limb. In general, the girdle bones, mandibles, and the small bones of the foot were rarely burnt. Anatomical distribution of burning between the archaeological contexts and periods does not differ substantially.

Table 6.24 Wrocław. Incidence of burning on main anatomical portions. The quantity (#) is the number of remains (MNS) which are burnt; the incidence in the percent out of total MNS for the body part/portion. Calcined bones excluded

Wrocław	Cattle		Caprines		Pig	
	#	%MNS	#	%MNS	#	%MNS
Mandible	**0**	0%	**5**	2%	**0**	0%
Scapula	**1**	6%	**2**	3%	**1**	4%
Forelimbs - ends	**1**	2%	**10**	4%	**2**	4%
Forelimbs - shafts	**7**	18%	**29**	10%	**7**	13%
Pelvis	**1**	4%	**1**	2%	**1**	4%
Hindlimbs - ends	**2**	4%	**3**	2%	**2**	3%
Hindlimbs - shafts	**3**	8%	**21**	8%	**8**	14%
Metapodials - ends	**0**	0%	**7**	1%	**0**	0%
Metapodials - shafts	**5**	10%	**66**	17%	**0**	0%
Phalanges & tarsals	**1**	1%	**1**	1%	**1**	3%
Total	**21**	4%	**145**	6%	**22**	5%

In conclusion, the pattern of burning suggests the meat was heated predominately in a way that left little traces of burning on bones. Presumably it was deboned for cooking. Roasting whole chunks of meat with bones was very rare. Burning of shafts implies that many long bones, notably the caprine metapodials, were heated on the fire after defleshing. This may be connected to the practice of consuming roasted marrow, which was taken out of the bone after heating the bone mid-shaft and breaking it. A smaller incidence of burning on hindlimbs may be associated with a differential treatment of bones after porging, as seen at Chełm.

6.6.4.3 Lelów

Burning was more common at Lelów than at the other analysed sites. Burning is present on 12% of bones from Lelów (n=212 NISP). The frequency of burning on cattle and caprine bones is similar with the exception of area A3/PerB, where burning is much more frequent on caprine bones (fig. 6.90). Pig bones seem to be burnt more often than the ruminants' (average of 19% of NISP). Six percent of horse bones were burnt. The incidence of burning is similar in general for all contexts but two from period B: A3/PerB where a higher fraction was burnt and A4/PerB, where burning is very rare.

The majority of burnt bones were affected by the indirect influence of high temperature which resulted in scorching (71%), with little divergence in particular species. The remaining fraction (29%) consists of carbonised bones. A

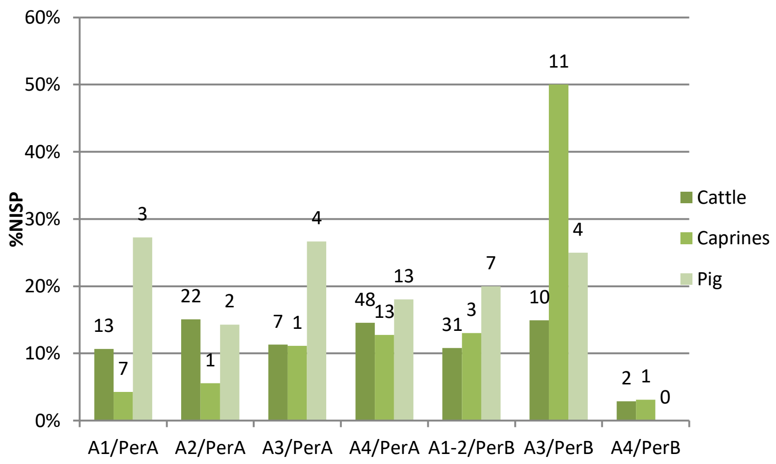

Fig. 6.90 Lelów. Incidence of burnt bones. Numbers indicate the amount of specimens burnt (NISP)

relatively high proportion of carbonised bones may suggest the importance of roasting meat cuts along with bones on the open fire.

The anatomical distribution of burning (table 6.25) suggests that all recorded parts of the cattle carcass received similar heating treatment. This is in opposition to the other analysed sites, where mostly shafts are burnt. A slightly different pattern emerges for caprines. Caprine forelimbs were burnt more often than hindlimbs, and shafts more often than the epiphyses. This resembles some of the other assemblages. This pattern suggests that bones were more often heated after defleshing, presumably to extract roasted marrow later. The

Table 6.25 Lelów. Incidence of burning on main anatomical portions. The quantity (#) is the number of remains (MNS) which are burnt; the incidence in the percent out of total MNS for the body part/portion. Calcined bones excluded

Lelów	Cattle		Caprines		Pig	
	#	%MNS	#	%MNS	#	%MNS
Mandible	**12**	19%	**3**	15%	**7**	18%
Scapula	**5**	8%	**1**	10%	**1**	10%
Forelimbs - ends	**10**	13%	**6**	16%	**8**	33%
Forelimbs - shafts	**9**	20%	**15**	39%	**11**	50%
Pelvis	**2**	7%	**1**	9%	**1**	13%
Hindlimbs - ends	**3**	6%	**1**	5%	**5**	20%
Hindlimbs - shafts	**5**	17%	**4**	18%	**8**	31%
Metapodials - ends	**84**	13%	**2**	3%	**0**	0%
Metapodials - shafts	**64**	18%	**7**	18%	**0**	0%
Phalanges & tarsals	**19**	17%	**2**	29%	**1**	50%
Total	**213**	15%	**42**	16%	**42**	24%

different incidence of marks on fore– and hindlimbs may be connected to the way the bones were processed after porging.

Burning on pig bones was recorded mostly on the upper parts of the limb. There was little difference in the occurrence of burning between the contexts and periods.

6.6.4.4 Prague

Burned bones are scarce at both sites in Prague. Burning pattern was very different for Prague Staronová and Libeň. At Staronová, it is only present on approximately 6% of specimens (n=27 NISP), with little difference between cattle and caprines. These were mostly bones showing signs of scorching, but two specimens were carbonised. At Libeň, burning is absent for houses 30, 31, and 34, but is present in less than 1% of the assemblage from both phases of house 29 (each phase n=2 NISP). These are again, mostly scorching, but one specimen was carbonised. Bones of no other species had signs of heat alternation.

The rarity of burning suggests that meat processing was presumably done on deboned cuts, or that the common method of processing did not leave any burning marks — such as cooking in water. Burning at Staronová was noted a little more commonly on long bone shafts than articular ends (table 6.26). This may imply roasting of defleshed bones for further marrow consumption, as seen at the other analysed sites.

Table 6.26 Prague. Incidence of burning on main anatomical portions. The quantity (#) is the number of remains (MNS) which are burnt; the incidence in the percent out of total MNS for the body part/portion. Calcined bones excluded

Prague	Cattle				Caprines			
	Staronová		Libeň		Staronová		Libeň	
	#	%MNS	#	%MNS	#	%MNS	#	%MNS
Mandible	0	0%	0	0%	0	0%	0	0%
Scapula	2	20%	0	0%	0	0%	0	0%
Forelimbs - ends	1	10%	0	0%	1	4%	1	1%
Forelimbs - shafts	3	21%	1	4%	3	6%	1	1%
Pelvis	0	0%	0	0%	0	0%	-	-
Hindlimbs - ends	0	0%	0	0%	0	0%	0	0%
Hindlimbs - shafts	1	14%	0	0%	5	10%	0	0%
Metapodials - ends	0	0%	0	0%	1	4%	0	0%
Metapodials - shafts	5	33%	1	4%	5	18%	0	0%
Phalanges & tarsals	1	3%	0	0%	0	0%	-	-
Total	13	10%	2	1%	15	6%	2	1%

Chapter 7

Finding the *Displaced Tendon*. The process of porging and its zooarchaeological indicators

The religious prescriptions and the historic observance of porging are presented in section 2.1.3. In the following chapter I tackle the possible zooarchaeological implications. The first part of the chapter, section 7.1, focuses on the basics of anatomy of the tissues which are to be removed according to the Judaic laws and customs. The second part, section 7.2, presents and discusses two separate actualistic studies I performed to determine what kinds of marks may be left on bones after porging according to religious prescriptions. In the third part, section 7.3, I use the gathered information to search for similar patterns in the archaeological material. The fourth part, section 7.4, sums up the outcomes and discusses the analogies available in the literature.

7.1 Anatomy of the forbidden tissues

Porging removes two prohibited nerves: the 'inner nerve', or *gid hanasheh*, which is forbidden in the Torah; and the 'outer nerve', or *gid hachitzon*, whose prohibition derives from the Talmud. There are some differences in the interpretation of the nature of those tissues (see section 2.1.3). I will focus on the interpretation in the Ashkenazi tradition, since that tradition would most likely be practised in Polish and Czech cities.

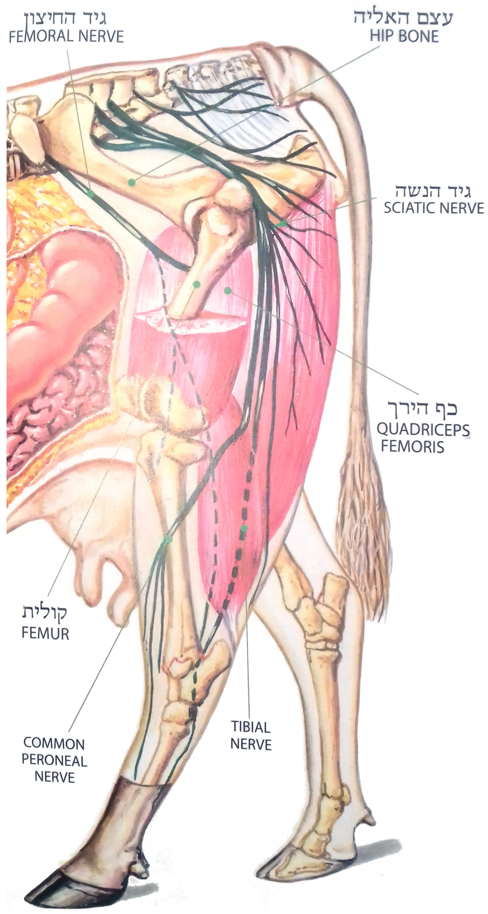

Fig. 7.1 Location of cattle nerves relevant in porging. Illustration from Lach (2011, p.95)

The '**inner nerve**', or *gid hanasheh*, refers to the sciatic nerve; and in the Ashkenazi tradition includes all its branches (Lach, 2011, p.194–197). The sciatic nerve is the continuation of the sciatic plexus, emerging from the intervertebral foramina located in the lumbar and sacral vertebrae (fig. 7.1, and fig. 7.2) (König et al., 2004, p.522–525). It exits pelvis through the greater sciatic notch, next to the ischiatic spine of the innominate. It passes the proximal epiphysis of the femur mostly on its caudal side (fig. 7.2). At the proximal third of the femur, it divides into tibial nerve and common fibular (peroneal) nerve (König et al., 2004, p.525). These two nerves are not close to the femur shaft, but they pass its distal epiphysis on the caudal side. In the midfemoral area, the tibial nerve gives off sural nerve, which passes in between the condyles of the distal femur. The common fibular nerve passes by the lateral condyle of the distal femur; then it detaches the superficial fibular nerve and divides into superficial and deep branches (König et al., 2004, p.528). Both further divide, and one of the

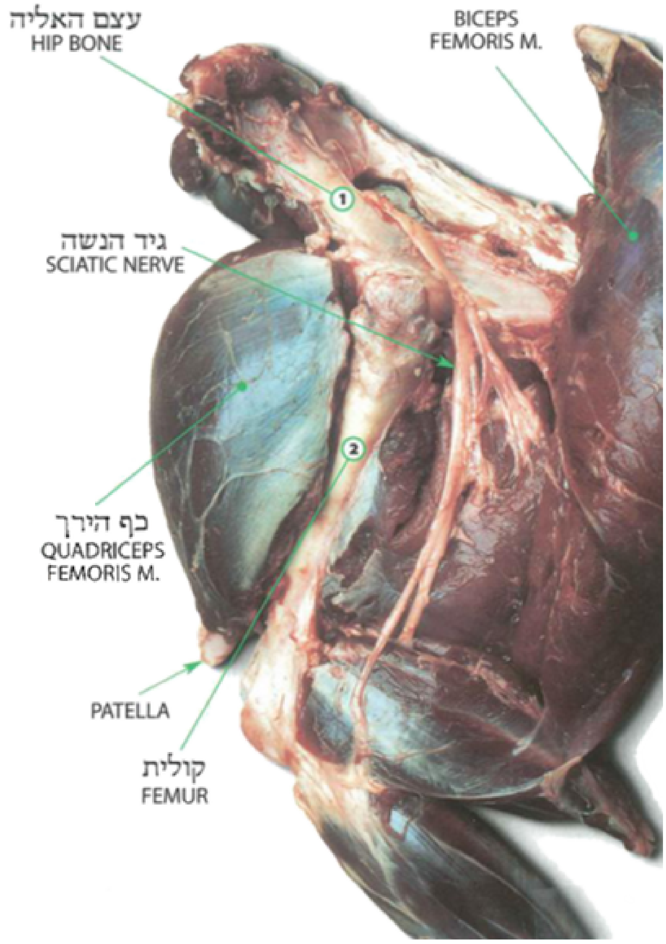

Fig. 7.2 Location of 'inner nerve': sciatic nerve. Illustration from Lach (2011, p.95)

branches of the deep fibular nerve passes the dorsal aspect of the tarsus. These nerves and their branches descend the limb further distally.

The '**outer nerve**', or *gid hachitzon*, in the Ashkenazi tradition refers to the femoral nerve and its branches (Lach, 2011, p.194–197). The femoral nerve is located on the medial side of the leg (fig. 7.1 and fig. 7.3). It descends from the lumbar vertebrae, passes the pelvis adjacently to pectin pubis, and branches into the saphenous nerve, which enters the femoral canal (König et al., 2004, p.522). The saphenous nerve passes the femoral canal cranially to the femoral artery. In the middle section of the thigh this nerve is located mostly shallow under the skin, but its small branches reach deeper and can be found near the medial side of the stifle joint. The saphenous nerve then descends down the entire limb, to the hoof (Lach, 2011, p.196).

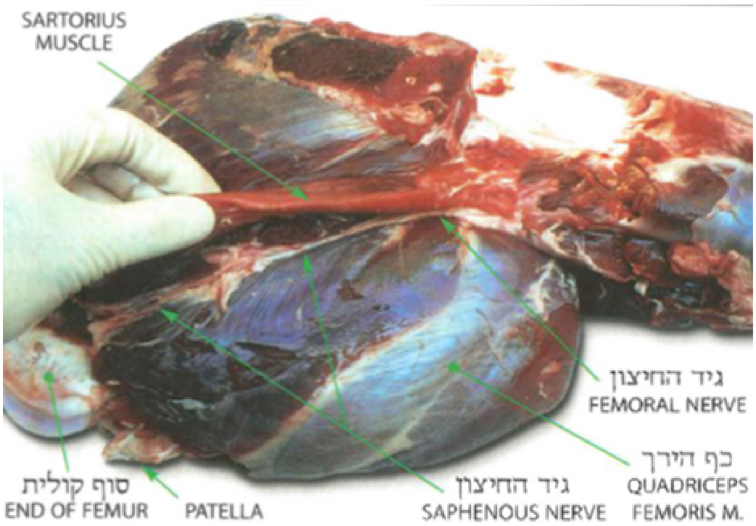

Fig. 7.3 Location of 'outer nerve': femoral nerve. Illustration from Lach (2011, p.95)

7.2 Potential of porging in producing a pattern of butchery marks on bones

Based on the religious regulations dated to the Middle Ages (see details in section 2.1.3), there seem to be three main ways porging may theoretically leave marks on the bone. They are listed below, and later in this chapter I investigate how they can actually occur.

Firstly, cutting off major nerves, their branches, and the surrounding fat and veins may potentially leave cut marks on adjacent bone. The sciatic and femoral nerves with their main branches are embedded in the muscle in most locations, passing near the bone only occasionally (see fig. 7.2 and fig. 7.3). The few possible locations where removing the nerves may involve slicing the bone include the vertebrae from which the nerves descent; the ischium and the caudal aspect of the greater trochanter of the femur which are close to the sciatic nerve (see fig. 7.1 and fig. 7.2); and the medial part of the stifle joint near distal femur and proximal tibia, where branches of the saphenous nerve are located. It is possible to remove the major nerves with very little or no cutting to the bone; assuming the person wielding the blade has a sound knowledge of anatomy and no particular guidelines on the way it supposed to be done. The porging, however, is not an efficient surgery, but a butchery activity governed by numerous religious rules, traditions, and habits. The porger is obliged, especially in the Ashkenazi tradition, to seek and cut off all the branches, even the thinnest, and the fat and blood vessels in the practice called 'digging' (Lach, 2011, p.99 and 197). Hence, even if porging of the main nerves will not affect the bone in many locations, the 'digging' for branches and other tissues may. Still, it may be very difficult to detect this practice on archaeological bone due to equifinality. Occasional cut marks produced during porging may not be possible to be differentiated from disarticulation or filleting. Only a very particular, distinct, and redundant pattern of cutting would need to be present to be unequivocally associated with porging.

Secondly, the religious prescriptions require scraping of bones in order to remove the remnants of prohibited tissues (see section 2.1.3); this practice may potentially result in a variety of scraping marks on the surface of the femur, tibia, and pelvis. Scraping of bones in order to remove soft tissues is usually rather rare in assemblages from medieval urban sites. It is much more common in societies which use blunt implements to smash the bone to access marrow: it serves to remove the periosteum which would cause the implement to slide off the bone (e.g. Binford, 1981). It is not essential in the medieval or early modern butchery, when iron or steel cleavers were used to split bones.

Thirdly, the prescription of breaking hindlimb bones in order to finish the porging (see section 2.1.3) may result in chop marks in specific locations, repeated for many specimens. However, removing the epiphyses also facilitates marrow extraction and bones may be split into several parts for cooking and this is not specific to the Jewish practice of porging and is present on bones from archaeological sites of all periods. Chopping may be therefore used as an indicator of porging only if done in an uncommon and distinct way, and different for hind- and forelimbs; otherwise, it will be impossible to unequivocally attribute it to porging.

In the next section, I will try to determine, in a controlled actualistic experiment, whether these three actions genuinely leave marks on bones. Firstly, I will discuss the ethnographic case study of modern porging in Israel. Secondly, I will tackle the problem of the identification of the marks scraping can leave on bones.

7.2.1 An ethnographic case study of modern porging in Israel

This section describes the outcomes of an ethnographic research I conducted in Israel in order to learn the way present-day porging is preformed and determine what marks it leaves on bones. This part of study was carried out in cooperation with Ram Bouchnick (Kinneret College, Israel).

The research included witnessing and documenting butchery and porging, and collecting the bones for subsequent analysis. The chosen subject was a rural orthodox community in Netivot (Heb. נתיבות), Southern Israel.

I attended a butchery and porging event of a young goat, which I documented in pictures and recordings. The witnessed process was not industrialised but rather carried out at a very small scale by a few local religious butchers in the presence of a rabbi in a garden of a household. It was meant to fulfil the food needs of the butchers and their social circle during the upcoming holiday of *Passover*, or *Pesach*. One of them was the ritual slaughterer, *shoychet*, and most of further butchery was done by another one, who also acted as the porger, *menakker*. The butchers carried out the butchery in their usual manner, although they were aware of the purpose of the study. They were using standard modern steel knifes and cleavers. After the butchery I collected the pelves, femora, and tibiae.

Over the course of the following several months, more bones of sheep and goats were procured by my colleague in Israel; they derived from subsequent butchery events carried out by the same butchers. All the events took place in similar circumstances, though I only attended the first.

All bones were obtained raw, straight from the butchers; therefore, no cut marks related to food preparation or consumption were made. Due to logistic constrains, only bones of pelvis, femur and tibia were acquired; hence, this study will focus on porging of the hindquarters, rather than the whole butchery process. Collected raw bones were deposited for natural decay in an open-air cage at the Department of Archaeology, University of Haifa, and recovered a year later, cleaned and analysed.

The total number of collected caprine legs is 18: eight left ones and ten right ones. Each leg includes pelvis, femur, and tibia. Apart from the first case (a goat), It is not known whether the bones came from sheep or goat.

7.2.1.1 A butchery and porging episode in Netivot

During the recorded butchery episode, a juvenile male goat was killed according to the *shechita* prescriptions (see section 2.1.3). The feet were removed at the

Fig. 7.4 Porging in Netivot: (a) One of the butchers initiating the processing of the goat carcass. (b) Part of the inspection of the carcass, *bedikah*. The butcher blows air to the lungs to determine whether they have perforations. Finding them would mean that the animal is not kosher, and prevent the consumption of the meat. (c) The twelfth and thirteenth ribs are cut apart marking the border between the front and hind parts of the carcass. Subsequently, a cut will be made through the spine to release the front part. (d) The butcher shows the location of the sciatic nerve, *gid hanasheh*. (e) Removing meat from inside of the thigh. (f) Butcher is cutting away muscles from the right side of the pubic area. The left side was previously already cut; the acetabulum and the femoral head are exposed and partly disarticulated

carpal/tarsal joints, and they were then hanged on hooks through the gambrel space (between calcaneal tendon and tibia). The cut on the hock (tarsal joint) was made between the astragalus and centroquartal; therefore astragali and calcanei were left with the shanks, whilst the centroquartals were discarded with the feet. The carcass was subsequently decapitated, skinned, cut open and eviscerated (fig. 7.4, picture a). Its lungs were inspected for lesions according to the *bedikah* prescriptions to determine whether the animal was kosher (fig. 7.4, picture b). The shoulders were cut off between scapulae and the ribcage, and the sternum was vertically chopped through. Instead of dividing it lengthwise the spine, as it is usually done in modern butchery, the carcass was divided into the front part — which requires only little porging — and the hind part. The trunk was separated between the twelfth and thirteenth ribs, which is traditional in Jewish butchery (fig. 7.4, picture c).

After cutting off the front part and all the ribs, only the hind legs and a part of the spine remained suspended on the hooks. Working on the pelvic area and the medial part of the thighs, the butcher removed the kosher cuts of meat and sliced off pieces of forbidden fat, *chelev*, which surround the main muscles. He placed them in separate containers. Subsequently, he determined the location of the sciatic nerve, *gid hanasheh*, stating that it starts eight centimetres from the spine (fig. 7.4, picture d). It seemed that the butcher was not concerned with the femoral nerve — a nerve prohibited in Ashkenazi tradition as the *gid hachitzon*. He cut the inside of the tight (fig. 7.4, picture e) and the pubic area (fig. 7.4, picture f), to release the main muscles covering femur. Cutting into the femoral head and the acetabulum, he disarticulated the hip joint, paying attention to the ligament of the head of the femur — if damaged prior to his actions, the meat would not be kosher (fig. 7.4, picture f).

To reveal the sciatic nerve, the meat had to be cut off the femur and the bone needed to be removed. Hence, the muscles on the shaft of the femur were cut (fig. 7.5, picture a), and during this process the knife was drawn longitudinally through the thigh, often along the femur shaft, touching the bone. These actions left long slicing marks seen on the proximal part of the shaft (see below). Eventually, the whole shaft was released, exposing the sciatic nerve (fig. 7.5, picture b). The femur was then cut off the stifle joint and saved for subsequent processing (fig. 7.5, picture c). The remaining muscles of the thigh were removed, and the whole leg was cut off from the pelvis (fig. 7.5, picture d). The shank — the tibia with some muscles and tendons — was also detached from

Fig. 7.5 Porging in Netivot: (a) Removing meat from the femur. The knife leaves long cut marks on the surface of the bone, seen on the proximal part of the shaft on fig. 7.8 (b) Muscles of the thigh were cut apart to release the femur and expose the sciatic nerve (the long and thick white tissue). (c) The disarticulation of the stifle joint. The condyles of distal femur are exposed. (d) Removing of the leg from the pelvis. (e) One of the butchers holding a disarticulated shank. (f) The carcass, divided into chunks after the primary butchery, is prepared for further processing on a cutting board. (g) The butcher filleting the shank. The distal part, with the astragalus exposed, is on the left-hand side of the picture. (h) Filleting marks on the proximal part of shaft of tibia

the muscles of the upper part of the leg (fig. 7.5, picture e). At this point all hindquarters were disarticulated, and the separated cuts consisted of:

- the loin with the part of the spine,
- the hip (pelvis and sacrum, but most of the meat was already sliced off),
- the disarticulated and filleted femora,
- the boned muscles of the thigh,
- the shanks

They were placed in a container to be ready for the next stage of processing, which took place on a nearby porch.

Further porging was performed on a chopping board (fig. 7.5, picture f). The head was opened to extract the brain; the tongue was chopped off the mandible. The forequarters and spine were cut and chopped into cuts ready for meal preparation. Most of the butcher's work was focused on the hindquarters. The loin was porged from the remaining prohibited fat and filleted. The remnants of meat were removed from the hip. The pelvis itself has many pieces of prohibited tissues; however, it would be cumbersome to porge, due to the awkward shape of the bone and was not considered to be worth doing. Hence, the sacrum and both pelves were discarded altogether, not even split. The sciatic nerve, *gid hanasheh*, and the prohibited fat were removed from previously boned muscles of the thigh. At this point, the femur had already been filleted during the initial part of the butchery, but the tibia had most of the meat still attached. The butcher removed the gastrocnemius muscle, which constituted the majority of meat still located on the shank: he sliced it lengthwise the bone on the cranial and caudal sides of the proximal half of the shaft of tibia (fig. 7.5, picture g), and cut off the ends of the muscle perpendicularly. These actions left, respectively, longitudinal and perpendicular marks on the shaft (fig. 7.5, picture h). He also briefly shaved the tendons and prohibited nerves off the shaft. The butchers did not consider the nerves in the shank — including tibial nerve and common peroneal nerve — to be *gid hanasheh* itself. In their tradition, these nerves were *knotnot* (Heb. קנוקנות), the branches of *gid hanasheh*, forbidden by the rabbinic ordinance. It is worth mentioning that these nerves are considered as a part of *gid hanasheh* in the Ashkenazi tradition (see 2.1.3).

The final part of porging included removing the epiphyses of femora and tibiae. The supervising rabbi explained — after the religious texts (see section 2.1.3) —

Fig. 7.6 Porging in Netivot: (a) Filleted femur before the removal of the ends. (b) Filleted tibia before the removal of the ends. (c) Removing epiphyses of the femur. (d–e) Removing epiphyses of tibiae. (f) Two tibiae and a femur with their epiphyses chopped off. Both epiphyses of the femur were removed, whereas only the proximal epiphyses were removed from the tibiae; the distal epiphysis in both cases is still articulated to calcaneus and astragalus and the major tendons. Discarded epiphyses are on the left-hand side of the picture and were considered not kosher

that the ends are to be removed because the branches of *gid hanasheh* terminate there and a lot of *chelev* is present on joints. It is impossible to remove those tissues from the bone with a knife; hence, the ends need to be chopped off in order for the bone to be kosher and used for stock or marrow consumption. He argued that both ends of femur, but only the proximal end of tibia, were to be removed, as this was the way it was done "since the olden days". Consequently, the butcher removed the epiphyses of both femora and both proximal epiphyses of the tibiae. This action was done after the bone had already been filleted (fig. 7.6, pictures a–b); the butcher placed it vertically on the cutting board, and used a heavy cleaver, delivering a series of blows to the shaft near the epiphysis (fig. 7.6, pictures c–e). The angle of the blows was acute in relation to the bone, resulting in long chop marks. The blows were delivered on the circumference of the shaft: the butcher rotated the bone after each blow, which successfully removed part of the epiphysis. Each epiphysis required a couple to several blows, targeted usually at three locations. For the proximal femur these locations were, approximately: the neck of the femur, on the medial side of the bone; the lateral part of the greater trochanter, and the lesser trochanter, on the caudal side. For the distal femur three locations were also targeted: two sides of the popliteal surface, above the condyles; and the trochlear tuberosity. For the proximal tibia one location was the tibial tuberosity, and the other two were the two sides of the bone on the caudal aspect, below each of the condyles. The epiphyses were discarded as not kosher, and the shafts, if not claimed for the analysis, would have been used in the kitchen (fig. 7.6, picture f). On a side note: epiphyses of humeri and radii were not chopped off. This concluded the butchery process.

The bones from subsequent episodes of butchery, collected from the butchers later, allegedly underwent a similar process. There was, however, one major difference: the epiphyses were rarely chopped off. The reason for this will be discussed below.

7.2.1.2 Butchery marks on ethnographic bones from Netivot

Figures in this section show the distribution of butchery marks on all bones from Netivot. Many of the recorded marks could not be unambiguously attributed to a specific butchery activity; this is a typical limitation of the actualistic ethnographic — or any zooarchaeological for that matter — butchery studies (see Nilssen, 2000, p.24).

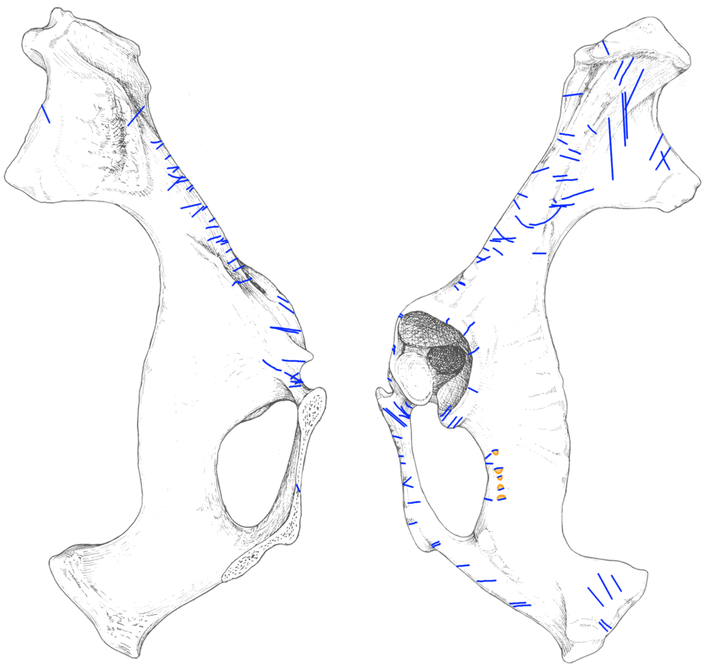

Fig. 7.7 Butchery marks recorded on pelves (n=18) from the ethnographic study at Netivot. Key: blue lines — slice marks; orange areas terminating with a blue line — knick marks

Pelvis (fig. 7.7). Butchery marks on pelvis are present on 17 out of 18 specimens. With one exception, the marks are slice marks. The majority of marks are on the body of the ilium: they were presumably left during the filleting of the bone. Marks on the pubis can be attributed to the action of opening the thigh (see 7.4, picture f). The sciatic nerve passes the ischium, and its removal may be expected to leave butchery marks there. Marks on that region are, however, few. One specimen bears an interesting series of knick marks in this area (marked in orange on fig. 7.7). These marks, unfortunately, are difficult to attribute to a specific event. It was mentioned above that pelvis was not porged intensively during the witnessed butchery, as it was considered not possible to be properly porged by the butchers in Netivot. As a result, rather little attention was given to it before it was discarded as not kosher. Pelves were not even chopped through the pubis, which is usually commonly done by butchers of many other cultural backgrounds. This suggests that no pattern of butchery marks left by porging is present on pelvis.

Femur (fig. 7.8). Butchery marks were recorded on all 18 analysed femora. The majority of bones, 17 specimens, have slice marks (blue marks on fig. 7.8). Commonly present (on 11 specimens) are longitudinal or oblique long slices, usually on the medial side of the shaft. These slice marks were made during filleting of the femur (seen on fig. 7.5, picture a); this action was not porging

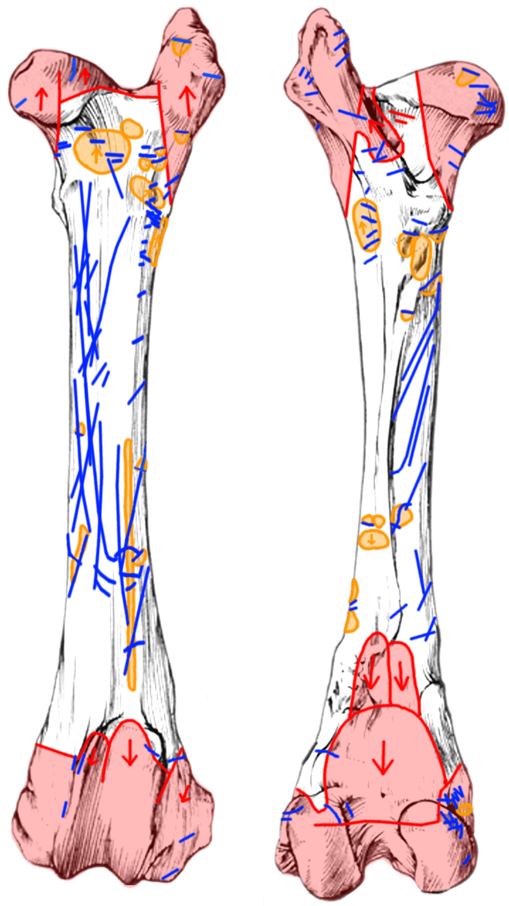

Fig. 7.8 Butchery marks recorded on femora (n=18) from the ethnographic study at Netivot. Key: blue lines — slice marks; orange areas — scoop marks, orange areas terminating with a blue line — knick marks, red areas — chopping marks (with direction indicated by an arrow) and chopped off parts

itself, but the preparation to it. Another cluster of slice marks, most probably also created during the filleting, was observed on the lateral aspect of the proximal part of the shaft — these marks are short and horizontal or slightly oblique. They were recorded on eight specimens. Disarticulation of the hip joint left marks on 11 specimens; these are slice marks located mostly on the cranial aspect of the proximal epiphyses and on the head of the femur and the greater trochanter. Scoop and knick marks are present on nine specimens. Most of them are rather random, short and incidental marks which were made during the above-mentioned filleting process, when the knife cut too deep into the bone. Only on the femora from the initial butchery episode witnessed in Netivot scoop marks are different. They are wider and deeper (see the orange areas on the cranial aspect of the proximal shaft on fig. 7.8); made by the cleaver during porging of the bones, when the knife did not struck the bone with enough force to penetrate it (seen also in picture on fig. 7.9, and fig. 7.10). The last type consists of chop marks, found only on femora from the initial episode (red areas on fig. 7.8). These were long marks through the bone, located near the epiphyses (fig. 7.9, fig. 7.10). Their origin was discussed in the previous section. To sum up, there is no indication that the recorded slice marks on femur reflect the pattern of porging, but the pattern of chop marks was produced during the action of bone porging.

Fig. 7.9 Chop and scoop marks on one of the proximal femora from porging in Netivot, made during the removal of the epiphysis by the porger

Fig. 7.10 Chop and scoop marks on one of the distal femora from porging in Netivot, made during the removal of the epiphysis by the porger

Tibia (fig. 7.11). Butchery marks were present on 16 out of 18 tibiae. Slicing marks were the most common, as they were present on 16 specimens. Some slicing marks were left during the disarticulation of the proximal epiphysis (six specimens). Another action reflected on the bones was filleting, as seen in fig. 7.5, picture g. It left long oblique or vertical marks on the shaft made during filleting (six specimens). All 16 specimens bore short marks along the shaft,

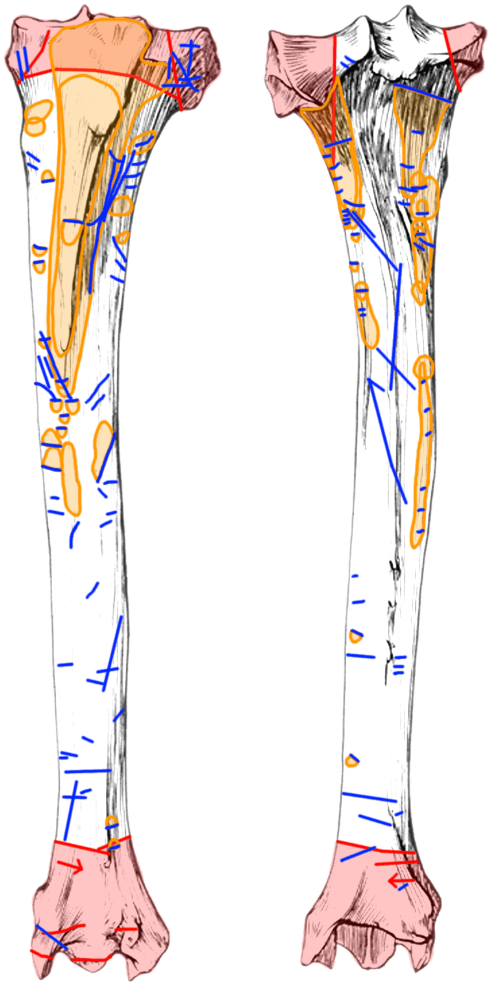

Fig. 7.11 Butchery marks recorded on tibiae (n=18) from the ethnographic study at Netivot. Key: blue lines — slice marks; orange areas — scoop marks, orange areas terminating with a blue line — knick marks, red areas — chopping marks (with direction indicated by an arrow) and chopped off parts

horizontal and slightly oblique: mostly slice mark, and on six specimens also knick marks (orange areas with blue lines on fig. 7.11). They were presumably left during filleting or scraping of the bone. Two specimens (both from the original butchery episode in Netivot) had their proximal epiphyses chopped off (red patterns on fig. 7.11); this was accompanied by long and deep scoop marks on the proximal part of the shaft, on the tibial tuberosity and on the caudal aspect of the bone (see fig. 7.12). These scoop marks were also witnessed on another specimen. Distal epiphyses were chopped off in three cases. All three cases occurred on bones procured after the initial butchery episode and had only the distal epiphyses removed, but not the proximal ones. The technique of chopping was different in those cases than for the proximal tibia as described above: the chopping did not occur at an acute angle to the axis of the bone, but transversely, with one or two strong blows a few centimetres above the epiphysis. These epiphyses were removed not during porging, but during the initial stage of butchery, when the feet are removed.

To conclude, butchery marks recorded on tibiae are generally not associated with porging; however, a few distinct marks may be attributed to it. During the porging witnessed in the first butchery episode in Netivot, the porger briefly scraped the shafts of the forbidden tissues and removed the proximal epiphyses, which are deemed not to be kosher. These actions left a distinct pattern of chopping on the proximal epiphyses (long and acute chop marks), scoop marks on the tibial tuberosity and a few long scoop marks on the shaft (fig. 7.11 and fig. 7.12).

Fig. 7.12 Chop and scoop marks on proximal tibiae from porging in Netivot, made during the removal of the epiphyses by the porger

7.2.1.3 The limitations of the ethnographic study in Netivot

The ethnographic research in Netivot shed light on the process of porging; however, was also burdened by an unexpected issue.

Before conducting the observations, I had not considered the Jewish tradition to be an important factor influencing the process of porging. Initially, I had assumed that all prescriptions for porging derive from the Talmudic texts, and hence are uniform for all the Jewish butchers. However, much of the regulations and traditions actually derive from much younger scriptures of the medieval and post-medieval Jewish sages. As discussed before in section 2.1.3, the rationale behind the butchery and porging derives from Talmud, but the very technique of its preparation depends heavily on the local tradition and the practical hands-on training of the butcher. The tradition also affects the understanding of terms *gid hanasheh* and *gid hachitzon*: the prohibited inner and the outer nerves (see discussion in section 2.1.3). For the Ashkenazi butchers, the former is the sciatic nerve with all its descending branches, and the latter is the femoral nerve with all set of its branches. The Ashkenazi tradition also instructs the porgers to undertake so-called 'digging' for all the branches, even the thinnest ones, and remove them along with adjacent fat and many blood vessels which cross them. In the Sephardic tradition the understanding of the inner and outer nerves may be slightly different (see section 2.1.3), as the femoral nerve may not need to be removed. This difference makes the Sephardic porging much less time consuming and meticulous, and explains why the Ashkenazi communities in Europe and America in recent centuries ceased performing their painstaking version of porging. The modern butchery and porging traditions in Israel follow the mix of traditions of the early twentieth century settlers, and are often based on the Sephardic tradition. The porgers from Netivot did not remove the femoral nerve, nor did they engage in painstaking 'digging' for the thinnest branches of the nerve. This means that the process witnessed in Netivot most probably represents a less meticulous porging technique than in the medieval and early modern cities of Poland and Bohemia. Ideally, future ethnographic research should need to look into the Ashkenazi present-day porging, in order to investigate possible differences.

The current study, fortunately, is still useful for zooarchaeological research as it confirmed that porging may result in producing direct marks on bones. The Netivot butchers, in consonance to the medieval Judaic prescriptions (see section 2.1.3), split the epiphyses of femur and tibia from the shafts, but they did not do this on the regular basis. The bones from the initial butchery event witnessed in Netivot were split, but the bones provided by the butchers for the research later were generally not broken. There are two possible explanations: there is no use of bone grease and marrow in this community; or the butcher simply did not care to remove the ends, because the bone was not meant for consumption, as instead it was handed out to us for the analysis. The former reason requires further explanation. The initial event, during which the epiphyses were chopped off, took place before the holiday of *Passover*. During *Seder*, the ritual *Passover* feast, it is required to have a *Zeroa*, a symbol of the sacrificed lamb, which is a roasted sheep or goat bone, ideally from the shank (Cohn, 1981). The bones from the witnessed episode of butchery were supposed to serve this purpose. The bones collected later were processed after the *Passover*; they were not needed any more for the *Zeroa*. They were also not needed for food as the bone grease and marrow are generally not a popular food choice in modern society, due to the abundance of better quality food; therefore, bones were not porged, most likely because there was no use for them.

7.2.2 Scraping — actualistic experiment

Scraping may be performed to remove thin remnants of soft tissues overlaying the bone after filleting; such as the residues of muscles, tendons, or the periosteum. The medieval religious prescriptions require scraping of bones in order to remove the remnants of forbidden soft tissues and to finish the process of porging. It is not described, though, how this process of scraping should look like.

When using a metal blade, it seems that **two techniques for scraping** may be used. The first case occurs when the blade is drawn perpendicularly along the surface of the bone, with a right angle (fig. 7.13, picture a); the second is when the blade is held at an acute angle to the bone (fig. 7.13, picture b). During the former, when the blade is driven over the flat surface of the bone — in long bones the easiest way to perform this is along the long axis of the shaft — the surface of the bone is generally not severely shaved away, but the knife may leave fine **longitudinal striations** (fig. 7.13, picture c; see also examples on fig. 7.22, and in Nilssen, 2000, p.38). If too much pressure is applied to the knife, the blade may bounce or skip over the surface during its sweep (Newcomer, 1974; Olsen, 1988). This will leave characteristic types of marks resembling a bar pattern: regular, closely spaced corrugations, oriented at the right angle to the striations, that is perpendicular to the direction the blade was drawn. These marks are called **chatter marks** (fig. 7.13, picture d, see also examples on fig. 7.23, and in Newcomer, 1974; Olsen, 1988). This technique, that is a knife oriented at the right angle to the bone, is unlikely to be used in filleting: it would not be possible to remove thick cuts of meat, because it merely scrapes the remnants of soft tissues from the filleted bone.

In the second technique, when the blade is tilted and forms and acute angle with the surface of the bone, the knife will remove the soft tissue and may shave a thin part of the cortical surface (see also chapter 4.6.3). This kind of mark is

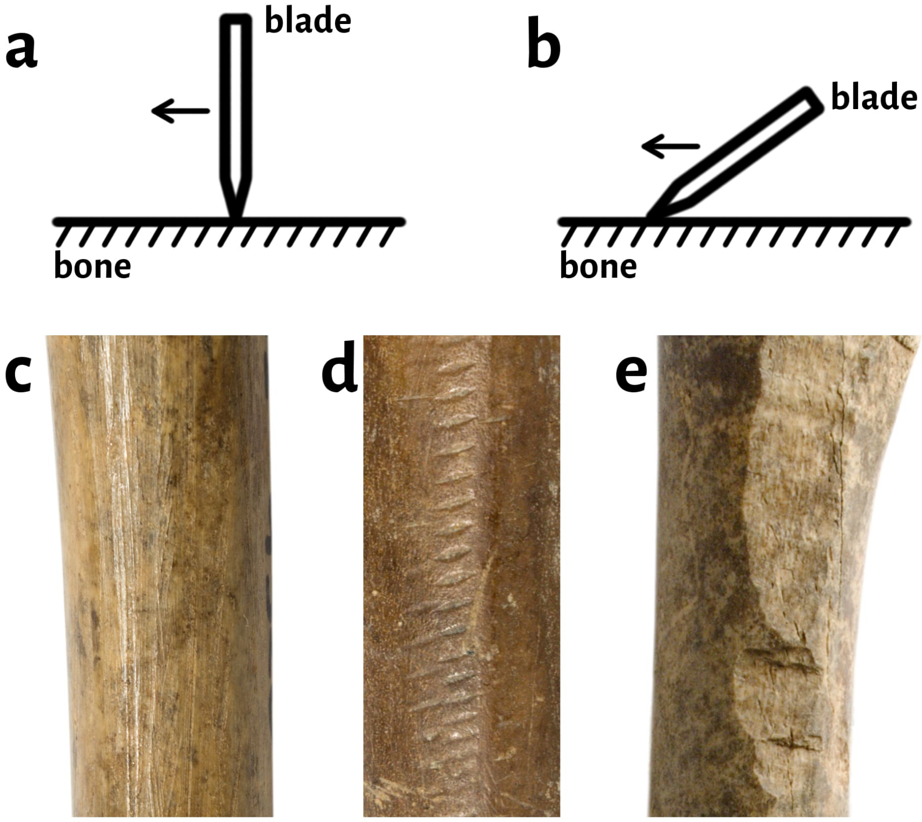

Fig. 7.13 Different kinds of scraping marks on bones: (a) Schematic of scraping with the blade oriented with a right angle. (b) Schematic of scraping with the blade oriented with an acute angle. (c) Example of longitudinal striations. (d) Example of chatter marks. (e) Example of scoop/shaving and knick marks

referred to as **shaving** or **scoop mark** (fig. 7.13, picture e, and also Seetah, 2006, p.128). Scoop marks are sometimes left during filleting, because in this action the knife may remove thicker layers of meat from the bone. Filleting scoop marks tend to be short (Nilssen, 2000, p.584).

To determine how the action of scraping is performed and demonstrate what marks it leaves on the bone I conducted a small experiment. I used two sets of sheep femora and tibiae, obtained with cuts of meat attached, from a local English butchers. I removed the meat in a roughly similar fashion to the porging I had witnessed in Netivot. I was left with bones which still had remnants of meat attached (fig. 7.14, pictures a–b), and roughly resembled those I had witnessed at Netivot (fig. 7.7, pictures a–b).

In this exercise I used two knifes: a wide and heavy knife which may resemble a small cleaver, and a smaller boning knife[1]. I have tried two different actions: (1)

[1] My family heirloom that belonged to my relative, a butcher in the early 1900's Poland

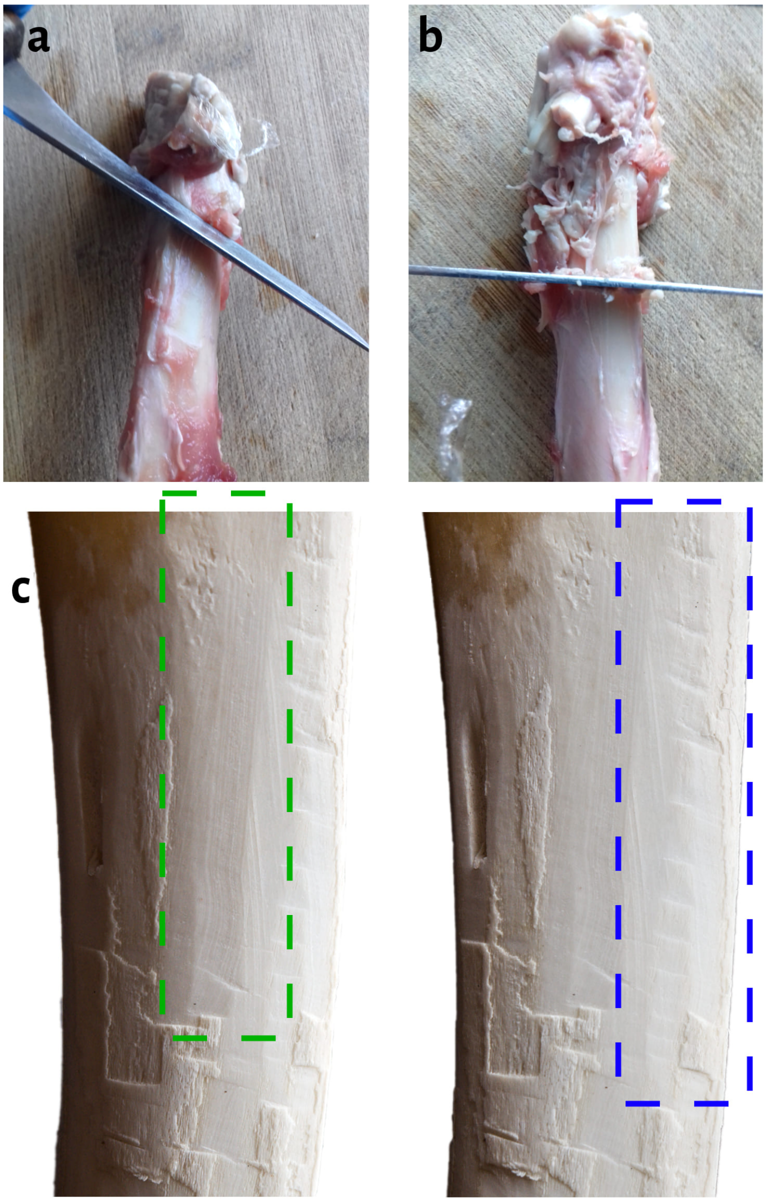

Fig. 7.14 Experimental scraping of bones: (a) Knife held with an acute angle to the surface of the bone producing shaving/scoop marks. (b) Knife held with a right angle to the surface of the bone scratching the surface. (c) Caudal aspect of the shaft of one of the tibiae: chatter marks produced during the experiment in blue; longitudinal striations in green

the knife was driven along the shaft with its blade tilted at the acute angle to the surface of the bone (fig. 7.14, picture a), and (2) the knife was driven along the shaft with its blade at the right angle to the surface of the bone (fig. 7.14, picture b). Each of those actions I also performed with two intensities: applying little amount of force, just enough to remove some soft tissues, and applying the largest force possible.

The results, as expected, have supported the information from the literature (Newcomer, 1974; Olsen, 1988; Seetah, 2006). As seen in fig. 7.14, picture a, the action of drawing the tilted blade along the shaft removes a thin shaving, or a flake, of bone, leaving a scoop mark behind. The amount of force applied to this action determines the depth of the scoop mark, but if the force is excessive the knife will bury into the bone and stop the movement, creating a so-called knick mark. The type of blade does not affect the shape of the mark itself; however, it was easier to apply larger force with the heavier blade, hence it would be more likely to leave deeper marks.

When the blade was hold at the right angle to the bone (fig. 7.14, picture b) the marks were different. When the amount of force was minimal, the knife produced barely visible longitudinal striations. With a larger force a very thin layer of bone was scraped off (fig. 7.14, picture c, in green). Finally, chatter marks were produced when the force applied to press the knife against the bone during the sweep was very large (fig. 7.14, picture c, in blue). With this amount of force the blade kept burying in the bone and forcing it to move along the bone caused it to 'jump', instead of moving smoothly. In turn, marks left by this action are akin to those described by Newcomer (1974) and Olsen (1988) as chatter marks. In needs to be stressed that the scraping of the bone which leaves chatter marks requires a very large amount of force, much larger than required to scrape off the periosteum. This is impractical and seems unnecessary, which is presumably the reason why these marks are very rare in butchery but are known in bone craftsmanship (Newcomer, 1974; Olsen, 1988).

Finally, this small actualistic experiment allowed me to determine and understand better a few of the possible types of marks which can be left on bone when the butcher is determined to remove all the remnants of soft tissues.

7.2.3 The outcomes of the actualistic studies — the possibilities for detecting porging in butchery marks on bones

The present actualistic studies have greatly contributed to the issue of detecting porging through the animal bones. There are three main conclusions.

Firstly, there is little or no possibility that cutting off the prohibited nerves will result in a pattern of slice marks. If such marks occurred, they would be scarce and it would be probably impossible to differentiate them from filleting or disarticulation.

Secondly, the splitting of femur and tibia is a practised part of porging, albeit it is not performed if the bone itself is not meant to be used as a food resource. This means that it is possible to detect porging on archaeological femora and tibiae, based on a pattern of chopped off epiphyses; both for the femur, and presumably only the proximal one for the tibia. The pattern of chopping may possibly resemble the pattern evidenced for Netivot. The epiphyses after this process are discarded as not kosher and this may result in an underrepresentation of the epiphyses of femur and tibia comparing to shafts. This pattern, however, may also be caused by the worse preservation of epiphyses in the archaeological contexts. What is more, one has to be careful, because splitting bones may be performed as a part of regular marrow processing, which is present in many cultures and times.

Thirdly, scraping was performed only occasionally on bones from Netivot, despite the religious texts instructing the porger to scrape off the remnants of the prohibited tissues from the femur and tibia. This custom is practised by the Ashkenazi butchers, and was most probably performed in the past. The zooarchaeological literature supported by a small actualistic experiment performed here show that intense scraping may result in production of several different types of marks — longitudinal striations, chatter marks, and scoop/shaving marks — depending on the angle the blade was hold and the force that was applied. These kinds of marks, especially the chatter marks, which production requires applying force whose extent is not required during regular butchery, are usually not commonly found in great numbers on archaeological bones. Therefore, a repetitive and common pattern of these marks on archaeological femora and tibiae may be associated with porging.

In the next section of this chapter I will present the outcomes of the search for the above-mentioned patterns of chopping and scraping in the assemblages from the researched Polish and Czech archaeological sites.

7.3 Zooarchaeological application of the religious and ethnographic studies on porging

In the two previous sections of this chapter, I determined from the religious literary sources how porging is supposed to be performed, discussed what kind of marks on bones this process may leave, and investigated what marks it would have left when performed by the present-day religious butchers. In this section, I will apply the gathered information to the analysis of the archaeological assemblages. This approach is deductive — meaning that during the analysis of the archaeological bones I was not trying to assign any encountered random marks on bones of the hindquarters to porging. Rather, I was searching for a pattern determined by information from the previous two steps. I determined that there is little possibility that slicing marks will reflect the pattern. Therefore I focused on searching for a consistent pattern of scraping (shaving of the bone, striations and chatter marks) and bone breaking near the epiphyses on femora and tibiae. These kinds of marks were indeed present on bones from most analysed archaeological contexts, strongly suggesting a sound connection between medieval religious written regulations and the practice reflected in artefacts.

The following section will present the qualitative and quantitative data concerning the porging pattern at the five sites analysed in this thesis: Chełm, Wrocław, Lelów, Prague–Staronová Synagogue, and Prague–Libeň. These sites will be discussed in conjunction with comparative data from a recently published study on bones from a fourteenth–seventeenth century site in the Jewish district of Poznań, at the intersection of streets Szewska and Dominikańska 68 (Makowiecki, 2016c, p.217–220), which I have also briefly analysed in search for analogous butchery patterns.

Table 7.1 Distribution of cattle and caprine long bones (proximal–shaft–distal). Table repeats the data from section 6.1. Bars represent the relative bone frequencies in each assemblage

MNS	Cattle					Caprines				
	Chełm	Lelów	Wrocław	Prague Staronová	Prague Libeň	Chełm	Lelów	Wrocław	Prague Staronová	Prague Libeň
Humerus (p)	5	4	2	1	3	2	2	25	1	0
Humerus (s)	51	33	26	7	12	44	18	120	28	17
Humerus (d)	41	32	18	4	22	28	12	97	12	26
Radius (p)	34	23	13	5	40	27	12	86	13	29
Radius (s)	36	12	13	7	15	49	20	159	26	55
Radius (d)	16	17	14	0	6	20	11	61	1	15
Metacarpal (p)	59	158	22	3	7	12	16	181	9	5
Metacarpal (s)	53	149	28	6	9	14	17	200	12	5
Metacarpal (d)	32	123	12	1	9	8	13	124	2	4
Femur (p)	12	24	23	3	0	5	3	22	1	0
Femur (s)	14	14	19	4	2	9	5	105	23	1
Femur (d)	4	4	11	0	1	2	5	19	1	0
Tibia (p)	0	2	9	3	0	0	0	12	0	0
Tibia (s)	20	15	21	3	10	25	17	155	29	4
Tibia (d)	12	20	13	3	7	19	11	75	9	1
Metatarsal (p)	58	195	17	4	16	15	21	164	12	27
Metatarsal (s)	62	207	23	9	16	16	23	194	16	31
Metatarsal (d)	33	153	19	4	9	5	16	99	4	8

7.3.1 Porging-related bone splitting

Based on religious texts (see section 2.1.3) and the ethnographic analogy from Netivot, the practice of porging may involve chopping off the epiphyses of the femur and proximal tibia, which themselves are not porged and discarded.

The most obvious way to investigate this practice in an archaeological assemblage is to compare the number of epiphyses and shafts of those two elements. Unfortunately, this introduces the risk of equifinality, because the epiphyses are known to preserve worse than shafts due to their lower structural density and bone fusion (see section 5.6.2). The taphonomic bias may be particularly pronounced for the late fusing elements, including the above-mentioned bones. When the frequencies of epiphyses and shafts from the sites are taken into consideration (table 7.1), the discrepancies indeed occur, and epiphyses are generally underrepresented comparing to the shafts, both in fore- and hindlimbs. In a few cases, the bias against the epiphyses seems to be more pronounced for the femur and proximal tibia than for the other elements, especially in caprines of Wrocław and Prague Staronová. This means that the discrepancies between ends and shafts may be associated with porging. This feature alone, however, is not a reliable indicator of the presence of this practice due to the possible equifinality with the taphonomic loss — femur and proximal epiphysis of tibia are late fusing elements and tend to preserve badly.

Fig. 7.15 Examples of chop marks of a different angle: chopped at a very acute angle (<45°) on the left, chopped transversely (45°–90°) on the right

Another indicator of porging-related bone splitting is the direct presence of butchery marks. To investigate this, I tallied the long bones with their epiphyses chopped off. I took into the account only long bone shafts bearing chop marks and fulfilling a few assumed criteria: (1) have at least two chop marks with similar direction, shape, and location; (2) at least one of the blows caused the bone to split and the chop marks go through the bone so only one wall of the kerf is present; and (3) chop marks are located on the shaft, in the proximity of the fusion line (up to a few centimetres). Bones chopped through mid-shaft were not counted in this exercise. Apart from those criteria, two types of chop marks were differentiated: (A) the blow was delivered transversely to the shaft, leaving a chop mark with a wall angled between 45 and 90 degrees to the surface of the bone (fig. 7.15), or (B) the blow was delivered at an acute angle leaving a chop mark with a long wall oriented less than 45 degrees to the surface of the bone (fig. 7.15).

The frequencies of caprine and cattle long bones with chopped off epiphyses are presented in fig. 7.16, and fig. 7.17. This practice was almost exclusive to cattle and caprines. The ends of pig long bones were very rarely chopped: only two

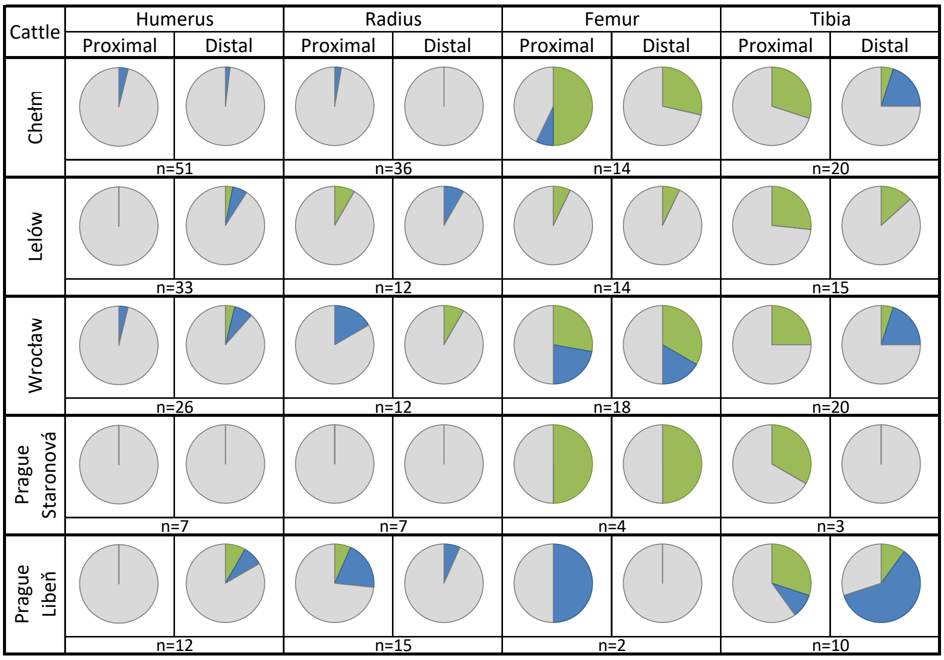

Fig. 7.16 Incidence of cattle long bones with epiphyses chopped off from the shaft. Green colour indicates the incidence in the assemblage of the specimens chopped at an acute angle (<45°) to the bone surface; blue — specimens chopped transversely (45°–90°) to the bone surface; grey — specimens with no visible traces of the removal of the epiphysis. The n numbers indicate the amount of shafts (MNS) in the particular assemblage. The criteria described in the text

specimens were recorded for Lelów (a proximal humerus and a proximal femur; 4% of total MNS), and four specimens for Wrocław (a proximal humerus, two distal humeri and a distal tibia; 4% of total MNS). A few conclusions emerge from fig. 7.16, and fig. 7.17:

1. It is clear that the ends of bones of the hindlimbs are much more frequently chopped off, than of the forelimbs. This pattern is very clear for caprines, a little less so for cattle, and absent for pig.

2. This practice was the most frequent on caprine bones from Wrocław, then Prague Staronová and Chełm; less so on cattle bones from those sites and at Lelów. It was rare, but not absent at Prague Libeň.

3. The removal of the ends of the femur and proximal tibia was predominately done in a different manner than for other elements. Most ends of those bones were chopped at an acute angle. Meanwhile, the distal tibia and the forelimb bones — which do not require porging — were chopped differently, in a transverse way, or the epiphyses were not removed at all.

The evidenced butchery pattern is very distinct and is present on the hindlimb bones from Wrocław, Prague Staronová, Chełm, Lelów and Prague Libeň. It is also present in a relatively large numbers at the site in Poznań (Makowiecki, 2016c, p.217–220). The shafts of femur with their epiphyses chopped off (see fig. 7.18) are common and redundant across the majority of the analysed contexts. The removing of the proximal (fig. 7.18, marked in red; fig. 7.19, pictures a–e) and distal (fig. 7.18, marked in red; fig. 7.19, pictures f–k) epiphyses of the femur was carried out usually with a few blows on the circumference of the shaft, with an acute angle to the surface of the bone. The marks strongly resemble marks witnessed at Netivot (see fig. 7.8, fig.7.9, fig.7.10), despite the fact that bones at Netivot were chopped more closely to the epiphyses. It is likely that the marks on the archaeological bones were made in an action similar to porging at Netivot (see fig. 7.6, pictures c).

A similar pattern is present for the tibia (fig. 7.20): long and acute chop marks were left on many bones after their proximal epiphyses were removed. The chop marks are accompanied by long scoop marks, and are commonly present on the tibial tuberosity (fig. 7.20, pictures a–g; fig. 7.21 pictures a–e), and other sides of the proximal tibia shaft (fig. 7.20, pictures h–l; fig. 7.21). These marks closely correspond to marks found on tibiae from Netivot (see fig. 7.11, fig. 7.12), and were likely to have been produced in a similar fashion (see fig. 7.6, pictures d–e). A common pattern for distal tibia, however, includes transverse splitting of the distal part of the shaft, about one third of the shaft from the distal end (see fig. fig. 6.70, fig. 6.79, and fig. 7.20, or not removing it at all. Some cattle tibiae, additionally to having their proximal epiphyses removed, were perpendicularly chopped through in proximal part of the shaft (i.e. about one-fourth of the length of the shaft from the proximal epiphysis), producing short cylinders, similar in looks to present-day commercially available so-called marrow or stock bones (fig. 7.21, pictures k–m).

The different treatment of the distal tibia compared to the femur and proximal tibia may be due to a practical custom: the distal part of tibia has substantially less meat than the upper parts of the leg. However, given the repetitiveness and distinctiveness of the pattern and its close resemblance to bones from Netivot, it is likely that the marks constitute an indication of porging.

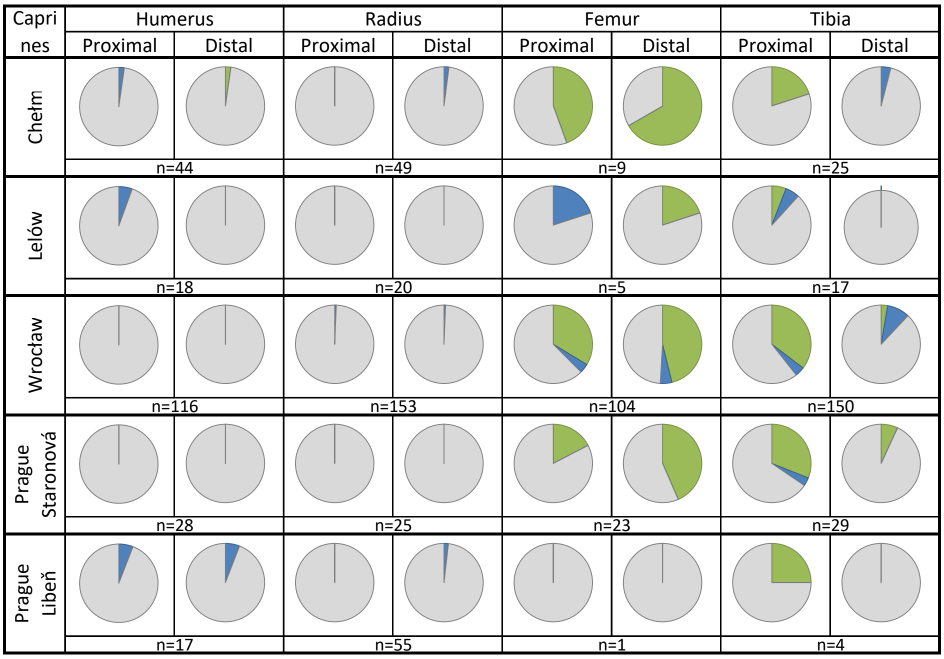

Fig. 7.17 Incidence of caprine long bones with epiphyses chopped off from the shaft. Green colour indicates the incidence in the assemblage of the specimens chopped at an acute angle (<45°) to the bone surface; blue — specimens chopped transversely (45°–90°) to the bone surface; grey — specimens with no visible traces of the removal of the epiphysis. The n numbers indicate the amount of shafts (MNS) in the particular assemblage. The criteria described in the text

Fig. 7.18 The porging pattern on archaeological femora. Key: chopping of the epiphyses in red, scoop/shaving in yellow, chatter marks in blue, longitudinal striations in green. (a) Poznań, cattle; (b) Prague Staronová, cattle; (c) Wrocław B3, juvenile cattle; (d) Wrocław, cattle; (e) Wrocław D, caprine; (f) Wrocław B3, caprine; (g) Chełm ph1, caprine; (h) Wrocław B3, caprine; (i) Prague Staronová, caprine; (j) Chełm ph2, caprine

Fig. 7.19 The porging pattern on archaeological femora. First row: chopping off the proximal end. Second row: chopping off the distal end. Third and fourth rows: scoop/shaving marks around the supracondylar fossa. The colour-key same as on fig. 7.18. (a–b) Wrocław B3, caprine; (c) Wrocław B3, juvenile cattle; (d) Poznań, cattle; (e) Prague Staronová, cattle; (f) Wrocław B3, caprine; (g) Wrocław D, caprine; (h) Wrocław B3, caprine; (i) Wrocław C3, caprine; (j) Chełm ph2, caprine; (k) Prague Staronová, cattle; (l–m) Chełm ph1, cattle; (n–o) Prague Staronová, cattle; (p) Wrocław B3, cattle; (q) Wrocław, cattle; (r) Poznań, cattle; (s–u) Wrocław B3, caprine

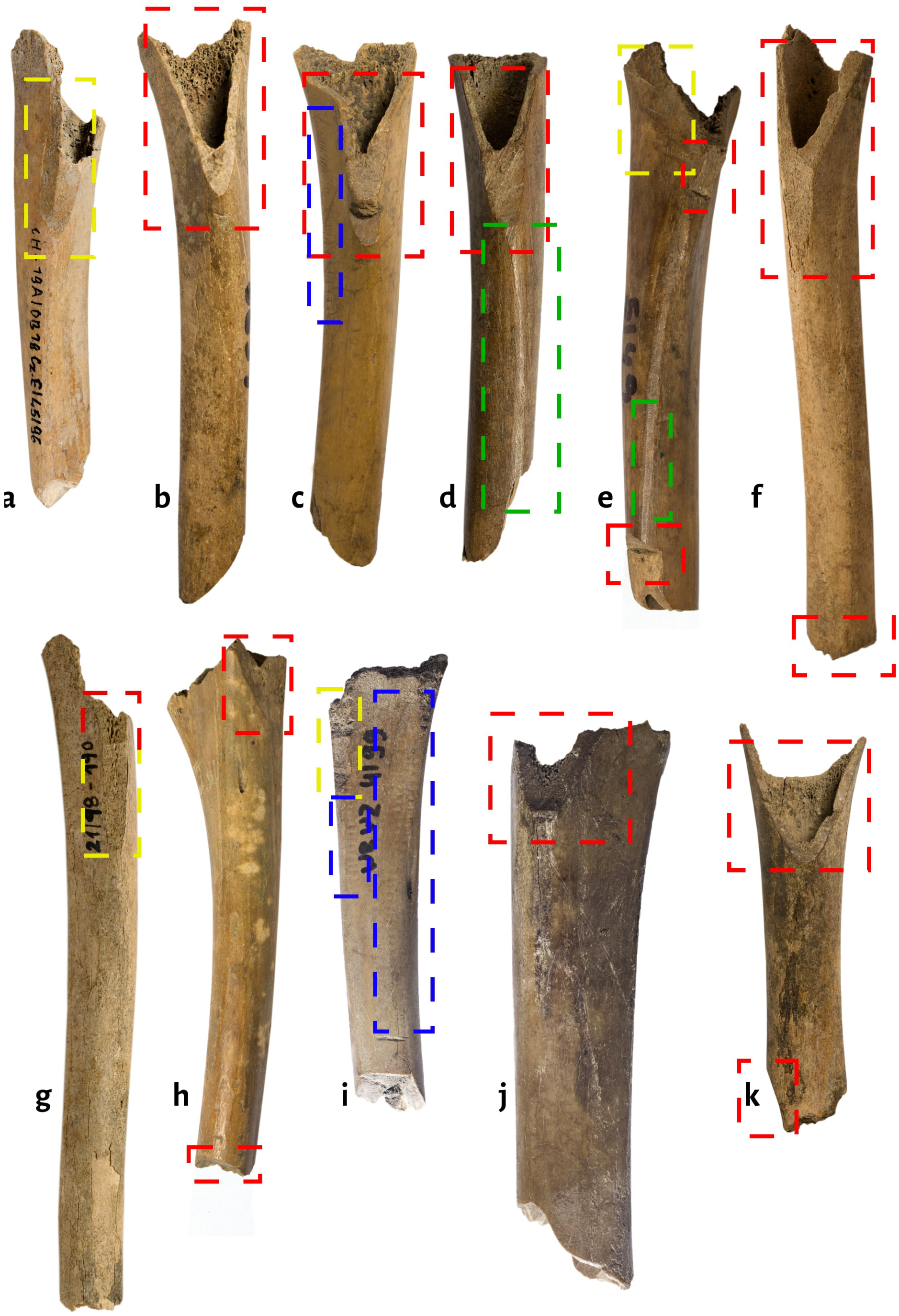

Fig. 7.20 The porging pattern on archaeological tibiae. The colour-key same as on fig. 7.18. (a) Chełm ph2, caprine; (b) Wrocław C3, caprine; (c–d) Wrocław B3, caprine; (e) Wrocław C3, caprine; (f–g) Prague Staronová, caprine; (h–i) Wrocław B3, caprine; (j) Wrocław B4, cattle; (k) Wrocław C2, juvenile cattle

Fig. 7.21 The porging pattern on archaeological tibiae. First row: chopping off the proximal ends of caprine tibiae seen on the tibial tuberosity. Second row: chopping off the proximal ends of caprine tibiae seen on the caudal side of the shaft. Third row: cattle tibiae with proximal ends removed and portioned shaft. (a–b) Wrocław B3; (c) Wrocław C3; (d) Wrocław B4; (e) Chełm ph2; (f) Wrocław C1; (g) Wrocław C3; (h) Wrocław B3; (i) Prague Staronová; (j) Wrocław B3; (k–l) Chełm ph2; (m) Prague Libeň ph2

7.3.2 Porging-related bone scraping

According to religious scriptures (see section 2.1.3), porging would also require scraping of the hindlimb bones from the remnants of forbidden tissues. This practice was not carried out extensively at Netivot, having only been observed on a tibia, which may be connected to a specific butchery tradition of modern Israel (see section 2.1.3).

To investigate this topic, I focused on the presence of three distinct types of scraping marks: longitudinal striations, chatter marks, and scoop/shaving marks (see section 7.2.2). All three types of marks were detected on bones of cattle and caprines from the researched sites, whereas pig bones very rarely bore them: only four pig limb bones in total from all sites had scoop marks. The pattern of scraping on cattle and caprine bones corresponds with the pattern of chopping off the ends described above: the majority of scraping was performed on bones with the ends removed. Longitudinal striations on the circumference of the shaft of femora and tibiae were common (fig. 7.22; and fig. 7.18, pictures e–f; fig. 7.19, picture f; fig. 7.20, pictures d–e) in caprines, and to a lesser extent cattle. These were often associated with chatter marks in places where the scraping blade was pushed against the bone with a larger force; for example, on the caudal side of the femur (fig. 7.23; and fig. 7.18, pictures d and h; fig. 7.19, picture h; fig. 7.20, pictures c and i). Scoop/shaving marks were found in clusters on caprine and cattle bones. They were commonly present on the caudal aspect of the shaft of the femur, especially in a cluster around the supracondylar fossa, where the marks were long and/or very abundant, suggesting a very meticulous cutting of the attached tendons (fig. 7.19, pictures l–u; and fig. 7.18, pictures a, c, f, g, i). In tibia, scoop/shaving marks were found on the tibial tuberosity and the circumference of the proximal part of the shaft (fig. 7.20, pictures, a, e, g, i; and fig. 7.21).

Scraping (collectively: striations, chatter marks and scoop marks) is substantially more common on long bones of the hindlimb — the femur and to a lesser extent the tibia — than on the forelimb (fig. 7.24, and 7.25). On cattle bones (fig. 7.24), scraping is present most often on femora, tibiae and less on the forelimbs. However, this does not hold true for Lelów and Libeň (see below). For caprines (fig. 7.25), this pattern is clearly visible on the most substantial assemblage from Wrocław, where a vast majority of femora and a majority of tibiae were scraped, whilst the forelimb bones have very few of those marks. A similar pattern is also clear for Prague Staronová, and somewhat for Chełm.

Fig. 7.22 Scratching (longitudinal striations) on bones with the porging pattern. (a) Wrocław D, sheep femur, lateral aspect of distal shaft; (b) Wrocław B3, sheep femur, caudal aspect of distal shaft; (c) Wrocław C3, sheep femur, lateral aspect of midshaft; (d) Wrocław B4, sheep femur, lateral aspect of distal shaft; (e) Wrocław B3, sheep femur, medial aspect; (f–g) Wrocław B3, sheep tibia, medial aspect; (h) Wrocław C1, caprine tibia, medial aspect of midshaft; (i) Wrocław B3, caprine tibia, medial aspect of proximal shaft; (j) Wrocław, caprine tibia, lateral aspect of midshaft

Fig. 7.23 Scratching (chatter marks) on bones with the porging pattern. (a–b) Wrocław B3, caprine tibia, lateral aspect of proximal shaft; (c) Wrocław B3, caprine tibia, cranial aspect of midshaft; (d) Wrocław A, caprine tibia, lateral aspect of midshaft; (e) Wrocław B3, caprine femur, caudal aspect of distal shaft; (f) Wrocław B3, cattle femur, cranial aspect of midshaft; (g) Wrocław A, cattle femur, lateral aspect of distal shaft; (h) Wrocław C3, caprine femur, medial aspect of midshaft; (i) Wrocław, cattle femur, medial aspect of shaft (j) Prague Libeň ph2, cattle tibia, medial aspect of midshaft

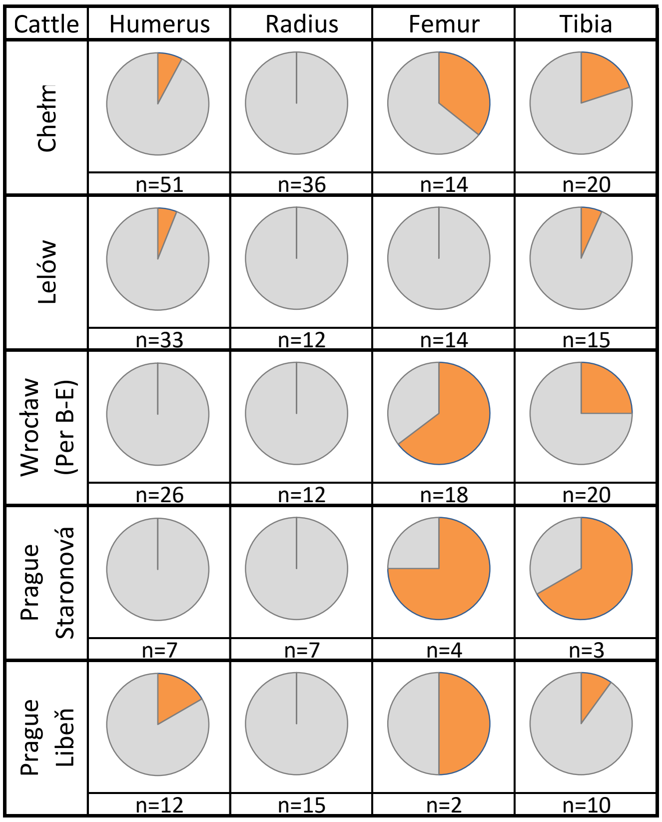

Fig. 7.24 Incidence of scraping (longitudinal striations, chatter marks, and scoop/shaving marks) on shafts of long bones of cattle (MNS)

The sites at Lelów and Prague Libeň, again, do not seem to follow the pattern. Scraping was also commonly present on cattle and caprine hindlimb bones from Poznań (for example fig. 7.18, picture a; fig. 7.19, picture r; and Makowiecki, 2016c, p.219–220).

The detailed analysis of the location and type of scraping marks was performed for the most substantial assemblage, Wrocław. Figure 7.26 shows the incidence of three types of scraping on specific zones of the bone: epiphyses and eight zones of the shaft of femur and nine zones of the shaft of tibia. Scraping was evidenced predominately on the shafts of those two elements, with very few cases bearing marks on the epiphyses or the distal part of the tibia shaft. Marks on the femur (fig. 7.26) follow the same pattern for both cattle and caprines. Longitudinal striations are generally present almost uniformly around the whole shaft (see examples on fig. 7.22), suggesting that femora were commonly fully scraped around their circumference. Chatter marks are also present on all locations of the shaft but are the most abundant on the caudal side of the bone (for caprines, more precisely, caudomedial). This suggests that the butchers performed scraping with a larger force on the caudal

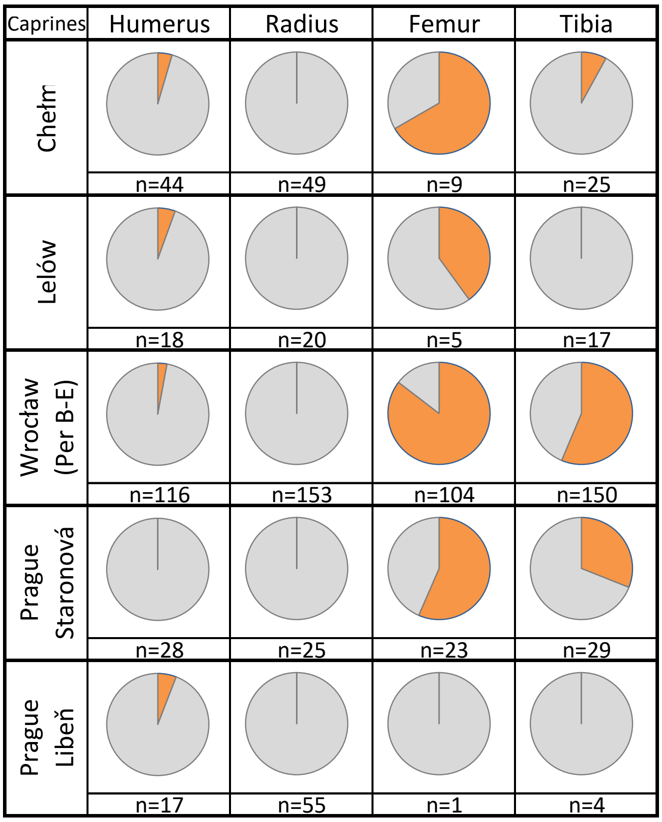

Fig. 7.25 Incidence of scraping (longitudinal striations, chatter marks, and scoop/shaving marks) on shafts of long bones of caprines (MNS)

side of the shaft. Scoop/shaving marks are rare on most parts of the femur, but common on the distal part of the shaft on its caudal side, predominately on the supracondylar fossa, where they occur in clusters (see examples on fig. 7.19, pictures l–u). These marks are often very deep, possibly made by a cleaver in an action aimed at removing the muscle attachments (see Rixson, 1989). On tibia (fig. 7.26), longitudinal striations are present around the circumference of the shaft (see examples on fig. 7.22), but are less abundant on the lateral side of the proximal part of the shaft. Chatter marks are also present in the same locations, but akin to the femur, they mostly occur on the caudal aspect of the shaft, especially in its proximal part. Scoop marks are seen on the proximal part of the shaft, mostly on the medial aspect and the tibial tuberosity.

7.4 Conclusions

The results of the research on the archaeological bones presented in this chapter seem to correspond with the medieval and early modern literary religious

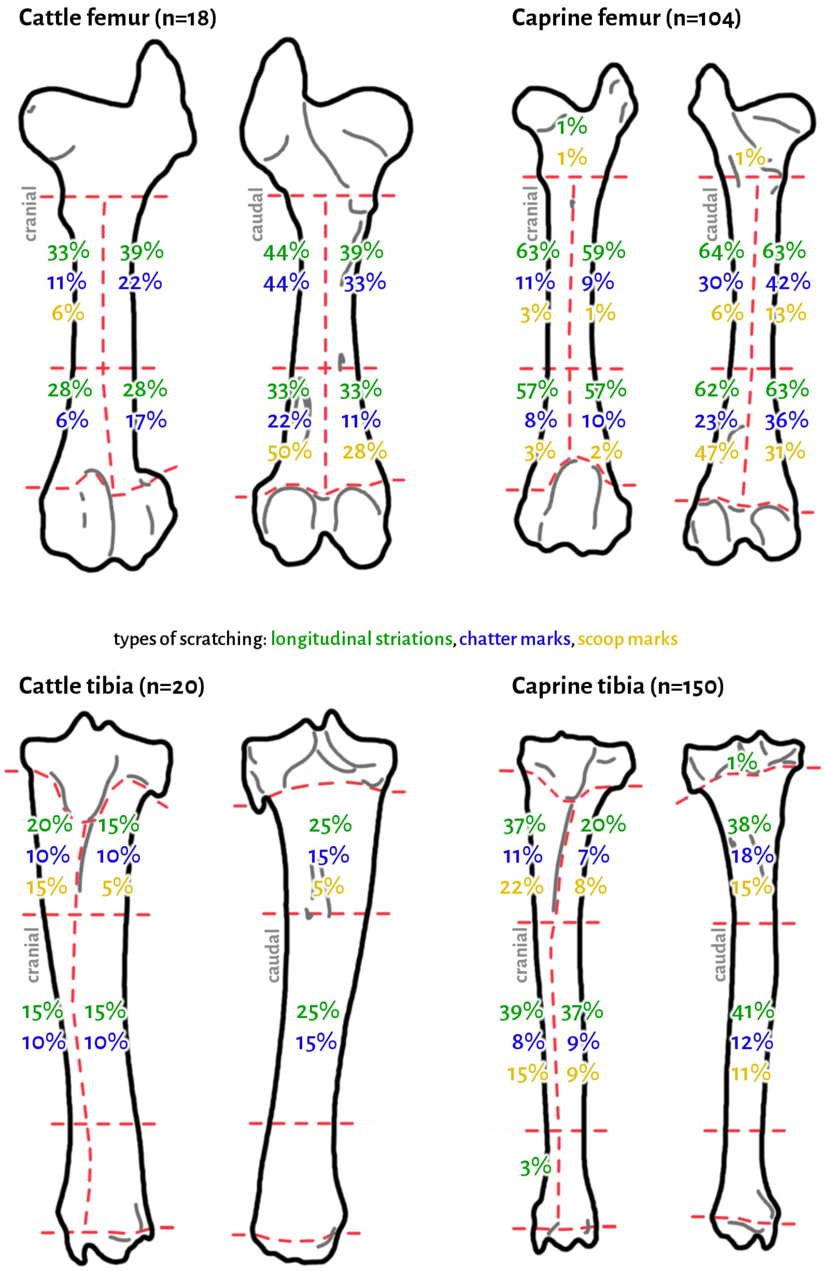

Fig. 7.26 Incidence and location of types of scraping (green for longitudinal striations, blue for chatter marks, and orange for scoop marks) on femora and tibiae at Wrocław, Więzienna 11 (MNS

prescriptions and data acquired from the study of the ethnographic bones from modern Israel. According to the religious prescriptions, porging is a complicated process involving removal of the forbidden tissues: certain fats, veins, and nerves, especially the sciatic nerve. My research shows that there is little possibility that cutting the sciatic nerve off would leave anything more but occasional slicing marks on bones in random locations. However, the medieval texts also mention porging to include removing of the ends of femur and tibia and scraping off the remnants of the forbidden soft tissues from the bone. It seems highly probable that the numerous cases of chopped off epiphyses and scraped shafts of archaeological femora and tibiae constitute a butchery pattern resulted from the action of porging by the medieval and early modern Jewish butchers.

The recorded chopping and scraping marks are very distinct, repetitive, and both types occur on the same specimens. Due to its complexity, the butchery action behind this pattern had to be very complicated and time consuming. It would render it impractical and unnecessary from an economic point of view. These marks are present only on cattle and caprines and are absent from bones of non-kosher species, such as pig. The pattern is very similar for bones of cattle and caprines. The clusters of marks are predominately, if not solely, present on bones of the hindlimb, which require extensive porging under Judaic law — the femur and proximal part of tibia — and not on the forelimbs.

The pattern is very consistent for the analysed sites, located hundreds of kilometres apart in a span of a few hundred years. This pattern is seen at Wrocław (in abundance in contexts dated to 1250 up to the 14th century; but bones with this pattern are incidentally present in contexts from 15th–17th century, presumably due to postdepositional perturbations), Prague Staronová Synagogue (11th–12th century), Chełm (15th–18th century), and Poznań (14th–17th century; from Makowiecki, 2016c, p.217–220). In smaller numbers, bones bearing this pattern were found at Lelów (14th–18th century), and in solitary cases at Prague Libeň (17th–18th century).

The low numbers of bones with a porging pattern at Libeň and Lelów requires an explanation. The presence of Jews in those two towns during the analysed period is reported by literary sources (see section 4.3.1, and 4.4.3), and low numbers of pig bones at both sites seem to confirm this information (albeit several contexts at Lelów seem to include mixed Christian and Jewish refuse; see section 6.1.3). The possible explanation of the scarcity of porged bones may lay in the body part representation. The composition of cattle and caprine bones from those two sites show an underrepresentation of the hindquarters compared to the forequarters. This suggests that a usual practice and tradition in Lelów and Libeň would not include porging, but rather the sale of the hind quarters as non-kosher meat to Christians, who resided in close proximity in both towns. However, the lack of porged bones or hindlimbs does not necessarily imply that porging was not performed. The porging of bones is performed by a trained butcher and will strip the bones of all the meat; therefore, all hindquarters' meat would be sold filleted and boneless. This means that finds of porged bones, in fact, constitute the evidence of cleaned bones acquired for a possible use of marrow and bone grease or occasionally for the *Zeroa* during the Passover (see section 7.2.1.3). Hence, the hindlimb bones would be scarce if marrow and bone grease were not a required product and were not regularly acquired by the townsfolk.

The analogies for the porging pattern in the local zooarchaeological literature are scarce. Similar repetitive and complex butchery marks were not recorded at any other local site, up to my best knowledge. The closest analogy is known a few hundreds of kilometres south of Poland and Bohemia, at a former Jewish quarter (Ger. Judenplatz — *Jewish place*) in Vienna, Austria (Czeika, 2008, p.60–74). In the assemblage from a well of a household inhabited before the 1420's, several cattle femora were found with chopped off epiphyses and extensive scooping on the shaft, resembling the porging pattern (fig. 7.27). The author notes that scooping is present on bones at local sites of Roman chronology, but is usually very rare on medieval bones from Vienna, concluding that this pattern is unusual. The porging pattern was, however, not reported or mentioned by several other studies on sites of known Jewish association. In a late/post medieval assemblage from a presume Jewish site in Berlin, some bones had their epiphyses removed, however the details of this process are not apparent (Morgenstern, 2015). A study of a large assemblage of bones from

Fig. 7.27 Examples of cattle femora from Vienna, site at Judenplatz, with chopped off epiphyses and scooping on the shaft resembling the porging pattern (picture from Czeika, 2008, p.62, fig.26)

the seventeenth-eighteenth century Jewish part of Amsterdam did not discuss the butchery marks analysis at all, and whether the pattern was present there is not known (Ijzereef, 1988). A research on an assemblage of bones from a fourteenth century Jewish site in Buda, Hungary, also does not mention the presence of a similar butchery pattern (Daróczi-Szabó, 2004). There was an underrepresentation of hindlimbs compared to forelimbs; however, cut marks on the recorded femora and tibiae were 'too few' for the analysis to be informative. The pattern was also not found at a few researched Jewish sites in ancient Israel, including at the Jerusalem City Dump of the Second Temple Period (Bar-Oz et al., 2007; Bouchnick et al., 2007; Greenfield and Bouchnick, 2010), and Yodefat and Gamla (Cope, 2004). Greenfield and Bouchnick (2010) did not find any distinct butchery marks on the hindlimb bones; they note that this may be due to a small sample size. Cope (2004) was searching for a possible butchery pattern connected to porging; however, she only identified an unrelated pattern of 'muscle stripping'.

The absence of the porging pattern at the Jewish sites from the literature may be caused by several factors. Firstly, butchery analysis is not always systematically performed in zooarchaeology: the pattern may therefore go unnoticed, which may be the case of the aforementioned Amsterdam. Secondly, in towns where porging was not performed, the hindlimbs would not be present, or if the porging was performed on a limited number of carcasses, the hindlimbs would be underrepresented and scarce. A small assemblage size caused by this would hinder the butchery analysis. This may be the case of Buda and Jerusalem. Lastly, it is possible that the tradition of porging involving breaking the epiphyses and scraping bones was not always an agreed religious custom. These actions are required by the medieval texts (see section 2.1.3), and are not mentioned by the Talmud itself. Hence, they might have been developed in the diaspora, after the exile of the Jewish people from ancient Israel. They may even constitute a predominately medieval Ashkenazic tradition in Central–Eastern Europe, which would explain their absence at the ancient Israelite sites. This issue requires further religious and zooarchaeological studies, whose chronological and geographical spans exceed the scope of this thesis.

The described 'porging pattern' on bones seem to constitute a distinct evidence of the presence of Jewish people in the archaeological area. The solitary instances of the femur or tibia with split ends and scraped shafts may be due to incidental selling of kosher products to non-Jews or postdepositional perturbations (which, however, still hint that the Jews resided in the vicinity of the site), but a common occurrence in an archaeological context may indicate the actual Jewish habitation at the site. On the other hand, porging is not always performed and there seem to be more ways of performing it, depending on the time period, location and local tradition. This means that whilst the findings of bones with this pattern likely indicate the presence of Jews in the area, their absence does not necessarily imply that they did not live there.

Chapter 8

Contextualising the zooarchaeological evidence

Chapter 6 presented the zooarchaeological analysis of faunal material from the sites at Chełm, Wrocław, Lelów, Prague–Staronová, and Prague–Libeň. In chapter 7 I described how Jewish method of butchery left marks on bones from modern Israel and demonstrated that similar evidence is available for the above-mentioned archaeological sites. In this chapter, the results of the previous analyses are interpreted and placed in a wider geographical and historical context.

8.1 Interpreting zooarchaeological data

The following section serves an important role of summarising and interpreting the analyses presented in the previous chapters. It uses the investigation on the historical and archaeological context of the finds, as presented in chapter 4, results of zooarchaeological analysis from chapter 6, and the study of porging pattern demonstrated in chapter 7. The details of the analyses in this chapter will often not be repeated or directly referred to, but the inquisitive reader will find them in the relevant chapter above.

All the analysed sites have some aspects in common. Sieving was not a regular part of the excavations at any of them. In most cases this was the cause of recovery bias against small anatomical elements, such as phalanges or tarsals, and also bones of species of small body size, such as caprines. In general, there is a pattern of density-mediated taphonomic destruction, causing underrepresentation of bones of low survivability. Analysed sites are located in towns and cities and generally constitute an example of urban consumption. Hence, the diversity of species is low and most bones derive from major livestock animals. The number of wild mammals is usually very low or they are completely absent. This is unsurprising, since game was largely unavailable to regular townsfolk in the Middle Ages and in early modern times its representation at archaeological sited plummeted (Makowiecki, 2016c, p.203).

8.1.1 Chełm

Chełm was an important Jewish town, called shtetl, in the Eastern Polish lands. The assemblage from Chełm derives from a large number of residential contexts from several locations of the town's Jewish quarter. These include wells and chalk tunnels filled with residential rubbish. The contexts were divided into two phases: phase 1 (15th–17th c.) with contemporary structure 20, and a younger phase 2 (17th–18th c.).

The Jewish character of the assemblage is reflected in the frequency of the species present. The diversity of species in the assemblage is low. Cattle remains are the most abundant, followed by caprines. Caprines, having smaller bones, are presumably underrepresented due to recovery bias. Taking this into the account means that the original disproportion between the number of bones of both taxa would be small. The ratio between sheep and goats is very balanced. Non-kosher animals, such as pig, horse, and others, are much less frequent.

The assemblage was affected by the taphonomic loss shaping the anatomical composition by removing the least durable bones from the record. The taphonomic agents are hard to identify and — given that most analysed archaeological features and layers come from different sites — may be different for all contexts. Despite that, some trends are visible. The majority of the assemblage is domestic kitchen waste, but only cattle, caprines, and pig show evidence of consumption by humans. Butchery marks on horse and fox bones do not attest the consumption of these animals but suggest that hides and skins of those species were sought.

In both cattle and caprines, heads and upper meaty parts of the limb are abundant in both phases. Cattle feet are uncommon in phase 1, but became more abundant in phase 2. Given the low consumption value of the metapodials, this may suggest the preference towards cheaper food, possibly associated with the economic decay Chełm faced in the late seventeenth century. Animal remains from Chełm are intensely fragmented and most of the fracturing occurred when bone was still fresh. This seems to be caused by the type of butchery predominant in all contexts: chopping to disarticulate legs and split bones into pot-sized portion. In structure 20, cattle remains consist mostly of a primary butchery waste: heads and feet. Similar assemblages are known in the literature; for example, in some Romano–British towns (Maltby, 1984, p.128–130). This context was partly a ditch or moat, which would be a suitable dump site for butchery performed nearby. A higher incidence of bones scavenged by dogs in this context indicate that the deposition site was exposed.

There is an abundance of caprine horncores in many contexts, including a cluster of goat horncores at Krzywa 16 Street. This presents some indication of the importance of horn working amongst the residents or the acquisition of goatskins (cf. Albarella, 2003). Evidence for cattle horn working, in the form of sawed-off horncores, was documented for phase 2, but is largely missing in the older assemblage. This coincides with the shift from phase 1 to phase 2 in the pattern of skinning marks on cattle skulls. In the younger period skinning marks on skulls were more frequent and repetitive.

Pig remains come from cuts of high meat value. They were frequently chewed on by the dogs, more often than bones of the ruminants. It is possible that some of them were brought in from different localities by the canines, but it cannot be excluded that they originally derive from the Jewish contexts.

There is a visible difference in treatment of fore– and hindquarters of cattle and caprines seemingly associated with the Jewish practice. Forequarters were more frequent than hindquarters. Forelimb bones are commonly burnt mid-shaft, whereas hindlimb bones are rarely burnt at all. The forelimbs are also more frequently chopped and broken into smaller pieces and pot-sized. Meanwhile, numerous femora and tibiae display porging pattern of butchery marks. Taphonomy of the forelimbs indicates that intensive diminution may be caused by preparing the bones for fat rendering, possibly as the result of their popularity as soup stock bones. A concurrent way of their processing was splitting them for marrow consumption. This was preceded by defleshing and roasting. The hindlimbs were rarely used that way. Porging was performed in the Chelmer Jewish community, but it appears that the hindquarter bones were not a popular dining choice. Some hindquarters might have been sold to Christians, which would partly explain the underrepresentation of that elements in the assemblage. However, it is equally possible that porged bones were just not commonly purchased due to the preference of the local Jews. The ones which made their way into the kitchens were used in a different way than parts of the forelimb. Possibly, they were cooked without the direct access to open fire. They were also not further split into pieces — the epiphyses were already removed during porging; hence, it was easier to access to the marrow cavity.

8.1.2 Wrocław

Wrocław was a multinational Silesian city with a substantial Jewish populace in the Middle Ages. The data derives from five periods of occupation of a residential lot at Więzienna 11, in the medieval–early modern Jewish district of the city.

The assemblage from Wrocław has suffered from a number of taphonomic factors, which affected the body and species part representation. Recovery bias against the small specimens is substantial and affected all the contexts at the site.

In the initial period of occupation (PerA, <1250 CE) — corresponding to the time the city was under the Polish and then Silesian authority — there was a lightly constructed building at the lot. Caprines were the most common species in the assemblage from this period, followed by pig, and then cattle. The data is too scarce to provide information on the preference of the cuts, but the abundance of mostly unbroken bones of caprine feet suggest that primary butchery could been performed at the lot, or that these parts were acquired by the inhabitants for a reason other than consumption. The permanent presence of the Jews in the city in this period was rather young according to historical texts; however, the porging pattern is already present on several bones. This implies the presence of the Jews in the vicinity of the site, and indicates that the early qahal was already organised enough to employ a menakker. Nonetheless, the occurrence of pig and hare remains implies that non-kosher animals were consumed locally too.

Under the Silesian reign over the city in the next period (PerB, 1250 CE–early 14th c.), the lot underwent development and it is possible to distinguish four functional zones: (B1) the main building in the front; (B2) adjacent horn comb and wooden barrel manufacturing and storage zone; (B3) the back buildings lent to artisans; and (B4) the sanitary area with latrines and wells.

The rubbish associated with the inhabitants of the main building — presumably the landlord who was a soldier, and his family (Wachowski, 1996) — show a predominance of caprines and pigs, then cattle. The assemblage is represented by a kitchen waste, but it does not contain cuts of high meat value. Conversely, mostly remains of heads and feet are predominant. Most bones were severely fragmented for marrow or fat rendering. Based on this, as well as other evidence (Buśko, 1999b, p.213) it may be concluded that the soldier and other inhabitants were not particularly wealthy. The previous interpretations assumed that they were Jews (Buśko, 1999b, p.213), and this may be supported by some finds of the porging pattern on bones in this area. However, the number of pig bones in this zone is much higher than in other areas, exceeding the number of cattle remains. This indicates that the soldier could in fact have been a Christian, and porged bones derive from his Jewish neighbours' waste, or that he was a Jew not observing kashrut diligently.

The assemblages from the other three zones differ from the main house. Caprine bones are more abundant than in the main house, cattle much less common, and pigs even scarcer. The presence of other species also stands in contrast to the main building. A relatively high number of horse and cat remains is present, and bones of some wild species were found in the rubbish from the back building. Butchery marks on horse bones indicate that meat of this species was processed, despite the contrary assumptions made by Socha et al. (1999, p.154). Horse bones were often split for further marrow extraction or fat rendering. Cats were exploited for their hides. The three back areas of the lot show the overrepresentation of parts of the cattle cranium and horncores compared to other parts of the bovine skeleton. Most cattle long bones, except of porged femora, were chopped cross-wise into a few pieces. Mandibles were chopped into several segments, a butchery pattern that is not present in later times. This appears to be a local butchery tradition of this period. Based on finds of numerous sawn bovine horncores, Buśko (1999b, p.212) states that the manufacture area was used by horn comb artisans. In contrast, caprine horn cores were very rare and presumably not needed for this purpose. Other parts of the caprine cranium were more abundant, and processed mandibles were common. This implies that parts of caprine heads — that is horncores, mandibles, and the rest of the cranium — were sold separately. Iconographical sources and archaeological case studies indicate that in some cases chopped off horns were still attached to hides acquired by the tanners (Serjeantson, 1989; Albarella, 2003). Besides the clear taphonomic loss of the small and less dense bones, most parts of the caprine carcass are well-represented. This includes meaty parts, which were less often chopped to pieces and fragmented than in cattle. The evidence of the Jewish presence is common with an abundance of the porging pattern that removed the majority of the hind limb epiphyses leaving only shafts.

In the next period (PerC; 14th c.) the city was under the Bohemian crown. The lot presumably changed its owners, but the functional zones known from the previous period, except the sanitary area, are still present in the assemblage. Buśko (1999b, p.213) states that the horn comb workshop ceased to exist, and is not evidenced in this period. Data for this period shows a high predominance of caprines over cattle and a small amount of pigs. Rubbish from the main building is different than from the other areas: it contains much higher percentage of cattle due to a high number of cattle horn cores. Surprisingly, the vast majority of them did not bear marks from horn removal or skinning. They may constitute remnants of construction (Armitage, 1989b) or tannery refuse (Serjeantson, 1989), but no direct evidence supporting either is present. Caprine body part representation focuses on heads, mostly mandibles, and lower parts of limbs, especially the feet. The number of bones of 'meaty' parts of the caprine carcass is generally lower than in the previous period. The main building has also lower frequencies of upper parts of the limb than the back areas of the lot. The porging pattern is present in all contexts. Horse in this period still constitutes a noticeable portion of the assemblage. Contrary to the previous period, however, horse remains in this context derive mostly from the primary butchery and evidence of their consumption is rare.

In period D (late 14th–early 15th c.) the city was still Bohemian. The lot at Więzienna 11 saw many structural changes; it was razed, and the layout of the structures altered completely (Buśko, 1999b, p.213). The stratigraphic transition between period C and D is hence very sharp, functional zones are not differentiated. As in previous periods, caprines dominate these assemblages with much fewer cattle and pigs. Cattle body part representation focuses on elements of low consumption utility: parts of the head and some foot bones. In caprine body part frequency mandibles and feet dominate. The porging pattern is present but there is a noticeable underrepresentation of caprine hind limbs compared to forelimbs. This may indicate that the Jews were still residing in the area but the porging was not as common and the upper parts of hindquarters were underrepresented comparing to forelimbs. Incidentally, this does not affect the proportions of metacarpals and metatarsals, as both elements are abundant. The possible reason for this is presented below. Meanwhile, the assemblage from this period is abundant with butchered pig bones which clearly constitute kitchen waste. Also, many horse remains were found, but butchery evidence does not support the claim of consumption of these animals. A vast array of combs from cattle metapodials, beads from cattle long bone shafts and dice suggest the presence of bone manufacturing workshop being located at the lot in this period (Buśko, 1999b, p.213; Jaworski, 1999, p.92). It is striking that the manufacturers never used pig bones for crafting.

Contexts from period E (15th–17th c.) are not as well stratified as in the previous cases, and there is a distinct possibility of a residual contamination of the assemblage. The presence of finds possibly associated with Christian tradition in this period indicates that the lot was no longer inhabited by the Jews (Buśko, 1999b, p.214). Pits with traces of fur, ash, and quicklime indicate that tannery production was undertaken at the lot (cf. Serjeantson, 1989). Numerous cattle horncores found in those pits were probably acquired with hides by the tanners and are the probable waste of this production (Buśko, 1999a, p.95).

The dominance of kosher species in the Wrocław assemblage, the underrepresentation of hind limbs in some contexts, and the abundance of bones with the porging pattern strongly suggests that the lot was inhabited by Jews. Their presence in the neighbourhood would date to before year 1250, but most of the evidence comes from later periods. In Silesian and Bohemian times (late 13th up to 14th century; periods B and C), at least some of the inhabitants of the buildings at the back of the lot were Jewish. The data is showing the evidence of consumption of non-kosher species, such as pig and horse in the late thirteenth–early fourteenth century. It is difficult to determine whether the Jewish inhabitants were transgressing or were not the sole residents of the households. Jews were also present here until the early fifteenth century, but the lot was presumably shared with Christians. It is also possible that horse meat and fat were consumed because of the difficult economical conditions. Similar situation was noted in West Cotton, where the famine was the cause for horse meat consumption (Albarella and Davis, 2010).

Most contexts at Wrocław display an interesting pattern of underrepresentation of the upper parts of the hindlimb, whereas those that are present bear evidence of being porged. This underrepresentation potentially may be caused by trade of some of the hindquarters to Christians, as the historical sources attest for a well developed Jewish meat market in Wrocław, providing meat also for Christians (Ziątkowski, 2000, p.11; Davies and Moorhouse, 2002, p.91–92).

The underrepresentation of the hindquarters at Więzienna in that time (period B) is not substantial enough to suggest that it is caused by a regular trade of the un-porged cuts to Christians. On the contrary, porging was performed locally and bones of the hindquarters were used by the Jews; although, possibly the defleshed bones of the hindlimb were a less popular dining choice for the Jewish patrons. This does not entirely contradicts the historians' claim, as even in communities where porging is a common practice, Jewish butchers produce large quantities of non-kosher meat due to mistakes during shechita and presence of animals not deemed kosher due to their diseases. The inter-community meat trade ceased around 1315 CE, when the Catholic Church insisted on banning it, claiming it was 'poisoned' (Berman, 1941, p.218). Since then, porging had to be performed in Wrocław to minimise the economic loss, and it is well evidenced in the faunal record at Więzienna.

8.1.3 Lelów

The assemblage of animal bones from Lelów derives from a variety of archaeological layers and features excavated from four areas across a large part of the town centre. It was divided into periods A and B. In period A, dated to fourteenth to sixteenth century, this prospering town was one of the most important settlements in the Lesser Poland region. Permanent Jewish habitation in the town commenced in the late fifteenth century and in the sixteenth century it accounted to several dozen Jewish families. In period B — seventeenth and eighteenth century — Lelów deteriorated and became insignificant. During this period the number of Lelover Jews dropped dramatically and the relations with Christians were repeatedly tense.

The lack of sieving during the excavation caused underrepresentation of small specimens and possibly accounts for the small number of bones of species of small body size. In a clear contrast to other analysed sites, fragmentation of the assemblage is not severe. Many cattle bones, mostly metapodials, were found unbroken. The small fragments, however, may be underrepresented due to the recovery bias

The animal bone assemblage from excavations at Lelów displays very low diversity of species. The majority of bones derive from domestic cattle followed by caprines, with small fractions of pig and horse. There seems to be a difference in spatial distribution of species. In the western/central part of the market square bones of species other than cattle are scarce. In the east of the Lelów centre cattle still dominates, but caprine and pig bones are more frequent than in the west.

The predominance of cattle in the assemblage depends on a great abundance of metapodials compared to the rest of the skeleton. The majority of those metapodials were from adult animals and had a particular state of preservation: unbroken, abraded and trampled but rarely gnawed by dogs and rodents or weathered. It is not known whether these metapodials were deposited in a particular manner as the archaeologists did not record their specific placement inside the trenches. Large proportions of them were recovered from layers which were the historic streets of Lelów. The specific character of those finds and their state of preservation indicate their possible usage as a structural material for paving the alleys, or flooring the nearby houses. The bones would be laid horizontally, possibly being incorporated into the discovered log-paved road (see Dobrakowski et al., 2013). This phenomenon was observed in both periods and in all areas of the town centre, suggesting that metapodials were widely used in this way in early modern Lelów. Case-studies from historic periods in other countries account for a similar usage of these bones. Metapodials are an abundant by-product of butchery and tanning. In early modern Britain, until the late eighteenth century, they constituted a cheap building material. They are known to have been used in construction in structural and decorative purposes, including filling the walls or paving and flooring (Armitage, 1989a,b; Rielly, 2003). So-called 'knuckle-bone' [1] floors were fashionable in the seventeenth–early eighteenth century England, especially in Oxford (Armitage, 1989b). A similar use of metapodials was identified in a seventeenth century archaeological context from Panama City (Cooke and Rovira, 1983).

Period A is characterised by a large presence of scapulae in all areas, often chopped through their glenoid cavities in a characteristic manner. Incidentally, scapulae are virtually absent in period B. One may speculate whether this reflects the decline in consumption of beef shoulders in association with the indicated by historians deterioration of Lelów in later centuries (see section 4.3). Other cattle body parts are generally scarce and only limited conclusions on the character of consumption can be drawn.

As for caprines, an overrepresentation of forequarters compared to hindquarters is seen in area 4 in period A. Another striking fact is the abundance of

[1] Armitage (1989b) argued the term *knuckle-bone* used to refer to metapodials, not as today, to astragali

caprine bones in area 1 in period A. This is due to the presence of a high number of goat and some sheep horncores in and around an early modern age household located at Krótka street. The goat horncore deposit in that context is accompanied by an unusually large number of cattle horncores and mandibles. It is unlikely this deposit is associated with consumption. Assemblages of horncores, mostly cattle, may be the result of using those bones for construction purposes — for drainage or even wall construction (see Armitage, 1989b). This assemblage, however, lacks any evidence supporting this claim; it is more likely to be a horn-working (cf. Noddle, 1994) or goatskin (cf. Albarella, 2003) refuse dump. Based on the butchery mark analysis the former is more probable: most of the horncores were chopped at the base to facilitate extracting of the horn sheath, and skinning marks are very rare on those skulls. Similar deposits of horncores in pits were previously interpreted as soaking-pits associated with horn-working, for example in York in Britain (Wenham, 1964).

The pig assemblage consists predominately of bones of high survivability, such as mandibles and long bone shafts. Horse bones are present in all contexts. Some, like metapodials, seem to be used in a similar fashion as cattle metapodials, as paving or flooring material. Numerous finds of bones of all parts of the horse skeleton bear cut marks from all stages of the butchery process, including disarticulation of cuts rich in meat and filleting. Despite assumptions made by the archaeologists (cf. Dobrakowski et al., 2013), this constitutes a rather clear evidence of acquiring horse meat.

The investigation of the Jewish presence in Lelów is difficult to conduct. A number of points imply that the town centre was indeed inhabited by the Jews, and their kitchen waste eventually ended up in the street's accumulation layers. Bones of non-kosher species are infrequent but more common than expected, and bear clear proofs of being a consumption waste. Forelimbs are predominant over hindlimbs in a few contexts: for cattle in the western part of the town centre in period B (A1–2/PerB) and for caprines in the eastern part of the centre in period A (A4/PerA). Butchery analysis attests to the presence of a porging pattern on some cattle and caprine bones. Long bones of caprine forelimbs have larger numbers of burnt bones than hindlimbs, suggesting a different treatment of porged hindquarters.

Nonetheless, most probably the majority of archaeological contexts includes refuse of mixed origins: Jewish and Christian. Because of this, it is impossible to recognise clear areas of Jewish and Christian habitation in the town centre — possibly the town even lacked distinct religious quarters and the Jewish and Christian populace lived intermixed. Another issue concerns the trade of meat. The seeming preference towards forequarters may imply that hindquarters were sold out as not porged to the Christians. In this scenario, however, porging-related bias against the hindquarters should not be so evident due to the Jewish–Christian mix in the archaeological contexts. Moreover, butchery mark evidence implies that porging was certainly a practice performed in Lelów. Hence, another conclusion seems more probable: bones of the hindlimb defleshed in porging would be less popular and only occasionally used by the townsfolk for consumption purposes.

8.1.4 Prague–Staronová

Staronová synagogue was one of the most important landmarks of Prague's medieval Jewish Town. The analysed assemblage comes from habitation layers and features pre-dating the construction of the Gothic temple. They were associated with the previous wooden structure, possibly also a synagogue. The faunal remains presumably constitute consumption waste of local residents, dumped to the temple's construction pits or accumulated into the surrounding layers. The assemblage was divided in three groups: northern part of the temple (SN1: 12th c.), southern part (SN2: 11th-12th c.), and a small assemblage from the eastern annexe (SN3: 13th-14th c.).

Taphonomic analysis indicates that the deposition of rubbish was not rapid and probably not organised. Consumption waste was dumped in the open, where bones were commonly gnawed by dogs and suffered from weathering and trampling. As a result, bones of low survivability are underrepresented in the assemblage. Moreover, potentially many specimens of small size and bones of smaller species were not recovered during the excavation.

Despite the recovery bias, caprines largely prevail at Staronová, but it is difficult to assess the proportion of sheep to goats due to the paucity of data. Cattle bones constitute the second most frequent animal. Bones of non-kosher species are very rare.

The site appears to be an example of a consumer site acquiring meat from the butchers, and not being involved in a large scale local production. Primary butchery waste, including horncores, is only occasionally present. Cattle body part representation is focused on bones of meaty parts of the carcass, namely girdles and long bones, shafts mostly. Shafts also predominate in the caprine assemblage, but girdle bones are not as common in caprines as in cattle. Caprine mandibles are abundant.

There is no substantial difference between the representation of bones of fore– and hindlimbs in cattle and caprines. If porging would not be performed locally, bones of the hindquarters would likely be underrepresented on account of their trade to Christians. As a matter of fact, the presence of porging pattern on a large portion of femora and tibiae demonstrates that porging was performed in the local community. The evidence for porging in the twelfth century is not surprising. The Catholic Church in that period deemed Jews untouchable for the Christians and Christian-Jewish relationships in Prague greatly deteriorated. In that setting, selling of the un-porged meat was certainly difficult if not impossible and porging was a necessity. The archaeological contexts from the southern part of the temple were dated as early as to the eleventh century and the occurrence of porging in those times is also meaningful. The Jewish community of Prague had only recently been established, no more than about a century earlier. It was also one of the few communities in the whole of Central-Eastern Europe. The presence of a trained porger implies that it was already a developed and well-organised community, which is not that evident from the historical sources. Incidentally, this would also constitute the oldest case of porging observed at the analysed sites. This would date this particular method of porging to at least the eleventh century, two centuries earlier than described in the literary sources (see section 2.1.3.3).

The vast majority of cattle bones was heavily fragmented, mostly due to butchery. In the juxtaposition to this, the breakage of caprine bones was less severe; but it is equally possible that the smallest, most fragmented fragments of caprine bones were not recovered or recorded due to their size. Evidence of burning was proportionally more common on shafts than epiphyses. For many long bones, burning on the shafts indicated that the defleshed bone was subject to heat treatment. This type of burning occurred also on metapodials, femora and tibiae. These bones were presumably available to consumers already defleshed: metapodials, because there is little meat on them in the first place; and femora and tibiae because all the meat along with the epiphyses would be removed during porging done by the professional butcher/porger. Roasting of defleshed bones would indicate the special interest in marrow consumption leading to the consumer choice of acquiring bones from the vendor.

A notable find is a whole cranium and a mandible of a horse, presumably representing the deposition of a severed horse head. It was recovered at the southern annexe to the synagogue, but the specific context of the find is unknown. Finds of horse heads in the construction pits of buildings are widespread in medieval and post-medieval European contexts (see Armitage, 1989b, and references therein). They might constitute a so-called 'foundation sacrifice' to 'protect the building from unwanted spirits'. This custom is present in Christianity but is pagan in origin. Horse heads are often located in foundations of Christian churches (Armitage, 1989b). In Judaism, the horse is not kosher and does not have such strong symbolism. It seems unlikely, but not impossible, that a deposit of a severed head would be used to 'protect' a synagogue. Should this be the case here, the find would constitute a very unusual example of cross-cultural influence in Jewish–Christian relations.

8.1.5 Prague–Libeň

The second assemblage from Prague comes from Libeň, an agricultural hinterland of the medieval and post-medieval metropolis. The assemblage derives from four houses in Jewish part of Libeň. Bones were recovered from domestic contexts and presumably constitute examples of casual rubbish disposal associated with the households. For systematic disposal of rubbish in larger quantities the Libeň inhabitants would supposedly use the river, located in the close proximity. House 29 was used during two phases (phase 1: 17th–early 18th c.; phase 2: 18th c.), and both phases yielded substantial bone assemblages. Finds from houses 30, 31, and 34 were almost contemporary to the early phase of use of house 29 (late 16th–17th c.). The assemblage from house 30 was fairly large, whereas houses 31 and 34 only produced a small amount of material.

As in the case of other analysed sites, hand-collection during the excavation caused potential underrepresentation of smaller anatomical elements and species of small body size. For the earlier period — houses 29 (phase 1), 30, 31, and 34 — waste deposition was rapid and bones displayed little evidence of gnawing and weathering. Cattle bones are very fragmented but caprine bones much less so. The vast majority of them were fragmented as fresh. Caprine bones from the younger phase at house 29 are less severely fragmented than in the older phase, and most were broken as dry. Some were weathered and dog-gnawed. This suggests a possible change in waste removal practice compared to phase 1 — from concealed and rapid to more open-air.

The assemblages from the earlier period, (phase 1, house 29 and 30), display a very low diversity of species. Caprines predominate, followed by cattle. Sheep vastly outnumber goats. Pig, horse and red deer are present in house 30, but only in isolated instances, mostly in the form of loose teeth. In the younger phase of the habitation of house 29 the situation slightly changes, as the number of cattle and caprine bones is more even. Sheep is again more numerous than goat. These species are accompanied by occasional finds of horse, roe deer, cat and the skeleton of a dog. Pig is absent. Bones of these animals do not exhibit clear signs of consumption and appear to be stray finds.

Cattle body part representation is inconsistent with primary butchery refuse. Horncores are virtually absent and metapodials are scarce, apart from metatarsals in phase 2 at house 29. Mandibles and forelimbs dominate. Cattle bones were often chopped; in fact, butchery marks other than chop marks are very rare at Libeň. As it was mentioned, cattle bones were heavily fragmented which is associated with the butchery pattern present. For some body parts — such as radius, metatarsal, and mandible — chopping was very intensive. Marks were oriented in all directions and it was apparent that the main reason of this action was to split the bone into many smaller pieces. These marks indicate the practice of extracting grease (Rixson, 1989) or splitting bones for soup (Mensch, 1974). This was presumably done by cooking: bones from Libeň bear virtually no burning marks, implying roasting on open fire was not practised.

Caprine body part representation is similar. In older contexts mandibles and radii are much more frequent than other elements. Hindlimbs are virtually absent, with the exception of metatarsals, but metacarpals are absent. In the younger phase of the habitation of house 29 the numbers of metatarsals and metacarpals are higher but the rest of the body part representation hardly changes. Bones were commonly split, and no porging was present.

Assemblages from all contexts at Libeň appear to reflect a standard residential kitchen waste. The species representation largely confirms the Jewish character of the site. A large disproportion in quantities of fore– and hindlimb bones of cattle and caprines at Libeň appears to be associated with porging. The first obvious explanation is that porging was not performed locally and the hindquarters were traded to Christians. The second explanation assumes that porging was performed, but because it involves defleshing of bones by the butcher, these meatless bones of hindlimbs were not a popular consumer choice. In fact, both options seem to be plausible: the former in the older period and the latter in the younger period. Houses with the older dating (phase 1 at house 29, house 30) are lacking all parts of cattle and caprine hindquarters including the metatarsals. This would be an obvious outcome when whole, undivided hindquarters sold to Christians. Meat trade to Christians was forbidden in the fifteenth and sixteenth century Prague (Berman, 1941, p.222). Phase 1 at Libeň is dated slightly later, since the late sixteenth up to early eighteenth century, and according to historical texts, the attitude of the Christian rulers of Prague towards the Jews was steady then (Demetz, 1997). The lack of hindlimbs in the assemblage may imply that the situation was steady enough that the inter-cultural meat trade returned to Prague and that porging was no longer not a necessity.

In phase 2 at house 29 cattle and caprine metatarsals and cattle shanks are more frequent. A few bones in this context also display butchery marks with a porging pattern. This may suggest that porging was actually performed in the eighteenth century in Libeň, but the inhabitants of house 29 were only seldom purchasing porged and defleshed bones with intent of consumption. Presence of porgers in the eighteenth century Prague is also suggested by historical sources (Zivotofsky, 2006). This was a period of increased anti-Semitic sentiment among the local Christian populace and the rulers, and meat trade between the communities would be difficult.

8.2 Cattle and caprines husbandry

The interpretation of mortality profiles from medieval and post-medieval urban sites brings different challenges than those from prehistoric sites, but it may provide different information. Such assemblages of bones will rarely simply reflect the husbandry strategies or the recurring[2] products usage of the local societies. The animal bones will often represent animals brought to town from the rural producer sites, with the intention of meat trade; a phenomenon evidenced for British Middle Saxon Ipswich and Anglian York (O'Connor, 1991, p.249). This means that the data does not reflect the local population and subsistence agriculture, but rather the 'crop' of production (O'Connor, 1989, 2003, p.157). Animals from different, sometimes distant, places were driven on the hoof to medieval and post-medieval urban markets (O'Connor, 1989, 2003, p.157). These animals were a product of mixed farming, not only meat-driven

[2] Traditionally referred to as *secondary* products. I decided not to use this term here as it is embedded in the discussion on the Neolithic *secondary products revolution* (Sherratt, 1981)

production. This may greatly obscure the information about the husbandry strategies and the production of the animal resources, but may provide information about resources provisioned to towns and cities: the consumer sites.

In the interpretation of the mortality profiles from urban assemblages a few important biases need to be taken into the account. The taphonomic bias is very important, and not entirely specific to urban sites, but especially severe in those contexts. Assemblages may display underestimated numbers of juveniles due to taphonomic destruction of the juvenile epiphyses (cf. Brain, 1983; Lyman, 1994) and juvenile mandibles (Munson and Garniewicz, 2003). This will produce mortality profiles leaning towards the older population. A more distinct bias for the urban sites is represented by the pattern of animal product provisioning. Different parts of the animal carcass in the urban context may be distributed and eventually deposited in different localities resulting in their underrepresentation (cf. O'Connor, 1992). For example, mandibles attached to the skull may end up in a tannery or horn-working, rather than in domestic context. Another potential bias is associated with modes of butchery, and is especially important in the context of this research. The process of porging is associated with removing of both epiphyses of the femur and the proximal epiphysis of the tibia. These three anatomical areas may be missing in the assemblage where porging was common, as is seen in caprines at Wrocław and Prague–Staronová. The underrepresentation of these epiphyses may affect the epiphyseal ageing profiles.

Another important limitation concerns comparisons of mortality profiles with other sites from the literature. The ageing methodology used by different researchers publishing reports from Polish and Czech sites may differ immensely. Moreover, the methodology used in this thesis, based on methods widely used in British zooarchaeology, is also different. In the end, the quantitative comparisons of mortality patterns between sites analysed here and published previously proved to be impossible. In the circumstances where anchoring my results in a wider context was beneficial, I limited my comparisons to qualitative descriptions.

8.2.1 Cattle husbandry

At the oldest analysed site, Prague–Staronová (11th–12th c.), ageing data suggests that the majority of cattle were slaughtered in their third year, with few deaths of the younger animals. This data may be heavily biased against the juveniles on account of the taphonomic destruction. Contemporary sites in Prague (see table 8.1) display similar ageing pattern. The site at Pařížská street in the Jewish Town had also predominance of adults with some subadults (Burian, 2011). Likewise, the site at Klementinum, near the river outside of the Jewish Town (Burian, 2016). Slightly different profile was present at the Vyšehrad hillfort, where most cattle was slaughter in their adulthood but some juvenile and even neonatal deaths are present (Kyselỳ, 2015). The remains of calves could be represented there on account of less severe taphonomical factors, but it is possible that this constitutes an example of wider geographical tendency of provisioning of high-status sites with quality veal (Sykes, 2006), meat largely unavailable to the regular burghers, Jewish and Christian alike.

Moving up north, to a slightly younger site at Wrocław, cattle represented in the assemblage were slaughtered in a somewhat earlier age. The mandibular profiles for period B (late 13th–early 14th c.), suggest main culling period between 1.5 and 3 years of age (see figure 8.1). Epiphyseal fusion, however, lowers the age of the main cull to 1–1.5 year. Some animals were much older, in their young adulthood. Similar epiphyseal data is suggested for the next period, period C (14th c.). There appears to be a change in the late fourteenth–early fifteenth century (Period D), where more animals were slaughtered in their first year and later in before coming to the age of 2–3 years. Distribution of sexes at Wrocław leans towards higher number of females, except for period B where is more balanced between bulls, cows, and steers. Results suggest that cattle derived from mixed husbandry. In the thirteenth–fourteenth century part of the cattle was slaughtered for meat in their prime young age, but a substantial part, presumably females used in dairy production, was kept for longer.

Slightly younger to Wrocław and further east, the site at Lelów (period A: 14th–16th c.; period B: 17th–18th c.) has a steady mortality of juveniles, sub-adults and the largest group portion of young adult or later deaths (see figure 8.1). Epiphyseal fusion data from both periods at Lelów underlines the predominance of mortality of young adults with very few juveniles, possibly due to taphonomic bias. The steady mortality of juveniles and older animals suggests that animals provided to Lelów came from mixed husbandry regimes. A number of cattle in their meat prime was accompanied by older individuals presumably used for obtaining recurring products for a few years. In period A, these products seems to be mostly diary as the osteometrical data shows a

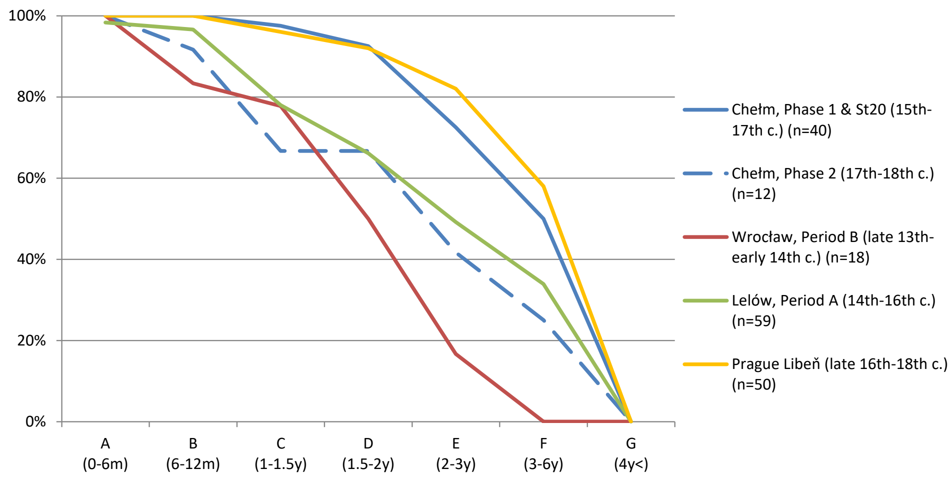

Fig. 8.1 Mortality profiles of cattle on the analysed sites based on mandibular age stages. Graph summarises data from section 6.3

vast overrepresentation of females, then steers and few bulls. Later, in period B, more balanced representation of cows, steers, and bulls suggest a shift towards exploitation of cattle as beasts of burden. This shift may be explained through literary sources. Historians argue that in the sixteenth–eighteenth century Poland the milk production ability of cattle was not efficient, thus cow milk was less important than that of sheep (Topolski, 1957, p.236). This would naturally also increase the value of cattle as draught animals.

Further east, at Chełm, in the older phase (15th–17th c.) cattle kill-off pattern is focused on young adult individuals (see figure 8.1). There is some presence of juvenile deaths in phase 2 (17th–18th c.), where mortality is akin to that observed at Lelów, but otherwise they are largely missing, possibly due to taphonomy. The horncore shape indicates that most Chełm cattle were steers, and pathological conditions of a few animals suggest they were used as drought animals. Taking into the account the historical sources mentioned in the previous paragraph (Topolski, 1957, p.236), it seems likely that traction, rather than milk, was the main role of cattle husbandry in the region, and the town was provisioned with meat of beasts of burden. The inhabitants of Chełm were provided with beef of cattle older than the optimal meat producing age, often the oxen, after a few years' yield of pulling the plough. It is probable that this is connected to the cultural context and Jewish inhabitants were provisioned with meat from the animals kept for the recurring products and past their meat prime. This is akin to the situation at Prague–Staronová, but evidence from other contemporary Prague sites suggest this also might be the case for the Christian burghers, but not the higher status inhabitants of the hillfort. Whether this is true for the

Chelmer Jews or the entirety of the Chełm townsfolk is difficult conclude with certainty because comparable data from Chełm Christian sites is unavailable.

At the youngest site, Prague–Libeň (late 16th–18th c.) the mortality profile is similar to the younger phase at Chełm (see figure 8.1). It displays the focus on young adults and older individuals, with very low numbers of juveniles. The bias towards adult bones may be rooted in taphonomy, but its uniform presence for mandibular, epiphyseal, and horncore data may suggest that it reflects — at least partly — the original profile. In that case, it is possible that the bulk of cattle driven to Libeň for meat was at least a few years old and was used for dairy or traction purposes. The sexing data, unfortunately, is too scarce to contribute to this interpretation. However, there may be a different explanation to the lack of neonatals and juveniles that is specific to Libeň's history. Libeň was an agricultural hinterland of Prague, and its residents were engaged in cattle trade and butchery, provisioning meat for Prague (Vyšohlíd, 2012a, 2014). Arguably, veal and prime beef being of higher value were sold to vendors in Prague city centre instead of being used in Libeň. That would leave them with the surplus of older animals (cf. Sykes, 2006).

8.2.2 Caprines husbandry

Turning to caprines, at the earliest site at Prague–Staronová (11th–12th c.), the mortality profile indicates a substantial presence of lamb deaths, as well as a peak in deaths of young adults (see figure 8.2). Unfortunately, sexing data for this assemblage is scarce and the sex ratios are unattainable. A large presence of older individual points to wool or possibly milk production. The peak of lamb deaths is much more intriguing. In dairy farming newborn males would often be culled, which would partly explain the presence of age group B — although the peak of mortality in the traditional model of diary oriented strategy falls on age group A (cf. Payne, 1973). The data, however, shows the representation of slightly older lambs as well. These unlikely constitute juvenile mortality, as this would occur at the producer site. The site is located in the heart of a medieval metropolis and was predominately a consumer site, where livestock, maybe with the exception of pigs and the odd milk ewe was not kept (O'Connor, 1989, 1992). Therefore, the higher representation of juveniles indicates the existence of the demand and market for tender lamb meat. At a contemporary site at Prague–Klementinum (see table 8.1) caprine mortality was similar. Most were slaughtered in their adult age, over 6 years old, but some lambs in their first

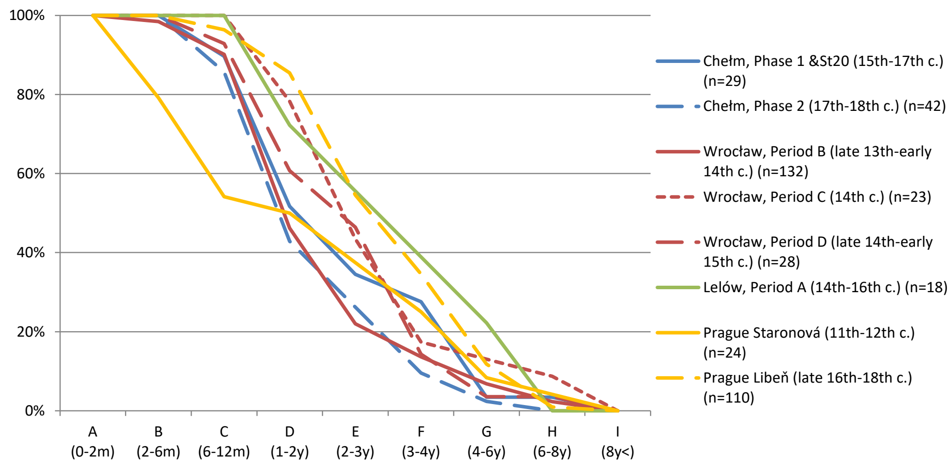

Fig. 8.2 Mortality profiles of caprines on the analysed sites based on mandibular age stages. Graph summarises data from section 6.3

year were also found (Burian, 2016). In the Jewish Town at Pařížská street adult and subadults caprines were present, but the lambs are missing — possibly due to the taphonomic loss (Burian, 2011). The Royal hillfort at Vyšehrad had a good representation of young adults and lambs (Kyselỳ, 2015). Therefore, it appears that lamb meat was available for most members of the society in medieval Prague and its consumption was widespread.

In Wrocław (see figure 8.2), caprines in period B (late 13th–early 14th. c.) display a peak of mortality around 18 months of life, and then a steady decrease in population. Small numbers of older animals may suggest smaller interest in production of wool or dairy. Although, older individuals may be underestimated due to the urban character of the site, this may also be caused by the urban market favouring juvenile meat. This pattern changed in the fourteenth–early fifteenth century (Periods C–D) in favour of older animals of a few years of age. A similar transition, although happening earlier, is known for Britain, where meat-focused early medieval strategy was changed to wool-focused in the late Middle Ages (Ryder, 1974; Albarella, 1997b) resulting in a larger representation of sheep in the assemblages from late twelfth and mid-fourteenth century (Sykes, 2006)[3]. In the case of Wrocław the important product locally obtained from caprines may have been milk. There is little difference between sheep and goat mortality profiles in the assemblage implying that the strategies for their husbandry were similar. In goats, the assemblages are comprised largely of females, hinting to dairy production. Sheep sexing data is not available though. This interpretation is consistent with historical sources claiming

[3] Makowiecki (2016c, p.204) connects the increase in numbers of caprines in the late Middle Ages in Poland with advancing deforestation of the lands

that in the early modern Poland sheep milk was valued more than cattle milk (Topolski, 1957, p.236).

Eastwards from Wrocław, in Lelów (period A: 14th–16th c.; period B: 17th–18th c.), caprine ageing data is scarce. Mandibular age analysis (see figure 8.2) presumably underestimates the juveniles, which are abundant in epiphyseal fusion profiles. The combination of the results of both methods suggests a mixed strategy. There was clearly a demand for lamb meat, but a large portion of consumed meat derived from much older animals kept for wool and/or milk.

In Chełm (phase 1: 15th–17th c.; phase 2: 17th–18th c.), the major cull affected the second-year olds, but a substantial portion of the animals died in the next three age stages, until the sixth year of age. There is a slight difference in kill-off patterns for sheep and goats: many sheep reached their fifth–sixth years, but goats were culled younger. The second-year cull represents the demand for caprines in their optimal meat age, showing the significance of young mutton, but the high proportion of older animals implies that the recurring products were also important. Wool, rather than milk, seems to be the most important product obtained from sheep. This is suggested by the lack of neonatal deaths — possibly also caused by the taphonomic bias or the consumer character of the site — and the sheep biometrical data indicating a large overrepresentation of males. A higher proportion of older animals in phase 2 may signify the increasing importance of wool in the later ages. This corroborates historical sources noting the importance of the Jewish merchants of Chełm in the wool and textile trade on a wide geographical scale. Cloth-making was an important branch of industry in Lelów due to the abundance of woolly sheep herds kept on local soils unsuitable for cultivation (Białowąs and Nowak, 2012, p.20–21). In goat, on the other hand, females largely predominate, implying that most of the animals not culled in their second year were females kept for milk. Therefore, despite the above-mentioned historical claim that sheep are the most important source of diary in this period (Topolski, 1957, p.236), the osteological evidence for Chełm does not strongly support this claim (this is not unexpected, see O'Connor, 1989). Sheep milk was certainly produced; however, it appears it was less important than wool.

At the youngest site in the analysis, Prague–Libeň (late 16th–18th c.), lamb mortality is very scarce (see figure 8.2). Most caprines were slaughtered between 3 and 6 year old. The bias against juveniles may be due to taphonomic destruction, but it is possible that, as in cattle, the juveniles were taken to the centre of Prague for trade. The predominance of animals of several years of age points towards exploitation of recurring products. Interestingly, sheep and goat display very similar profiles suggesting the role of both species in milk production. Milk goats were to be kept until around their fourth year, possibly slightly longer and then slaughtered for consumption. Most sheep were exploited in a similar fashion, but some were kept a few years longer, most possibly for wool.

8.3 Trends in size of animals

The following section summarises the results of the biometrical analysis on bones from the analysed sites in their wider geographical context (section 6.5)
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8.3.1 Size of cattle

Cattle at the earliest analysed site (Prague–Staronová, 11th–12th c.) was smaller than at the other sites. This is not surprising, given that the size of the domesticates is known to have increases from medieval to early modern times (Albarella, 2002).

The core of the cattle population from both periods at Lelów was of one morphotype. A wide range of sizes suggests that some outlier individuals were of a different type, including rather stocky animals. The presence of such different animals would not be surprising for a late medieval town located on important trade routes (Białowąs and Nowak, 2012, p.6). In period A (14th–16th c.) there is a strong trend towards slenderer animals, presumably females used for dairy production. Steers seem to be present in smaller numbers and bulls are even less frequent. For period B (17th–18th c.) this ratio seems to be more balanced, but only when the postcranial skeleton is used, because male horncores seem to be rare.

The Wrocław cattle (Periods B–D: late 13th–early 15th c.) had comparable body size and shapes to population from period A at Lelów (14th–16th c.), which is not surprising given their similar dating and geographical vicinity. What is more surprising, however, is the much smaller dispersion of sizes and shapes at Wrocław compared to Lelów. Wrocław was a larger city and much more important market than Lelów. It seems it would receive livestock driven from more regions and see more diverse populations In the discussed period, Wrocław was divided from Lelów by a state border, firstly as part of the Duchy of Silesia, then the Kingdom of Bohemia, which was engaged in a 'trading war' with Poland (Davies and Moorhouse, 2002, p.112). The trade conflict also affected the import of Polish cattle. This could have contributed to restricting population variability, as seen in the faunal record.

The population of cattle at Chełm is different, despite the similar chronology to Lelów. The animals in phase 1 (15th–17th c.) are larger and more robust than at Lelów, and this trend further develops with time in phase 2 (17th–18th c.). This is part of a wider countrywide trend of size increase in the early modern period, partly caused by the importation of large specimens from other parts of Europe and southern Russia, the latter being geographically close to Chełm (Chmielewski, 1963; Makowiecki, 2018). The presence of smaller individuals suggests further diversity of populations, not unexpected for a market town on a trade route. The majority of horns of Chełm cattle are long, but slender, presumably deriving from steers. In comparison with other sites, this may suggest that male horns prevail, or that the local form of cattle had larger horns. Given that the teeth in period B at Chełm are not larger than in period A or at the other sites, it is possible that the size change indicates a strong bias towards males in the sex ratio.

Cattle at the early modern Libeň (16th–18th c.) was much larger and more robust than anywhere else. This is a good example of the early modern livestock development. Dental and appendicular measurements from Libeň, compared to medieval data from Staronová in the same city, show large improvements in size.

To put my results in a wider geographical context, I calculated the withers height of cattle at the analysed sites and compared it to published sites in a relative temporal and geographical proximity. The log ratio method used in this thesis (see section 6.5.2) unfortunately does not allow comparisons with already published sites, unless the same standard value is used. This method is not commonly used in Poland and the Czech Republic, contrary to withers height that is widely used to compare sizes of populations in this area (see Makowiecki, 2018), hence providing a good reference base.

Medieval and late medieval cattle from published sites in Poland had similar withers heights (fig. 8.3); however, cattle from the medieval hillfort at Prague–Vyšehrad were generally larger (Kyselỳ, 2015; Makowiecki, 2016c, 2018). A

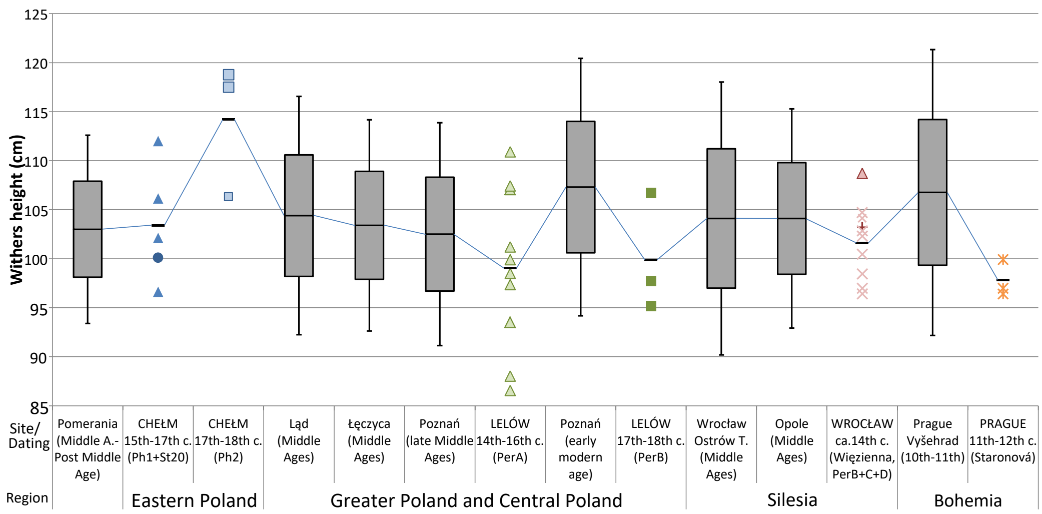

Fig. 8.3 Withers heights of cattle in the Middle Age and early modern times in different regions of the present-day Poland and Czech Republic. The withers height is calculated according to Tsalkin coefficient (1970) from the greatest length (GLl) of astragalus. Specimens from the studied sites are plotted as points (colours and shapes in reference to 6.52), the trends from the published reference sites are plotted as bars (the line in the middle represents the mean, the extent of the bar represents ca 1 standard deviation, the whiskers represent ca 1.96 standard deviation). Reference sources: Prague Vyšehrad, calculated by the author based on data from Kyselý (2015, p.524); Poznań: Makowiecki (2016c, fig.104); Ląd, Łęczyca, Wrocław Ostrów Tumski, and Opole: Makowiecki (2018, fig.6 and references therein)

major increase of the size of cattle happened in the early modern age, around the sixteenth or seventeenth century, as evidenced in the data from Poznań (see fig. 8.3 and Makowiecki, 2016c, 2018). This increase was presumably influenced by the import of stockier animals from other parts of Europe, including Southern Rus in the early modern period, and using it to interbreed with the local small cattle (Chmielewski, 1963; Makowiecki, 2018).

In relation to these published sites, the researched assemblages provide interesting results (fig. 8.3). In phase 1 at Chełm (including structure 20) the withers heights are similar to the late medieval sites, but they changed in phase 2, with the presence of two very large individuals. Their height is comparable to the largest individuals found at the contemporary sites of early modern Poznań (Makowiecki, 2016c). Such scarce data is very difficult to interpret. If the abovementioned premise of importing stocky cattle to Poznań from Southern Rus is true, one of the trade routes used for this long-distance import would have to pass through Chełm. This may draw a possible connection between the sites and the bovine populations, but this is only a speculation.

The withers heights of cattle from sites at Lelów, Wrocław and Prague Staronová in general fall in the range evidenced at other medieval and late medieval sites in the respective regions (Kyselỳ, 2015; Makowiecki, 2016c, 2018), but the lower means suggest that the population was somewhat shorter. The recorded cattle at the late medieval Lelów (period A) were smaller than populations of all the other medieval sites. This difference is reflected in the mean being a few centimetres smaller, and the presence of very short individuals (which height falls below the 95% confidence interval of all the reference sites). Cattle from Lelów in early modern times (period B) was also shorter than at the contemporary site in early modern Poznań, 300 km away (Makowiecki, 2016c, 2018), but the sample here is small. A similar trend is observed at Wrocław, where the population from the analysed site at Więzienna has a lower mean than the local reference sites, including a site in the same city on an island with ducal and ecclesial estates (Wrocław–Ostrów Tumski). The few individuals from Staronová synagogue in Prague were smaller than most of individuals at the Vyšehrad hillfort, also in Prague (cf. Kyselỳ, 2015). These findings are limited, and need to be treated with caution, but they may suggest that cattle from the researched Jewish sites tend to be shorter than those from Christian sites (e.g. at the ecclesial or ducal estates). This type of pattern is not unheard of. Smaller cattle was consumed by the common folk inhabiting the outer wards of the hillforts at the medieval Kałdus in Northern Poland and Ostrów Lednicki in the Greater Poland region, as opposed to the larger cattle consumed in the inner wards, where the nobility resided (Makowiecki, 2001, 2010). This would suggest that, at least in some medieval urban contexts, animals were slaughtered for specific communities separately — the upper class and the common folk, the Jews and the Christians — and that the less privileged, such as the Jews, were using the smaller, "worse" animals. This trend does not apply to Chełm though. Cattle from Chełm were of the largest size from the analysed assemblages comparable to the largest animals reported in the literature for the Greater Poland region.

8.3.2 Size of caprines

Information provided by the osteometrical study of caprine bones was, unfortunately, much smaller than for cattle, due to the paucity of the data.

The population of caprines at Lelów and Prague–Libeň seem to be similar in size, which is not surprising given the similar post-medieval dating of the two sites. The caprines of Chełm have more robust limbs — akin to cattle from the same town — also with a broader range of sizes. Again, as in Chełm cattle, the diversity of sizes may be associated with the trade routes going through Chełm provisioning it with animals from different regions. At Wrocław an interesting temporal change is evidenced. After period A (before 1250 CE) into the fourteenth century (period C, and partly B and D) the size of caprines decreases. Conversely, the improvement can be seen from the fifteenth century to the early modern era (period E), where animals were larger and more robust.

Caprine horncore sizes and shapes reveal some differences between sites. Sheep horncores at Lelów and Chełm predominately derive from males. This may not be a true representation of sex ratios of sheep at those sites. Horn-working craft may create a demand for larger male horns resulting in their overrepresentation. On the other hand, in many sheep breeds ewes may be naturally polled. This is in fact true for old Polish breeds such as the Heath sheep, and Polish Merino sheep (Załuska and Załuska, 1985). Based on the size of goat horncores, the Lelów goat population was the most diverse, with a range of shapes and sizes not seen at the other sites. Horncores at Lelów were also larger, Chełm horncores were shorter, and Wrocław horncores the shortest and the most robust. This evidence implies shape differences between local populations, but also in the age of slaughter. Lelów goats were largely adult, whereas most animals in Wrocław did not reach adulthood. The sex ratio of goats based on horncores is skewed towards males at Lelów, whereas at Wrocław and Chełm females dominate.

8.4 Species representation in a wider geographical context

Contextualising the analysed Jewish assemblages in a wider geographical context imposes several challenges. First of all, the nature of faunal assemblages is burdened with many issues. Bone preservation immensely differs from site to site and even from feature to feature. In such wide geographical and chronological span of sites, as is available for medieval and post-medieval Poland and Czech Republic, these differences are impossible to assess. Another important issue is introduced by the nature of urban assemblages. The level of mixing and residuality in urban assemblages is usually high (cf. O'Connor, 2003; Albarella, 2016). A different limitation is the archaeological excavation methodology, which can very greatly. Lastly, an important issue is the difference in zooarchaeological methodology. The diagnostic zone approach employed here is

Table 8.1 Medieval and post-medieval sites referenced in this chapter (selection of the 11th–13th century sites after Iwaszczuk, 2014)

#	City	Site	Region	Dating	Context	Reference	Cattle	Capri nes	Pig
1	Bnin	Site 1, phase 2	Greater Poland	12th-13th c.	Hillfort	Sobociński 1976	339	165	381
2	Bnin	Site 2b, phase 3	Greater Poland	late 12th-mid-13th c.	Inner settlement of the hillfort	Sobociński 1976	1052	529	1533
3	Busówno	Phase 2	Lesser Poland	12th-13th c.	Hillfort	Lasota-Moskalewska 2008	81	48	66
4	Gdańsk	Kładki 24	Pomerania	15th-early 17th c.	Urban	Makowiecka et al. 1998	9764	3255	2480
5	Gdańsk	Długa street	Pomerania	17th-18th	Urban/Prison	Makowiecki 2016	85	32	13
6	Nakonowo Stare	site 2	Kuyavia-Pomerania	18th-19th c.	Settlement	Osypińska 2014	635	107	226
7	Opole	Ostrówek, phase 2	Silesia	2nd half of 12th c.	Hillfort	Chrzanowska and Molenda 1978	549	198	779
8	Opole	Ostrówek, phase 3	Silesia	1st half of 13th c.	Hillfort	Chrzanowska and Molenda 1978	351	66	419
9	Poznań	Ostrów Tumski Plac Katedralny	Greater Poland	13-14th c.	Church estates	Makowiecki 2016	282	184	288
10	Poznań	Ostrów Tumski - NMP	Greater Poland	13-15th c.	Church estates	Makowiecki 2016	200	107	227
11	Poznań	Ostrów Tumski - NMP	Greater Poland	15-18th c.	Church estates	Makowiecki 2016	441	259	516
12	Poznań	Ostrów Tumski - Posadzego 5	Greater Poland	16-19th c.	Urban	Makowiecki 2016	316	111	89
13	Prague	Hradčany	Bohemia	late 11th-early 13th c.	Houses at the hillfort	Boháčová et al. 1990	238	31	141
14	Prague	Klementinum (oldest phase)	Bohemia	late 11-12 c.	Klementinum building complex near a Christian Chapel	Burian 2016	84	96	86
15	Prague	Pařížská	Bohemia	12th c.	Housing lot in the Jewish Town	Burian 2011	47	57	3
16	Prague	Vyšehrad (horizon 1)	Bohemia	10th-11th c.	Hillfort with the Royal Seat	Kyselý 2015	710	340	878
17	Przewłoka	Castle	Kyyavia	mid-14th c.	Castle	Chubur et al. 2015	287	122	393
18	Racot	site 25	Greater Poland	12th-13th c.	Hillfort	Makowiecki and Makowiecka 1995	120	35	53
19	Sadłów	Castle	Kuyavia-Pomerania	late 14th-17th	Castle	Makowiecki 2004	3806	269	199
20	Sąsiadka		Lesser Poland	mid-11th-early 13thc.	Hillfort and adjecent settlement	Krysiak 1966	11920	3646	9362
21	Sieradz	site 1, phase 2	Central Poland	12th-13th c.	Hillfort	Kubasiewicz 1963	2049	454	1233
22	Stargard	Austin Friary church, phase 1	North-West Poland	12th-14th c.	Friary/church	Makowiecki and Wiejacka 2016	416	404	566
23	Stargard	Market square	North-West Poland	2nd half of 13th c.	Urban	Makowiecki 2017	500	115	175
24	Stargard	Austin Friary church, phase 2	North-West Poland	14th-17th c.	Friary/church	Makowiecki and Wiejacka 2016	117	111	243
25	Stargard	Market square	North-West Poland	early 14th c.	Urban	Makowiecki 2017	211	65	102
26	Stargard	Market square	North-West Poland	14th c.	Urban	Makowiecki 2017	1282	508	592
27	Stargard	Austin Friary church, phase 3	North-West Poland	17th- early 19th c.	Church	Makowiecki and Wiejacka 2016	636	297	426
28	Stołpie	site 1	Lesser Poland	13th c.	Hillfort	Lasota-Moskalewska 2006	115	85	473
29	Tykocin	site 1	North-East Poland	12th-13th c.	Hillfort	Lasota-Moskalewska 1984	785	250	359
30	Tykocin	Castle	North-East Poland	late 15th-16th c.	Castle	Gręzak 2015	1410	328	279
31	Tykocin	Castle	North-East Poland	late 16th-18th c.	Castle	Gręzak 2015	3725	988	529
32	Wrocław	Ostrów Tumski (trench 1, phase 6)	Silesia	12th-13th c.	Hillfort	Chrzanowska 1986	246	29	618
33	Wrocław	Ostrów Tumski (trench 6, phase 4)	Silesia	12th-13th c.	Inner settlement of the hillfort	Myczkowski 1959	882	356	1240
34	Wrocław	Ostrów Tumski (trench 6, phase 5)	Silesia	12th-13th c.	Inner settlement of the hillfort	Myczkowski 1959	1411	546	2129

vastly different than the fragment approach commonly used at the compared sites (see section 5.2) imposing a danger of many data distortions. On the other hand, it has been proven that even seemingly straightforward analyses in the fragment approach paradigm can be inconsistent in a comparison between different researchers (cf. Morin et al., 2016a,b). Hence, one needs to be always cautious when dealing with data from different sources. This does not necessarily deem the comparisons worthless; however, they need to be treated just as the indication of general trends.

In the comparisons I used animal bone assemblages of substantial size, that is more than a hundred specimens, but usually it was much more than that. I tried to use sites of a geographical proximity, but when it was not possible I used sites from more distant areas of Poland. The results are divided into three periods:

- tenth–fourteenth century (in majority eleventh–thirteenth century) seen on fig. 8.4;
- fourteenth–seventeenth century (mostly before the seventeenth century) seen on fig. 8.6;
- seventeenth–eighteenth century (possibly some specimens from the nineteenth century) seen on fig. 8.7.

The sites are described in table 8.1. They can be roughly divided into three groups: urban/domestic sites, ecclesial sites, and hillforts and castles.

In the period between tenth–fourteenth century (fig. 8.4) a trend is seen for the hillfort sites (Myczkowski, 1959; Kubasiewicz, 1963; Krysiak, 1966; Sobociński, 1976; Chrzanowska and Molenda, 1978; Lasota-Moskalewska, 1984; Chrzanowska, 1986; Makowiecki and Makowiecka, 1995; Lasota-Moskalewska, 2006, 2008; Kyselỳ, 2015) to have the similar frequencies of pig and cattle. Caprines are rarely present. There appears to be slightly more caprine bones at the ecclesial sites (Makowiecki, 2016c; Makowiecki and Wiejacka, 2016). Urban sites tend to have fewer pig bones and more cattle and caprines (Boháčová et al., 1990; Burian, 2016; Makowiecki, 2016a). The outlier site (site number 15, Prague–Pařížská street, see Burian, 2011) comes from Prague Jewish Town and it is highly probable that the residents were Jewish.

A possible explanation of these results is the status difference. Residents of the hillforts, often having a higher status than regular townsfolk, could afford

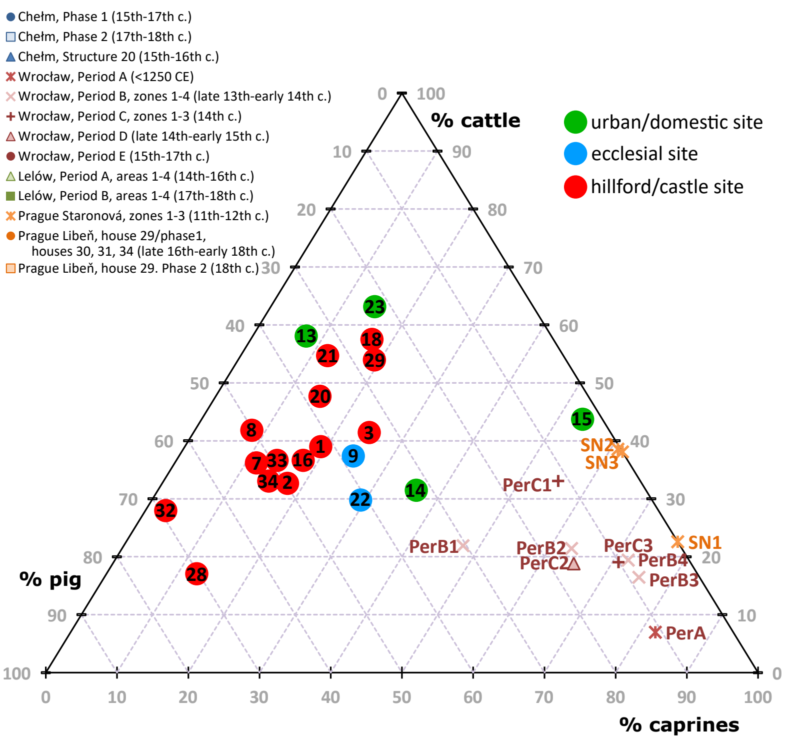

Fig. 8.4 Tertiary plot of the representation of three major domestic taxa in the 10th–14th century at the analysed sites and published reference sites. Numbers in coloured points correspond with site numbers in table 8.1.

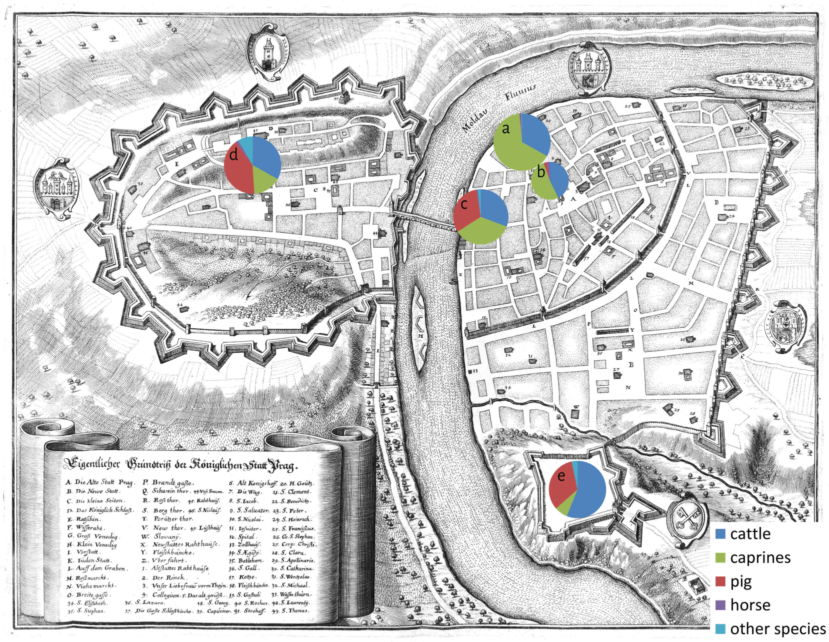

Fig. 8.5 Species representation at 10th–early 13th century sites in Prague. Sites: a — Staronová; b — Pařížská street (Burian, 2011); c — Klementinum, oldest phase (Burian, 2016); d — Vyšehrad, horizon 1 (Kyselỳ, 2015); e — Hradčany (Boháčová et al., 1990). Details in table 8.1. Map by Matthäus Merian, published in 1650 in *Topographia Bohemiae, Moraviae Et Silesiae*.

more meat. Therefore, they would tend to keep pigs — animals providing very little recurring value and kept only for their meat — in larger numbers than those species typically used for recurring products (cf. Sykes, 2006; Albarella, 2006). On the other hand, a more systematic study on meat consumption in the city of Poznań (Makowiecki, 2016c), attest that pig was common in most parts of the city in the early Middle Ages.

In this period, the Jewish residents of the lot at Więzienna in Wrocław (Period A, B, and C in red on fig. 8.4) and the Prague Jewish Town (Staronová in orange on fig. 8.4 and Pařížská street) were less depending on cattle, possibly even less than their Christian neighbours, and more on caprines. Interestingly, it appears that the number of cattle increased in time at Wrocław, from period A (pre 1250 CE) to periods B–C (late 13th –14th c.), but this data was scarce.

The abundance of sites in Prague allowed for comparisons between sites from different parts of the city within the tenth–early thirteenth century time frame (fig. 8.5). The clear difference is seen between Christian sites — in this case two high-status hillforts, Hradčany in west and Vyšehrad in south of the city (Boháčová et al., 1990; Kyselỳ, 2015) and a site near the Charles Bridge (Burian, 2016) — and the two sites in the Jewish town: Staronová and Pařížská street (Burian, 2011). The lack of pig is evident for the sites in Jewish Town. It also appears that the lack of pork consumption was compensated with larger mutton consumption, whereas beef intake seems not to be much larger, or not larger at all, than in the case of Christian sites. The differences in consumption between the two Christian hillforts are not relevant to the discussion about the Jewish Town.

In the late Middle Ages to early modern age, that is fourteenth–seventeenth century (fig. 8.6), Christian sites tend to have a larger cattle representation. Two hillforts and castles (Makowiecki, 2004; Gręzak, 2015; Chubur et al., 2016) almost entirely had cattle dominated distribution. Similar trend appears at urban sites (Makowiecka et al., 1998; Makowiecki, 2016a). Meanwhile, the ecclesial sites (Makowiecki, 2016c; Makowiecki and Wiejacka, 2016) did not change much.

The drop in pig representation may be a result of the decline of pork consumption in the late Middle Ages, a phenomenon already observed in Poland (Makowiecki, 2016c, p.205-206) and even more in Britain (Albarella, 2006; Sykes, 2006). In the light of ageing data (see section 8.2) suggesting predominance of older cattle, this may be interpreted as a highly economically efficient be-

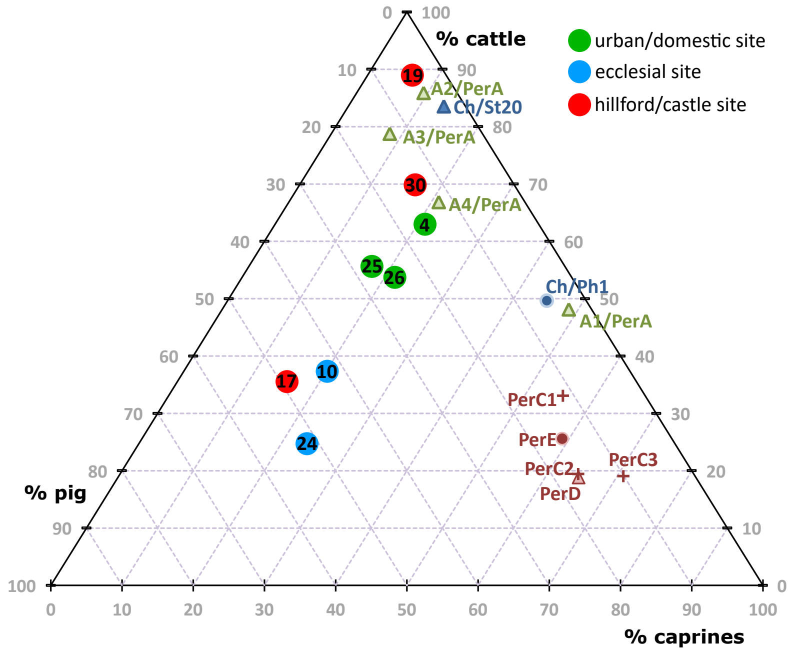

Fig. 8.6 Tertiary plot of the representation of three major domestic taxa in the 14th–17th century at the analysed sites and published reference sites. Key for sites analysed in this thesis as in fig. 8.4. Numbers in coloured points correspond with site numbers in table 8.1.

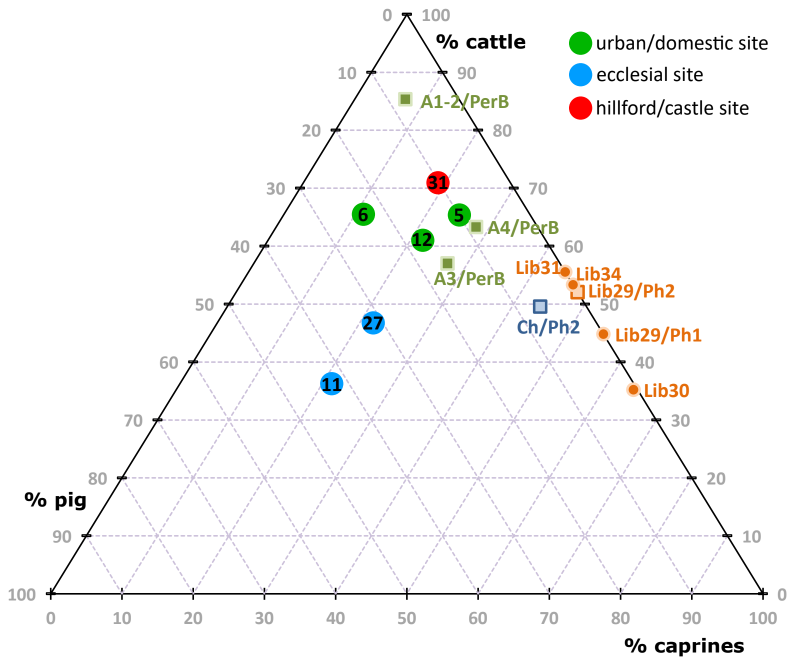

Fig. 8.7 Tertiary plot of the representation of three major domestic taxa in the 17th–18th century at the analysed sites and published reference sites. Key for sites analysed in this thesis as in fig. 8.4. Numbers in coloured points correspond with site numbers in table 8.1.

haviour. Larger value would be put on animals as the producers of recurring products, not meat, and consuming them only after they 'returned their worth'.

The seeming increase of the role of cattle in the assemblage in this period is somehow also present for some of the sites with Jewish habitation. Cattle slightly predominates in the older phases at Chełm (15th-17th c.) and Lelów (14th-16th c.), but the latter is caused by the predominance of cattle *knuckle-bone* flooring. This trend is missing at Wrocław, though.

A very similar tendency of cattle predominance holds true for the youngest period under scrutiny here, the seventeenth–eighteenth century (fig. 8.7). Both the castle (Gręzak, 2015) and urban sites seem to rely mostly on cattle (Osypińska, 2014; Makowiecki, 2016c,b). On the other hand, in the assemblages from the ecclesial sites pig was still common (Makowiecki, 2016c; Makowiecki and Wiejacka, 2016). The distribution is split between cattle and caprines at Libeň and Chełm, and it leans towards cattle at Lelów.

Table 8.2 Archaeological sites with presume Jewish presence referenced in this chapter

City	Site	Region	Dating	Context	Reference	Cattle	Caprines	Pig
Buda	Teleki palace: Well 8	Hungary	14th c.	Urban/well	Daróczi-Szabó 2004	389	145	3
Vienna	Judenplatz (Hausbrunnen am Judenplatz)	Austria	14th-15th c.	Urban	Czeika 2008	27	5	0
Berlin	Großer Jüdenhof	Germany	13th-early 14th c.	Urban (phase 0)	Morgenstern 2015	454	328	146
Berlin	Großer Jüdenhof	Germany	14th c.	Urban (phase 1-3)	Morgenstern 2015	1635	1422	350
Berlin	Großer Jüdenhof	Germany	14th-early 15th c.	Urban (phase 4)	Morgenstern 2015	774	842	95
Blauwhof		Belgium	16th-17th c.	Ximenez family estates	Aluve et al. 2015	305	503	95
Tàrrega		Catalonia	14th-15th c.	Settlement	Valenzuela-Lamas et al. 2014	51	1517	5
Puigcerdà		Catalonia	14th-15th c.	Settlement	Valenzuela-Lamas et al. 2014	250	1103	23
New York	Five Points - Feature AS IV	United States	19th c.	Urban	Milne and Crabtree 2001	199	61	43
Washington, Arkansas	Feature 14	United States	19 th c.	Household	Stewart-Abernathy and Ruff 1989	83	0	114

In a similar fashion I made a comparison between my sites and several published sites with presumed Jewish presence (see table 8.2). Unsurprisingly, they fit well into a pattern (see fig. 8.8), except of an outlier site at Washington in Arkansas with a large pork consumption by the residents of the Bloch household (Stewart-Abernathy and Ruff, 1989). The reference sites are of course

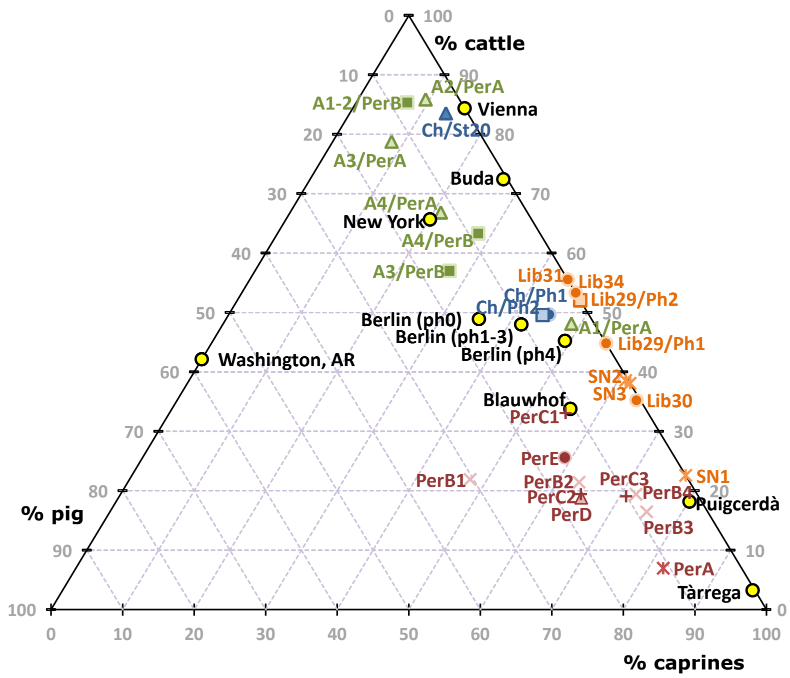

Fig. 8.8 Tertiary plot of the representation of three major domestic taxa at archaeological sites with presume Jewish presence referenced in this chapter (yellow points). Key for sites analysed in this thesis as in fig. 8.4. Details of the referenced sites in table 8.2.

very wide in their geographical and chronological span and some comparisons may be limited. One interesting observation is that the rubbish from the Blauwhof estate of the family Ximenez, Portuguese Jewish converts to Christianity, still resembles the Jewish pattern of species representational more than Christian (Aluwé et al., 2015). Another observation concerns the huge difference between cattle–caprine ratio at Jewish sites of roughly similar chronology (11th–14th c.) from Central–Eastern Europe; namely Wrocław, Prague–Staronová, Buda (Daróczi-Szabó, 2004), and Vienna (Czeika, 2008). Silesian and Bohemian Wrocław and Prague show a large preference towards caprines; meanwhile, in the southern lands of Austria and Hungary in Vienna and Buda, cattle was far more common. Meanwhile, in Berlin numbers of cattle and caprines were very balanced (Morgenstern, 2015). The reason for this wide disproportion is not obvious. It may be rooted in local economy or traditions but more systematic research is needed to clarify the issue.

In sum, the taxonomical representation of main domesticates demonstrates that regardless of the period, sites at Chełm, Wrocław, Prague–Staronová, Prague–Libeň, and to some extent Lelów are distinct from contemporary Christian sites of urban, high-status, and ecclesial origin. The obvious and expected difference is the underrepresentation of pig bones. However, it is demonstrated that in many cases Jewish sites do include some proportion of bones of this species but in those cases they still stand out from the Christian sites.

Tracing the importance of cattle throughout the ages provides one last interesting observation. Increasing relevance of cattle at the Christian sites at the expanse of pig is hinted in the presented data and it is a well-established information in the literature (Sykes, 2006; Albarella, 2006). The decrease in numbers of pigs in the late Middle Ages and early modern times accompanied by the increase of numbers of cattle is also noted for Poland (Makowiecki, 2016c, 2018, p.206). These changes may very well be caused not by the human taste or preferences but the economic development of the medieval and post-medieval cities (Makowiecki, 2016c, p.205). Simply put, the benefits of cow's milk, traction, horn, and hides overshadowed the taste for pork. In this context, the Jewish sites seem to display a similar trend of increasing relevance of cattle with time. From caprine based consumption in the early Middle Ages to cattle based in the post-medieval period, the Jewish taste seem to follow the same economic principles shaping their Christian neighbours' taste.

Chapter 9

Tales of bones, history, and Jewish culture

This chapter serves as a closing consideration on the role of zooarchaeology in the study of Jewish presence in the past. The vast amount of data and analyses presented in previous chapters leads us to conclude that it is indeed possible to detect faunal assemblages of Jewish origin, given favourable circumstances of deposition and preservation. Their detection is based on two main indicators, which are summarised in section 9.1. The researcher searching for a Jewish presence at the archaeological site may be surprised to see that pig bones may in fact not be entirely absent. I tackle this issue in section 9.2. The inquisitive researcher noticing the underrepresentation of hindquarters or particular patterns in their ageing and osteometrical data may benefit from reading section 9.3, where I discuss how trade and Jewish–Christian relations can affect animal bone assemblages. Lastly, one may find it interesting to know what bones are associated with a certain traditional festive dish (section 9.4).

9.1 Zooarchaeological indicators of Jewish presence

The interpretation of an animal bone assemblage as being associated with Jewish presence is based on two main zooarchaeological indicators. The first concerns the presence/absence and frequency of pig and other non-kosher species. The second is the evidence of the occurrence of porging — whether this is represented by the lack of hindquarters or the presence of a porging pattern of butchery marks.

The interpretive value of these two indicators has been discussed before (Ijzereef, 1988, 1989; Greenfield and Bouchnick, 2010; Valenzuela-Lamas et al., 2014) and I have summarised it in chapter 3. These indicators appear straightforward, but as the evidence presented in this thesis suggests, they needed to be supplemented and re-evaluated.

To determine whether faunal remains derive from a context of Jewish habitation we will first need to start looking at species representation. Judaic food taboos concern many species (see chapter 2), but in urban contexts most common non-kosher species of domestic mammals are pig and horse.

Horse bones are only occasionally present in large numbers in historical European archaeological sites. In many European cultures eating horse meat is not popular or even avoided all together (Gade, 1976; Simoons, 1994; Levine, 1998). When horse bones are represented in larger numbers, they often constitute remnants of disposal practice of working animals' carcasses. This kind of deposit may be present in layers associated with Jewish habitation in the form of unbroken or post-depositionally broken bones. This was the case for one of the sites in phase 1 at Chełm. On the other hand, kitchen waste of horse bones constitutes an important indicator, and may interpreted similarly to the occurrence of pig bones discussed below.

Pork avoidance may be much better visible in the faunal record than the horse avoidance. Pig bones commonly constitute a large portion of the assemblages from historic Europe, apart from Muslim area. Although pig bones may still be present in the Jewish contexts — for a plethora of reasons discussed in in the next section — the overall patterns of representation of the three main groups of domesticates (see fig. 8.4, fig. 8.6, and fig. 8.7) usually is very different from contemporary Christian sites. Hence, it is important to look at the species representation quantitatively in a wider geographical and temporal context.

Another indicator of Jewish presence concerns the process of butchery, shechita. The very act of slaughter is unlikely to provide zooarchaeological evidence (see section 2.1.2). Greenfield and Bouchnick (2010) briefly discussed the possibility of the lack of pathologies on bones as one of the indicators that the assemblage constitutes kosher waste. This is based on the fact that the carcass is inspected during bedikah, and some pathologies may deem whole animal not kosher. Unfortunately for the zooarchaeologists, the inspection is almost exclusively limited to the lungs; hence, abnormalities found on bones should not necessarily be interpreted as characterising non-kosher individuals (see section 2.1.2).

The most promising evidence concerns the process of porging (see section 2.1.3). When porging was not performed the hindquarters should be missing. The division between fore– and hind quarters will commonly be placed between the twelfth and thirteenth rib (see sections 2.1.3.4 and 7.2.1); therefore lumbar vertebrae, as well as bones of the hindlimbs, should be entirely missing in the assemblage. These could be sold to Christians (see section 9.3). When porging was performed, one can envisage the occurrence of a particular pattern of butchery marks, as described in details in chapter 7. Porging of bones would be performed only on femora and tibiae, though. Pelves were too difficult to be porged, hence they were always regarded as non-kosher. The branches of the forbidden nerve do not reach metatarsals, so porging of the bone is not performed. It is very possible for femora and tibiae to be missing from the assemblage even when porging was performed, though. By definition, porging would be performed by the butcher, not in particular households — at least since the Middle Ages, when household shechita was forbidden (cf. Cooper, 1993, p.108). The femur and tibia would be defleshed and deprived of their ends during porging (see chapter 7). This means that porgers were left with defleshed bone cylinders. This kind of product may be useful in cooking and vendors would surely be able to sell it to less wealthy patrons, or there would be a larger demand for this cut during the times of economic struggle. However, the amount of work put into the porging of those two bones might not be worth it from the perspective of a butcher. They may prefer to discard those parts or sell them to Christians if the demand for them from the Jewish patrons was low (but see section 9.4). In these circumstances, the bone assemblage may in fact have the bones of the hindlimb underrepresented, but possibly not all of them. For example, metatarsals, which would not require the butcher's laborious porging could be successfully sold, given that there was a demand for low utility parts such, as the feet.

As a final remark, it is important to consider these indicators quantitatively, comparing trends of whole assemblages, instead of single bones. Odd bones not fitting the species or body part representation patterns may be present in all assemblages. In fact, it is rare to see 'textbook' cases of Jewish assemblages, as some pig bones will be usually present, along with some pelves and a mix of porged and un-porged long bones. In the following section I discuss the reasons behind the existence of such oddities.

9.2 The abominable pig? Riddles of animal bones and kosher identity

As it is evident from the data presented in this thesis, pig bones were often present in assemblages likely to represent refuse from a seemingly kosher kitchen. At Chełm they make up several percent of the assemblage, depending on the period (see table 6.2). They are even more common at Wrocław (see table 6.7), also in contexts where other data strongly suggest Jewish presence. Notably, some of those contexts included representation of obviously non-kosher animals, such as horse and hare, and the butchery evidence leaves little doubts that flesh and fat of these animals were acquired. Lelów (see table 6.13) has the highest frequency of pigs among these sites, but it is less surprising. The contexts at Lelów cover a large public area of the city centre where Jews and Christians probably lived in proximity. Conversely, the two Prague assemblages, Staronová synagogue, and Libeň (see table 6.18), include virtually no remains of pig and other non-kosher species.

The presence of forbidden animals is not surprising if one looks at the wider literature. Excavations of the Jewish households in Berlin (Morgenstern, 2015), the rabbi Goldberg's household in New York (Milne and Crabtree, 2001), the Block's household in Washington (Stewart-Abernathy and Ruff, 1989), and the Ximenez's estate in Belgium (Aluwé et al., 2015) also produced pig bones (see fig. 8.8). Ijzereef (1988, 1989) distinguished Amsterdam's households into four groups, based on the frequency of pig bones. Jewish households were meant to have no pig bones at all. He interpreted households with less than 1% as Jewish but with some residual contamination of the pits. Then, assemblages with 1–5% of pigs would be 'non-kosher' Jewish households — such as inhabited by non-Jewish servants. Pits with above 5% of pig were supposed to mean that the household was not Jewish. His classification is, however, very arbitrary and encourages an interpretation that is devoid of context. Applying Ijzereef's rules would lead to interpreting all assemblages discussed in this thesis as non-Jewish, while there is plenty of other evidence suggesting that they were.

Now, to determine whether the presence of remains of pig and other consumable non-kosher animals in an assemblage negates its connection with Jewish people, let us consider the possible sources of non-kosher meat in a historical Jewish household.

One of the most obvious reasons for the presence of non-kosher species is deposition and taphonomy. In urban contexts where Jews and Christians would reside in proximity, it is very difficult to assume that a rubbish pit in ones backyard was not used by their neighbours. This explanation was used by Morgenstern (2015), who argued that her site was beyond the Jewish district and Jews and Christians lived close-by, sharing their courtyards or even houses. This is a reasonable explanation. As I mentioned above, I suspect this may be the case for Lelów too. It is likely to be the reason behind some of Wrocław and possibly Chełm non-kosher bones as well. At Wrocław, it is very probable that the building in the front part of the lot was inhabited by Christians, and the tenant houses at the back by Jews. In Chełm, Jews constitute a large proportion of the town population, and they lived close to Christians. The assemblages, however, mostly come from contexts deep inside the Jewish district, where Christians did not commonly live. Some contexts were rubbish dumps in underground chalk mining tunnels associated with particular houses, with access presumably from their basements. This limits the possibility of communal inter-cultural rubbish disposal practice.

Other taphonomic agents need to be taken into the consideration. Dogs are especially attracted to pig bones, due to their high fat content, and they are known to carry and move bobes around. As stray dogs would not respect the boundaries of medieval Jewish districts, it would be easy for them to introduce the odd pig bone from a different street, which would be then deposited there. The higher frequency of dog gnawing on pig bones at Chełm may be induced by this kind of scavenger behaviour. Moreover, bones can be intrusive or residual. This can happen as a consequence of a plethora of mechanical processes, which Are discussed in the literature (cf. Lyman, 1994; O'Connor, 2003; Albarella, 2016).

Finally, cultural reasons remain. One possible cultural source of non-kosher food in a Jewish household is the presence of non-Jews in it. The wealthiest Jewish houses could employ non-Jewish servants, or own slaves, who lived in their houses (Abrahams, 1896). Servants were usually not required to observe the dietary rules. The consumption waste of those individuals would most likely be dumped to the same places as the kosher kitchen waste. It is unlikely that this scenario would be present at the analysed sites though. None of them does indicate that their residents were particularly wealthy.

A particular type of non-Jewish servant and a likely source of non-kosher food were wet nurses. Baumgarten (2004, p.137–138) notes that non-Jewish wet nurses being responsible for feeding the Jewish infants would eat non-kosher and feed the children impure food. Sometimes this was allowed by the Jews, as many believed that children may eat non-kosher food, especially when their health requires it (Baumgarten, 2004, p.137–138). In fact, they would even feed them food they would not eat themselves. An apt example is the ruling of a thirteenth century French rabbi, Yechiel of Paris. His opinion was that minors may be given pork lard, even by the Jewish hand, since "an infant is like a sick person whose life is endangered" (Baumgarten, 2004, p.137). Lard could be consumed by Jewish children on regular occasions, even at the kosher table, dining around adults. Baumgarten (2004, p.137) claims that even though by modern standards non-kosher foods would have no place in a Jewish home, medieval Jews had different standards and would store such products. Of course many medieval Jews opposed that notion. Some rabbis of that period argued against allowing wet nurses to feed infants with non-kosher food and even encourage the Jews to convince their non-Jewish nurses to keep kosher.

A surprisingly possible and historically attested way pork can make its way into the Jewish home in represented by the meat vendor's mistake or ill will. Whereas most of the kosher meat trade was in Jewish hands, in some places — especially smaller towns — the kosher meat vendor was not Jewish (Berman, 1941, p.145). Moreover, in many places in historical Europe meat vendors, including Jewish ones, would sell both kosher and non-kosher meat, even pork, together (Berman, 1941, p.146–148). Occasionally, both meats would be presented in the vendor's shop mixed together. In the hand of a dishonest or simply clumsy vendor and an oblivious Jewish patron, not-kosher meat could be brought to a Jewish home unwittingly. There are known cases when dishonest Jewish butchers would sell pork as kosher meat, for example in nineteenth century Poland and Hungary (Berman, 1941, p.146–148). These are the known examples where the Jewish vendors were punished — there probably were many more undetected cases. The fate of the dishonest butcher was, however, rather harsh. The punishment for selling treyf meat to their Jewish brethren in the Middle Ages was flogging (Kozma, 2012, p.190) or even exile (Kozma, 2012, p.280). In fact, some form of punishment for the butcher applied even if the Jewish patron was intentionally buying non-kosher meat (Berman, 1941, p.148). Even the sole existence of laws against this practice means that it was common enough that the rabbinates needed to consider fixed punishments. Potentially, acquiring non-kosher meat intentionally or not, may be behind some of the bones of prohibited species found at Wrocław. In the early fourteenth century

Jewish butchers constituted a large group and also provisioned Christians with meat, making room for mistakes or ill will (Ziątkowski, 2000, p.11; Davies and Moorhouse, 2002, p.91–92).

Lastly, it is important to consider some forms of intentional leniency — or even transgression — in the actions of adult Jews. Pig is for many practicing Jews an unclean and abominable creature, which should not even be touched (Harris, 1985). Nonetheless, it needs to be considered that different individuals or even communities throughout Jewish history could have held less strict views about pork consumption.

However, the consequences of being caught not keeping kosher could be severe. For example, in fifteenth century Spain, an adult who was seen eating meat with milk[1] in a non-Jewish house was severely punished by kareth (Kozma, 2012, p.146). Interestingly, the punishment for eating pork would largely depend on the community and could be less severe; from 'merely' flogging and fasting every time the perpetrator engaged in pork consumption (Kozma, 2012, p.146), to torture for twelve months (Kozma, 2012, p.43).

Regardless of the consequences, such practice happened. Pork consumption by Hebrews is mentioned in the Bible (Isaiah 65:3-4; 66:17), in a passage dated to around 400–200 BCE. It was condemned, but it did happen during some secret religious meetings (Simoons, 1994, p.21). Later in antiquity, pork consumption was perceived by the Jews as a marker of non-Jewish customs (Rosenblum, 2010). In antiquity, a Jew who ate pork was perceived as transgressor or even an apostate (Kraemer, 2009, p.3).

One of the practical reasons for following kosher was to keep Jews separate from non-Jewish table. (Kraemer, 2009, p.17). The Bibical Book of Jubilees (22:16) states: "separate yourselves from the nations, do not eat with them". As such, keeping kosher could be perceived as an important ingredient of the distinctiveness of the Jewish collective identity. Commensal dining and mingling could lead to opening up to other cultures, and that would not be perceived as a good thing by the rabbinate (Kraemer, 2009, p.95). It could lead to tightening bonds with people of different faiths, and more intimate relations or inter-marriage. Meir ben Gedalia — a rabbi in the sixteenth–seventeenth century city of Lublin, close to Chełm — stated that *many* Jewish men transgress by participating in sexual intercourse with non-Jewish women (Fram, 1991,

[1] as mixing dairy with meat is severely forbidden in the Bible

p.101). The more traditional segment of the Jewish society would see this as a risky 'dilution' of biological and cultural identity.

Nonetheless, society gradually changed. The social environment of the sixteenth century Poland, when Jews enjoyed more religious freedom than in Western Europe led to an increase in inter-cultural connections (Kraemer, 2009, p.95–96). Embracing the mainstream Christian culture made some Jews laxer about the religious restrictions imposed upon them by Judaism, especially concerning food. Mixing of meat and dairy, pork and shellfish consumption would no longer be an issue for some individuals, who preferred assimilation to isolation (Kraemer, 2009, p.95). Some would be aware that they were transgressing, while others were presumably unaware of particular restrictions and would participate in the trend heedlessly (Kraemer, 2009, p.124). Consequently, many Jews in early modern Poland would dine with Christians on non-kosher food, to maintain good personal and business relations. Even the Catholic Church was aware of this, as records from sixteenth century Płock in Poland state that local nobility and townsfolk lived in harmony with the Jews, often engaging in commensal feasting (Pietrzyk, 1993).

Bone record can provide a grasp of these cultural processes affecting the Jewish societies in the past. Sometimes, kosher leniency would be associated with a more profound religious identity change. That is the case of the Ximenes merchant family in Belgium (Aluwé et al., 2015). The faunal evidence from their estate reflects their previous conversion to Christianity — they incorporated into their diet pork and some shellfish. The latter are not kosher, but are a good expression of one's wealth. The Ximenezes did, however, preserve some culinary practices of their Portuguese Jewish background, such as increased mutton consumption.

But the leniency in kosher observance does not need to reflect the shift in one's identity or religion. The Block family in Arkansas, whose religion and identity remained observantly Jewish, hardly kept kosher at home, as the faunal record suggests (Stewart-Abernathy and Ruff, 1989). Whether they changed their foodways for an economic reason because kosher meat was more expensive, or due to the lack of kosher butcher, or to assimilate to the mainstream American culture, historical texts suggest they maintained their Jewishness in some other areas of life. Another possible example of such leniency is the household of rabbi Goldberg in New York, who tried to keep kosher, and certainly was identifying himself as Jewish. Sometimes, however, he seemed to have provisioned his household with some cheaper, non-kosher (i.e. hindlimb)[2] beef cuts or even pork (Milne and Crabtree, 2001). Less direct evidence is from Amsterdam, where an assemblage of bones from a particular wealthy household strongly suggested that the inhabitants were Jewish and were keeping kosher (Ijzereef, 1988, 1989). They did, however, engaged in consumption of high-status non-Jewish food such as shellfish, possibly to express their wealth.

These considerations may shed new light on the occurence of prohibited animals — pig, and even horse or hare — in the kitchen waste at the Więzienna lot in Wrocław in the late thirteenth– early fifteenth century. The previously mentioned mixing of Jewish and Christian rubbish is certainly a factor behind some of the non-kosher finds, but it does not seem to explain it all. What is important, the mixed rubbish would also imply that the lot was co-inhabited by Jews and Christians, living side by side. This environment could accelerate acculturation. Despite being overwhelmingly observant of the dietary rules, the Jewish residents presumably allowed for some leniency in their foodways. This could be rooted in the deterioration in Christian attitude towards Jews happening in the fourteenth–fifteenth century. Incorporating some Christian food into their diet could be a symptom of assimilation in the hope of a better treatment, or maybe even forceful conversion. A seemingly more probable explanation would be financial. The Więzienna Jewish residents were artisans renting their homes from a Christian landlord and certainly they were not particularly wealthy. Kosher meat was expensive — even more so after the early thirteenth century ban on trade of Jewish meat to Christians. Kosher butchers would certainly raise their prices to compensate for treyf meat that they could not sell any more. Meat of non-kosher animals would be cheaper, especially that from horse, which was not a popular dining choice. Cases of famine-caused horse meat consumption are known to zooarchaeology, for example at West Cotton in Britain (Albarella and Davis, 2010). The Więzienna residents possibly had to make these compromises and transgressions to be able to sustain themselves.

The weakening observance of food restrictions was just one side of Jewish society in the early modern world. When some less-then-pious, lax individuals minimised the influence of the religious rules on their lives, to participate in the flourishing early modern Polish culture, others remained obedient to the rules. The pious, yeshiva educated 'True-Torah Jews' by all means still constituted

[2] In the nineteenth century America porging was not performed, and hindlimbs would never be kosher (cf. Greenfield and Bouchnick, 2010)

a vast party, shielding themselves from the outside world with restrictions on every aspect of their lives, including their food (Kraemer, 2009, p.96). For them, moving to new lands and being exposed to new, non-Jewish surroundings would involve segregating themselves ithin their communities. One of the crucial aspects of maintaining and underlining their Jewishness, often before anything else, was shechita and the access to kosher meat. Sir Moses Montefiore, the nineteenth century Jewish English banker, would take a shoychet with him on his travels, to maintain a steady flow of kosher meat (Berman, 1941, p.1). While travelling Christians would firstly look for their churches or chapels, the Jews seek a shoychet, whilst a synagogue was of a secondary concern. In fact, shechita was a factor that often caused Jews to reside together in compact masses (Berman, 1941, p.1). It was individuals like that, who escaping from the Holocaust preferred to die of starvation than accept a pork sausage from a friendly Christian (see Foer, 2010).

Zooarchaeology may never be able to detect a brief presence of Jewish newcomers. The mentioned Jews who needed a shoychet before the temple would not leave a substantial zooarchaeological footprint. What, however, zooarchaeology can provide is information about advanced Jewish communities with developed aspects of provisioning kosher meat. Without porging or friendly non-Jewish neighbours willing to buy the hindquarters, kosher meat will not be financially viable, and unobtainable for many. Only a developed Jewish community would afford a porger, as such butchery style requires good organisation. The porger needs to be thoroughly trained and possibly brought in from another well-established community. Porger was forbidden to serve as a regular butcher to the community due to the possible conflict of interest (Eisenstein, 1905). Such individual would be almost a communal officer, important for the stability of the new community (Berman, 1941, p.1). The communities predating 1250 CE in Wrocław, and in the eleventh–twelfth century Prague in the vicinity of Staronová synagogue were very young at that time. The findings of porged bones there imply that the Jewish communities were already well-organised and established. In fact, all the researched cities and towns in most periods have some evidence of porging on bones. It was already stated in this thesis many times that porging may be an economic necessity for a community, at times when the local Christian populace would not or could buy it, due to legal restrictions imposed by secular rulers or the Catholic Church.

9.3 The uneasy trade

Much of the meat from Jewish butchery will, in fact, end up not being kosher (Berman, 1941, p.208). There are many possible reasons for that. Firstly, the animal was imperfectly slain, and the whole carcass consequently spoiled. Secondly, during the examination of the properly slaughtered carcass, it became apparent that that animal had lesions in its lungs or other forbidden pathologies. These would deem the whole or a part of the carcass as inedible. Lastly, the hindquarters that were not porged could not be eaten. It is estimated that, in historic times, as much as one in four carcasses would end up being regarded as non kosher, due to errors in slaughter or pathologies (Berman, 1941). Without porging, another half of the carcass from each kosher animal had to be disposed of.

The best way to dispose of the non kosher, or treyf meat was to sell it. Meat trade betweem Jew and Christians is well documented in historical sources, as well as its banning. Part of the controversies about acquiring treyf meat by the Christians derives from the pope Innocent III's bulla from 1208. He was concerned with the fact that Christians were buying products considered by the Jews as 'not good enough' (Grayzel, 1933, p.126–127). Following this ruling, many European cities forbad Jewish–Christian meat trade and kosher butchers had to compensate for the inability to sell the treyf parts by raising prices. The medieval Church in Poland barred its followers from buying meat from the Jews in many cities, including Gniezno and Wrocław (Berman, 1941, p.218). It was also hugely restricted in the fifteenth and sixteenth century Prague (Berman, 1941, p.222). In the Bohemian town of Kolín, Christian burghers were opposing the trading of Jewish meat. The Jewish butchers would sell their non-kosher cattle hindquarters to a local caste, for the use of servants and hunting dogs. This practice made many Christian butchers lose their business and go bankrupt. The Christians therefore forced a contract upon their Jewish neighbours forbidding them to sell meat outside the city (Bondy, 1906, p.504). Another restriction would be the heavy taxation of kosher meat. For example, the infamous *korobka* tax introduced in the seventeenth century Poland (Berman, 1941, p.183), which made kosher meat much more expensive. On the other hand, some cities in the early modern period allowed the trade of Jewish meat; notably, Cracow, Poznań, Lublin, and Opatów (Berman, 1941, p.222). However, very often Jewish butchers needed to camouflage their involvement in the slaughter to be able to sell the meat to Christians (Zaremska, 2005).

The zooarchaeological evidence in the current research suggests both presented scenarios. The underrepresentation of hindquarters at Chełm and the older phase of Libeň would hint that at least some were sold to Christians. A similar scenario possibly applies to Lelów. Meanwhile, this practice is not evident at Wrocław or Prague–Staronová as much, because porging was common and hindquarters were acquired by the residents from the butchers.

Another aspect of Jewish–Christian trade relevant for the discussion is livestock trade. In many places Jewish merchants were involved in livestock trade, for example at Libeň (Vyšohlíd, 2014) or Chełm (Frydman, 1954, p.14). These Jewish traders would be able to provision meat for the Jewish communities. In other places though cattle trade was in Christian hands, and there are known cases when Jewish communities would not be able to provision themselves without Christian involvement. In an extreme case, in 1344 in German Landshut, a Jewish butcher was forced to buy all his cattle from Christian traders (Cooper, 1993, p.111). This literary evidence provokes a discussion on a different aspect of the Jewish relationship with the Christians.

A case of Christians in control of the provisioning of livestock to the Jewish community opens a range of possibilities for exploitation and maltreatment. This is an area where zooarchaeology may provide answers. The comparison of body size of cattle in section 8.3 shows that the populations from Jewish contexts at Prague–Staronová, Wrocław and Lelów were somehow shorter than animals from contemporary and geographically relevant Christian sites. Interpreting this in the light of similar results from low versus high status Christian sites in medieval Poland (Makowiecki, 2001, 2010), suggests that provisioning of livestock for different social groups was different: low-status folk was provided with smaller, 'worse' animals than the high-status people. Likewise, the Jews would be provided with smaller and 'worse' animals comparing to Christians. This pattern is not present at Chełm, and one can only speculate whether this has anything to do with the fact that Chelmer Jews traded livestock.

Another aspect of this kind of exploitation of the Jews could be present in the mortality patterns of cattle and caprines. As it is evident from section 8.2.1, the majority of analysed sites were provisioned with predominately older animals. A similar trend was noticed by Ijzereef (1988, 1989), who argued that Jewish butchers bought only adult oxen. The preference of Jewish butchers towards older cattle is surprising. In old cattle even one in four individuals would have lesions in lungs or other forbidden pathologies and would be deemed treyf and inedible for the Jews (Berman, 1941, p.208). A rational thing for Jewish butchers would be to buy young livestock to minimise the risk of losing the whole carcass. A possible explanation may use the information provided above. The local livestock traders, whether Christians or even Jewish, were provisioning the Jewish community with older dairy cows or beasts of burden whose quality of meat was worse. One the other hand, the development of husbandry in the late medieval and early modern times was moving towards higher numbers of cattle and exploitation of recurring products. Therefore, it is not clear whethger this pattern constitutes a trend connected to the Jewish provision or more of a general trend of that period.

9.4 Tradition, foodways and the Sabbath stew

> …you may ask how did this tradition start. I'll tell you …
> …I don't know. But it's a tradition!
>
> Tevye the Milkman
> *Fiddler on the Roof*

The medieval and early modern Jewish world was very open and supported contacts on regional or even international level. Rabbis and yeshiva students would often travel and exchange. For example, Prague was a frequent destination for rabbis from Poland (Kieval, 2011, p.14). Sources from Chełm note that many Chelmer Jewish families moved to Wrocław in the seventeenth century, and the Jewish trade between those two settlements was brisk (Frydman, 1954, p.21). Other sources from the sixteenth century mention a Poznań/Prague rabbi who settled in Chełm (Frydman, 1954, p.29). Long distance Jewish travel and trade is also suggested by archaeological finds associated with the researched site at Libeň. Many recovered clay pipes were of foreign origin, mostly from Saxony, Bohemia or Silesia (Vyšohlíd, 2014). Livestock merchants of Libeň had contacts with many Polish cites, including Poznań and Cracow, as is implied by the finds of coins from those places (Vyšohlíd, 2014). This all shows how interlinked the historical Jewish communities of cities and towns discussed in this thesis were.

Despite its international character, medieval and early modern Jewish culture, maintained particular regional traditions. Local traditions were often a crucial factor governing the observance of many Judaic rules. They would differ the most between the main diaspora populations, such as the Eastern European

Ashkenazim and the Iberian Sephardim. A German-born Talmudist of the fourteenth century, Asher Ben Yechiel, after his emigration to Spain wrote in his *Responsa* (after Zaremska, 2005, p.15):

> "*I would not eat according to* [Sephardi] *usage, adhering as I do to our own custom and to the tradition of our blessed forefathers, the sages of Ashkenaz, who received the Torah as an inheritance from their ancestors from the days of the destruction of the Temple. Likewise, the tradition of our* [Ashkenazic] *forebears and teachers in France is superior to that of the sons of this land.*"

Ben Yechiel's words encompass perfectly not only the diversity of Jewish customs, but also the crucial role of personal tradition in the observance of customs by a pious Jew.

Zooarchaeological data provides evidence of different trends in bone representation and butchery, which may sometimes be a genuine footprint reflecting the preferences, customs and foodways of those particular peoples. Unfortunately, this is not easy to establish and different factors are required to reconstruct people's customs from archaeological bone assemblages. The assemblages analysed in the current research at least partly provid information on food preparation and preferences. Some can be associated with a general Jewish culture, but others may even be representative of more specific standards of jewish food identities.

Certainly, some of the differences in species representation (see section 8.4) constitute actual differences in consumption of mutton, beef, and pork. And hopefully, section 8.1 presents some observable trends in food consumption.

Some of trends observable from animal bones were connected to the economic situations the Jewish residents were in. An apt example is Wrocław. The residents at Więzienna were seemingly facing harsh conditions. From the late thirteenth century till the early fifteenth century much of their meat consumption was based on the least favourable parts of the animal. They were acquiring cattle heads, with no horns and presumably with no skin and were cooking them in order to render as much fat as possible. They chopped mandibles to segments possibly with the same aim. They commonly split the bones into small pieces to take everything edible out of them. In as short span between late thirteenth and early fourteenth century they presumably even consumed pork, and horse meat and fat — as horse would presumably be cheaper than other types of meat — in a possible act of religious transgression. Throughout the fourteenth century, they also acquired lots of porged bones of the hindlimbs from the butchers. Let us return to this a bit later. Another possible example of poverty affecting the residents was at Chełm, where the number of consumed feet rose in the seventeenth century, which was a rough period in the history of that town. In contrast, a few centuries prior to that, the Jewish burghers of the eleventh–twelfth century Jewish Town in Prague, near the Staronová, would dine on many meaty chucks or upper parts of legs which may tell us something about their wealth.

Some other trends present in the bone record also reflect food preferences. At Lelów in the fourteenth–sixteenth century a particular cut of beef was popular. It was cut off from the shoulder blade, the spinous process was chopped off along with the meat and the glenoid cavity was hacked through (see section 6.6.1.3). This cut was no longer processed this way in the seventeenth–eighteenth century; in fact, scapulae are suddenly largely missing from the assemblage. This cut is certainly of good quality, but its absence in later times is not necessarily associated with impoverishment. In the same town also mutton would be consumed differently depending on the cut. Forelimbs were more often cooked near the fire than hindlimbs which would presumably be cooked in pots. The habitants of Jewish houses at Libeň would be interested in jaws and forelimbs; they would intensely chop their bones for fat rendering, rarely using open fire for food preparation.

These are only a few of the most striking differences in the assemblages. It is difficult, unfortunately, to assume whether they reflect general tendencies, personal preferences or differences in regional Jewish tradition.

If porging of the femur and tibia leaves the butcher with meatless bone cylinders, how to interpret their common occurence in some of the analysed kitchen waste? The only food value of those products is marrow. In section 7.4 I argued that these bone cylinders were used as a ritual item called Zeroa at the Seder feast held during the Passover. It is a likely use for them, but the Passover happens only once a year. Of course, the value of marrow consumption cannot be underestimated. For many cultures, even in modern Western fine dining, marrow is perceived as a delicacy.

From the discussion in chapter 7 it is very apparent that porging of bones is laborious and many Jewish butchers would probably consider it not worth doing, which may explain its absence from many contexts. In the contexts where porged bones were abundant, such as Wrocław or Prague–Staronová, it is fair to ask if this is an evidence of residents facing tough times, not being able to afford to buy meat and forced to base their diet on marrow? It is certainly possible, especially for Wrocław, where eating horse meat could have been a result of poverty. I would argue for another reason too, a cultural one. As a matter of fact, marrow bones were historically a crucial part of one of the most distinct and traditional Jewish dishes; the famous *tsholnt*.

Fig. 9.1 Copper tsholnt pot from Eastern Europe, ca. eighteenth century (from the Max Stern Collection, 1985.89., Yeshiva University Museum, New York)

Tsholnt (also cholent or schulet) is an Ashkenazi Jewish stew presumably originating from a Sabbath dish called *harrisa* eaten as early as the ninth century CE by the Middle Eastern Jews residing in the Arab lands (Cooper, 1993, p.102). In Ashkenazi culture it was first mentioned by Rabbi Isaac of Vienna in the early twelfth century, who had seen it being prepared in his teacher's home (Cooper, 1993, p.102). Tsholnt is and was usually eaten weekly during the Sabbath, when the religious rules prevent the pious ones from cooking. It is prepared on Friday in a large pot (see fig. 9.1), which simmers overnight in the oven. As early as the fifteenth century, when domestic ovens were not common, a casserole pot with tsholnt would be taken to the bakery and left there overnight in the bread oven (Cooper, 1993, p.184).

A traditional recipe for tsholnt includes beans, barley, potatoes and some other vegetables, meat or sausage, and a marrow bone (Cooper, 1993, p.186). Modern recipes often do not include marrow bones, but it seems that in the past they were a common and important ingredient. They would give the taste and nutritional content to the stew, especially when cuts of meat would be too expensive to use. Marrow bone as an ingredient was mentioned in a traditional recipe from early twentieth century Poland (Burr and Cohen, 1993, p.103), and in the oldest kosher cookbook in Poland by Rebekka Wolf, published in Poland in 1877, and earlier in Germany in 1856 (Wolf, 1856). Tsholnt was considered a delicatessen, and poor families could only afford to make it every two or three weeks (Cooper, 1993, p.187).

Was tsholnt behind so many porged bones found in the archaeological kitchen rubbish? It seems to be one of the possible reasons. Cooking of porged bones in large tsholnt pots would not require their intensive fragmentation. They already would lack the ends and the marrow would easily spread to the dish. Simmering in a stew would not leave burning marks on bones. Similar patterns are actually present on porged hindlimb bones from some of the sites. The porged bones at Chełm were not burnt, in sharp contrast with the commonly burnt forelimb bones. Porged bones were also rarely split more than they already were during porging, whereas forelimb bones were more often fragmented by chopping. Similar observation holds true for Wrocław: porged cattle femora were not split whereas other anatomical parts were fragmented. They were, however, burnt occasionally. At Lelów, the porged bones of caprines were less commonly burnt than the forelimbs. Contrary to this, porged bones at Prague–Staronová were often roasted on open fire suggesting a different culinary practice differentiating Bohemian from Silesian and Polish Jews.

The high frequency of porged bones at Wrocław, in some contexts exceeding the numbers of meaty parts of the forelimb, is worth commenting on. The residents were impoverished as it was discussed above. Common folk would probably eat little meat outside of Shabbat and other holidays (Kraemer, 2009, p.93). This possibly is the reason for the low number of meaty parts of the carcass. Should the large number of porged femora and tibiae make up the waste from tsholnts, it would constitute an assemblage accumulated over many months or years of Sabbaths. For the residents, to consume the traditional and possibly richer dish over the weekly holiday could be a matter of preserving their Jewish identity in uneasy times. The residents of other researched sites probably were not exposed to such rough conditions, but they were also acquiring and consuming porged 'marrow bones', possibly to make tsholnts as well. In Lelów, tsholnt was such an important tradition that in the last few centuries it has spread to local Christian people, becoming a local speciality. Until this day, Lelów annually celebrates its own festival of tsholnt and its Christian version called *ciulim* (Bakota and Płomiński, 2016)

But there is something odd about this too. In the Ashkenazi tradition tsholnt would include beef, whereas in the Sephardic version of the dish, it was more common to use mutton (Kressel, 2007). I have not found Ashkenazi recipes for tsholnt with mutton meat or bones. Meanwhile, the assemblages under scrutiny in this thesis, especially at Wrocław, Chełm and Prague–Staronová, included many porged caprine bones. Of course they may not derive from tsholnts after all. Also, one can argue this represents Sephardic influences arriving to Poland, Silesia and Bohemia when the Sephardic refugees were expelled in the late Middle Ages from the Western European countries (Johnson, 1987; Zaremska, 2005). It was suggested before in section 8.4, that Jewish diet was shaped by the same late and post medieval tendencies in urban meat provisioning as their Christian neighbours. The medieval sites saw a higher pork consumption, and in the late and post medieval periods this shifted towards cattle. The data may suggest a similar shift — but from caprines to cattle — could have happened for contemporary Jews. Therefore, the medieval Jewish kitchen potentially relied more on mutton than beef. It would also be reasonable to use it for the tsholnt as well. If that was the case, the Ashkenazi dining culture underwent a temporal change and, at some point in the beef-dominated early modern world, tsholnt started being an exclusively beef dish, as it is today.

Chapter 10

Conclusions

This thesis has opened new ways of investigating the development of religion and studying history of a religious, as well as ethnic, group through animal bone studies. It has also raised many questions, thus opening new possibilities for further research.

It has shown that Jewish diet and meat preparation practices can be reflected in zooarchaeological evidence, and animal bones can therefore be an important source of knowledge about the history of Jewish people. The study suggests that indicators of presence/absence of pig bones, as well as cattle and caprine hindlimb bones, are valuable, but they may be insufficient to successfully recognise the Jewish footprint in zooarchaeology. Therefore, they need to be supplemented with other lines of evidence. Basing on a vast array of religious and historical sources and ethnographic research, it has been possible to successfully recognise modes of Jewish butchery in form of porging practice. The evidence shows that porging, in the presented form, can be traced back as early as eleventh–twelfth century Prague, but it was present in the wider region of Central–Eastern Europe in the Middle Ages and early modern period. The pattern is, however, not known from the ancient sites of Israel, and is yet to be noticed in the Sephardi world of the Mediterranean. It is uncertain whether this practice was developed by the Eastern European Jews in the diaspora or was it known earlier in different regions. Wider European and Levantine study of butchery patterns, religious texts, and historical sources may provide answers to the questions of the development of this crucial religious practice, and the evolution of Judaism.

The research suggests that animals supplied to the medieval and post-medieval Jewish communities were less valuable — smaller and possibly older — than those provisioned for the Christians. This data is limited but consistent. Perhaps this is a consequence of the inferior role in society imposed upon the Jews by Christians and the anti-Semitic sentiment affecting the livestock trade. Further comparative osteometrical and ageing research on animal bones from Jewish and Christian sites may provide more detailed answers to this issue.

The thesis shows differences in meat consumption, which may be connected with differences in wealth and regional traditions, characterising variable Jewish communities. There are regional and temporal differences in cattle–caprine ratios and in patterns of meat consumption in Jewish communities from different countries in Central and Eastern Europe. The study also shows that some aspects of Jewish meat provisioning and consumption were governed by the same economic trends as the Christian ones. Further case-studies from other cities can add new resolution to these results.

The thesis has contributed to our understanding of the observance and transgression of religious dietary regulations, and their effects on Jewish identity in the Middle Ages and early modern period. It suggested that, just like in some historical and archaeological analogies, religious rules may have been dictated by non-religious contingencies, such as poverty. Further interdisciplinary zooarchaeological, archaeological and historical case-studies will provide more answers to the important historical questions on the development of Jewish identity.

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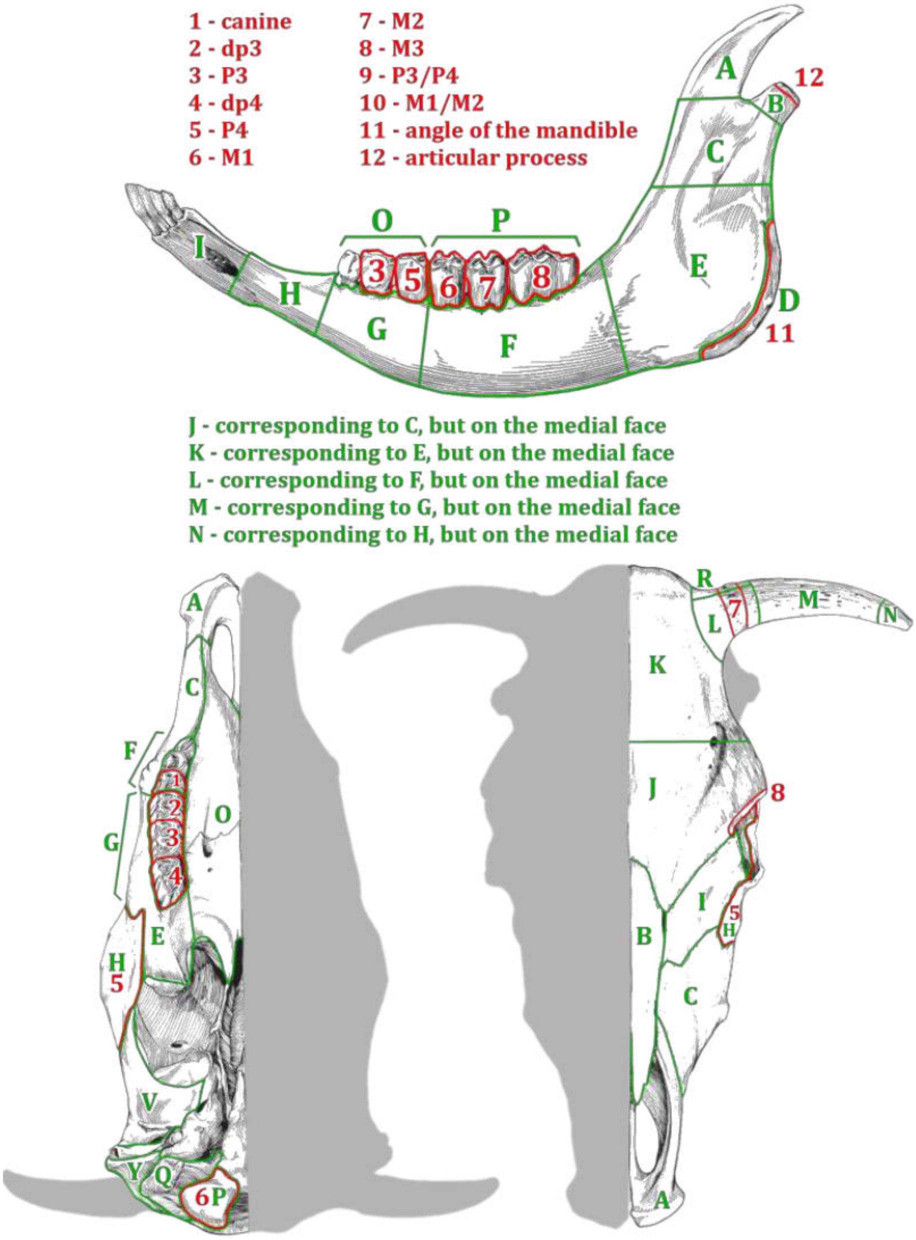
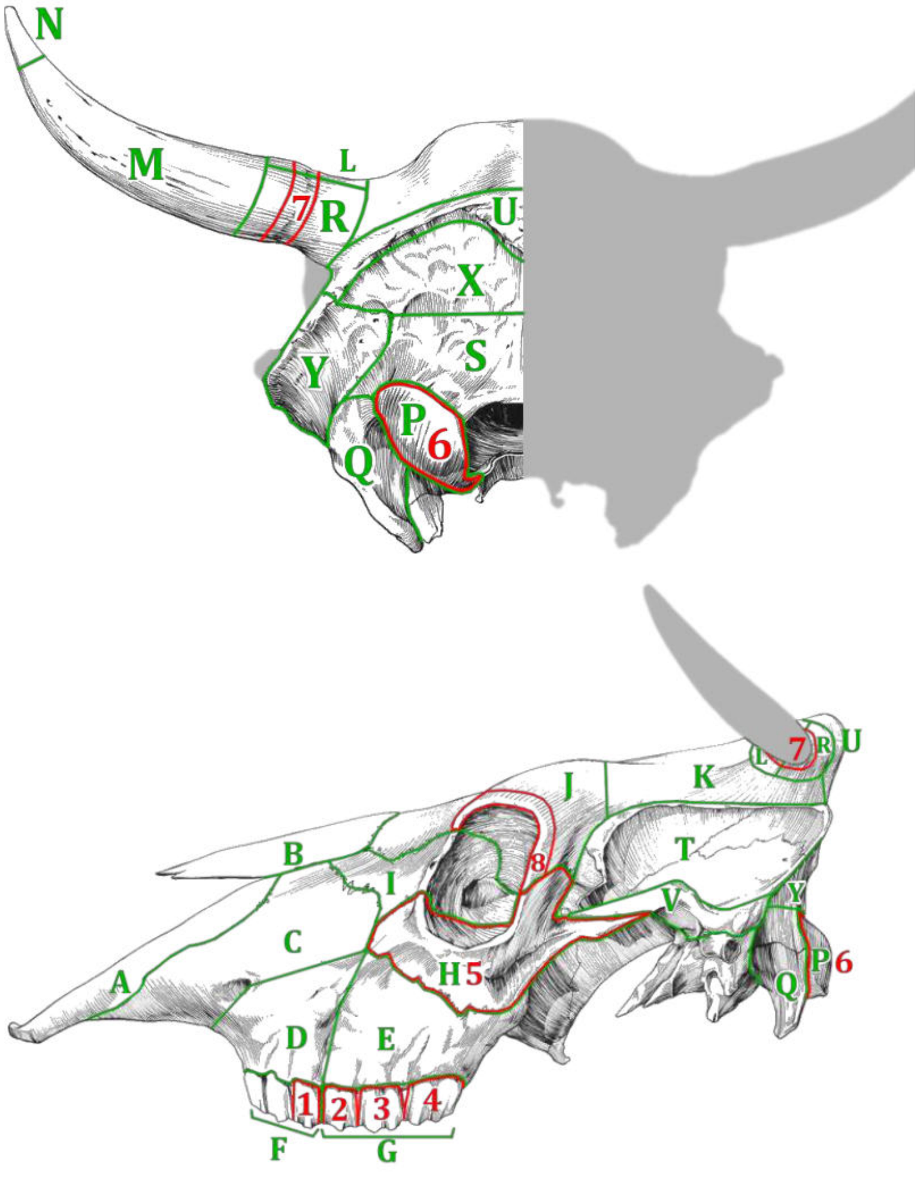
Appendix A

Diagnostic zones

Diagnostic zones

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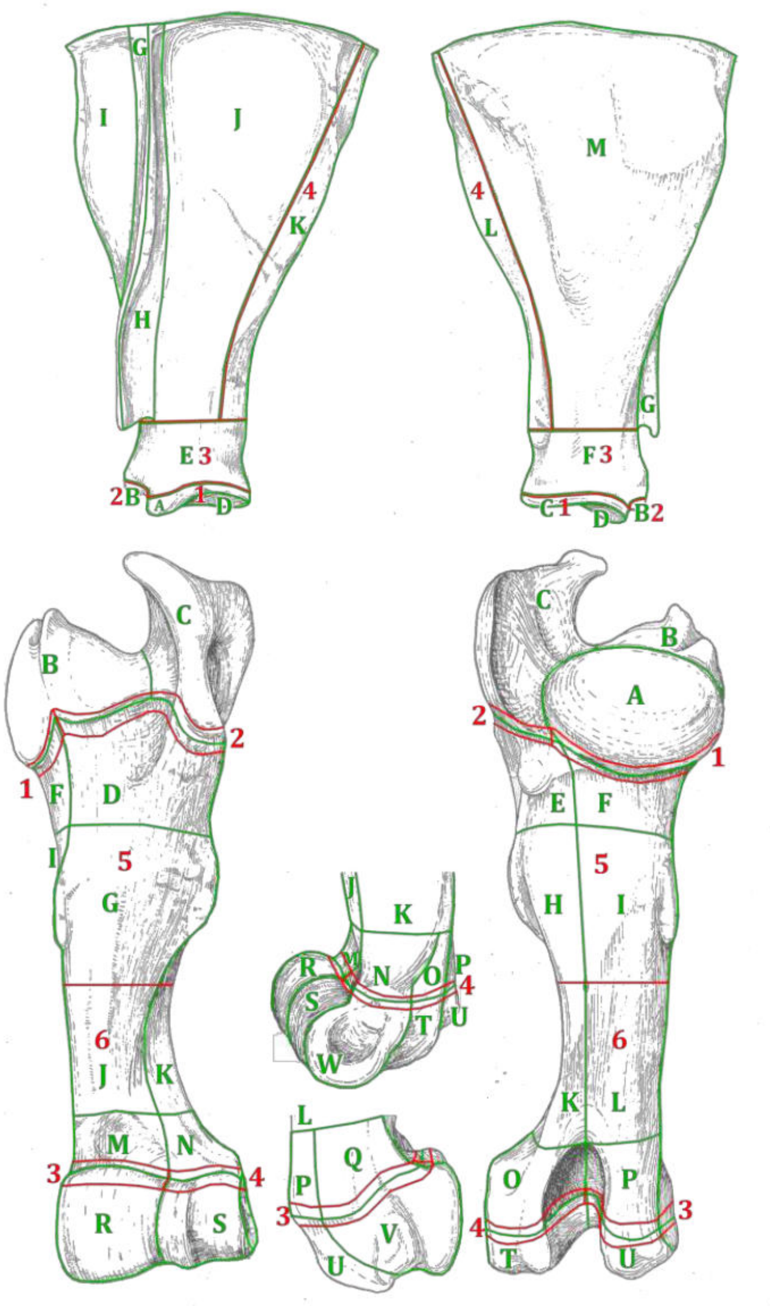
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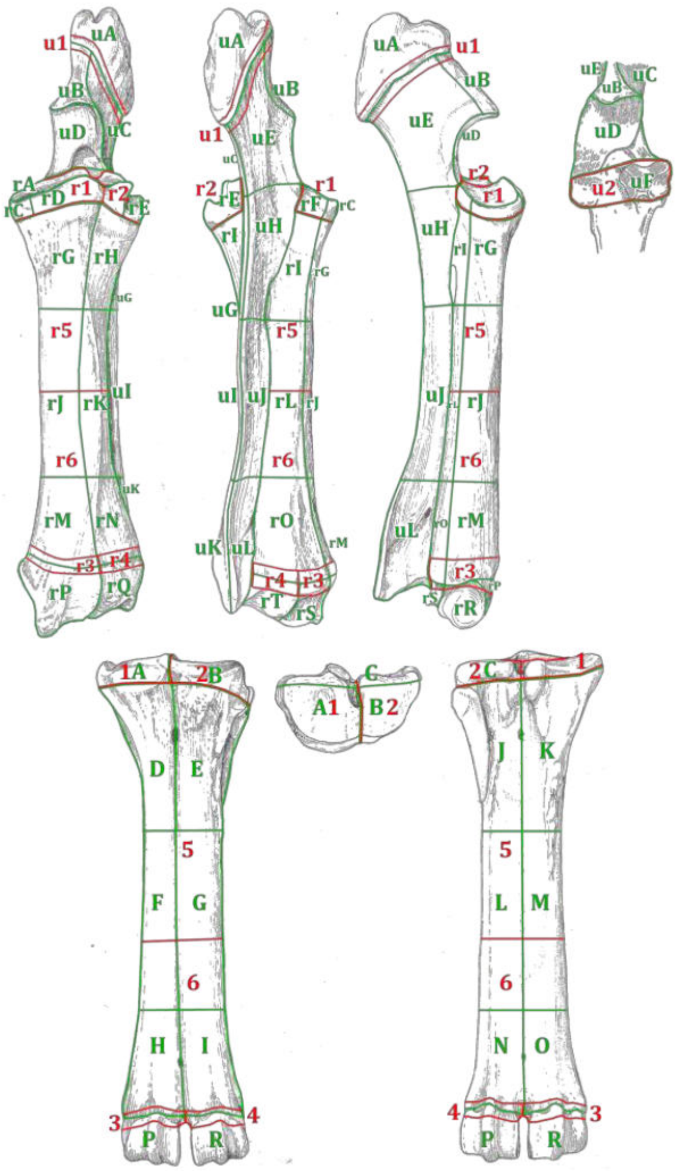

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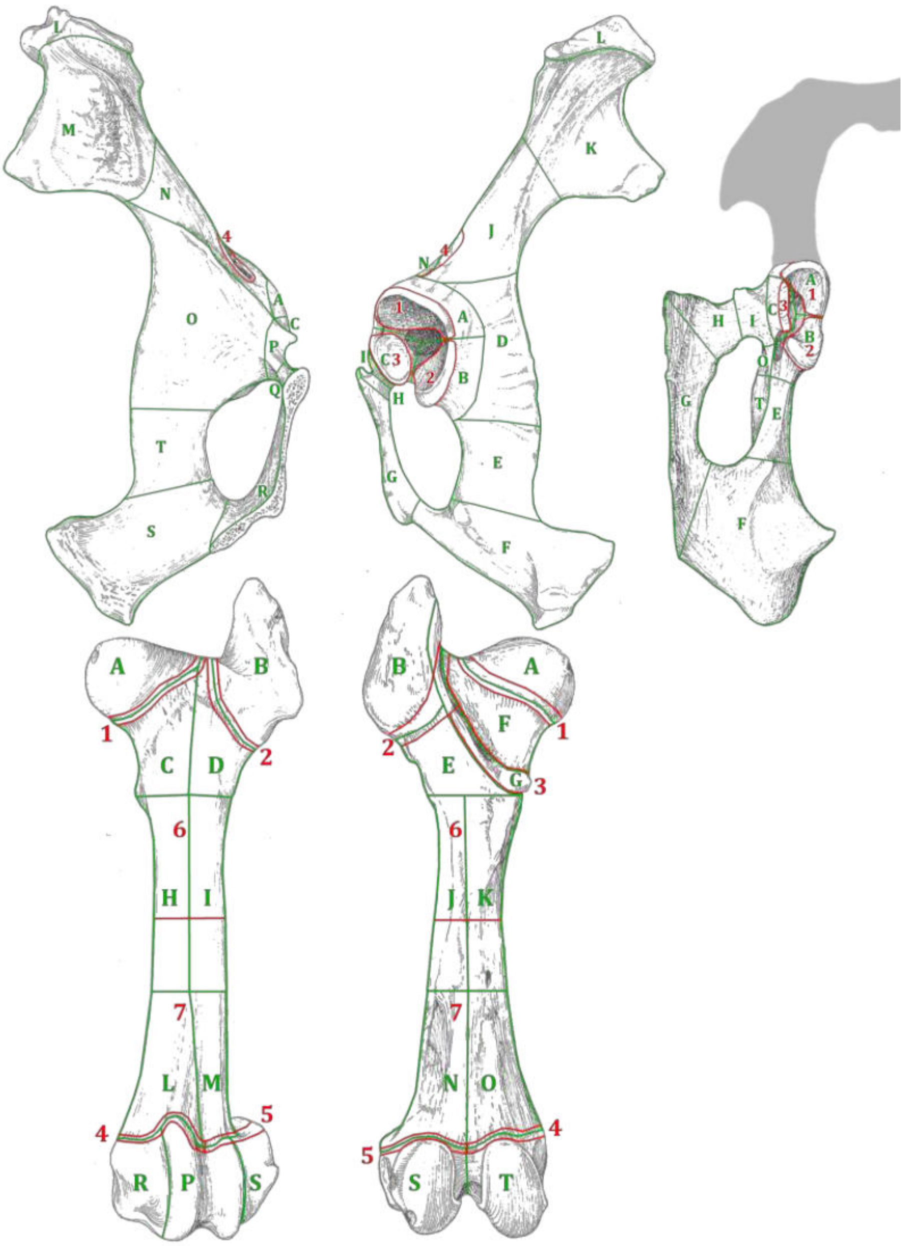

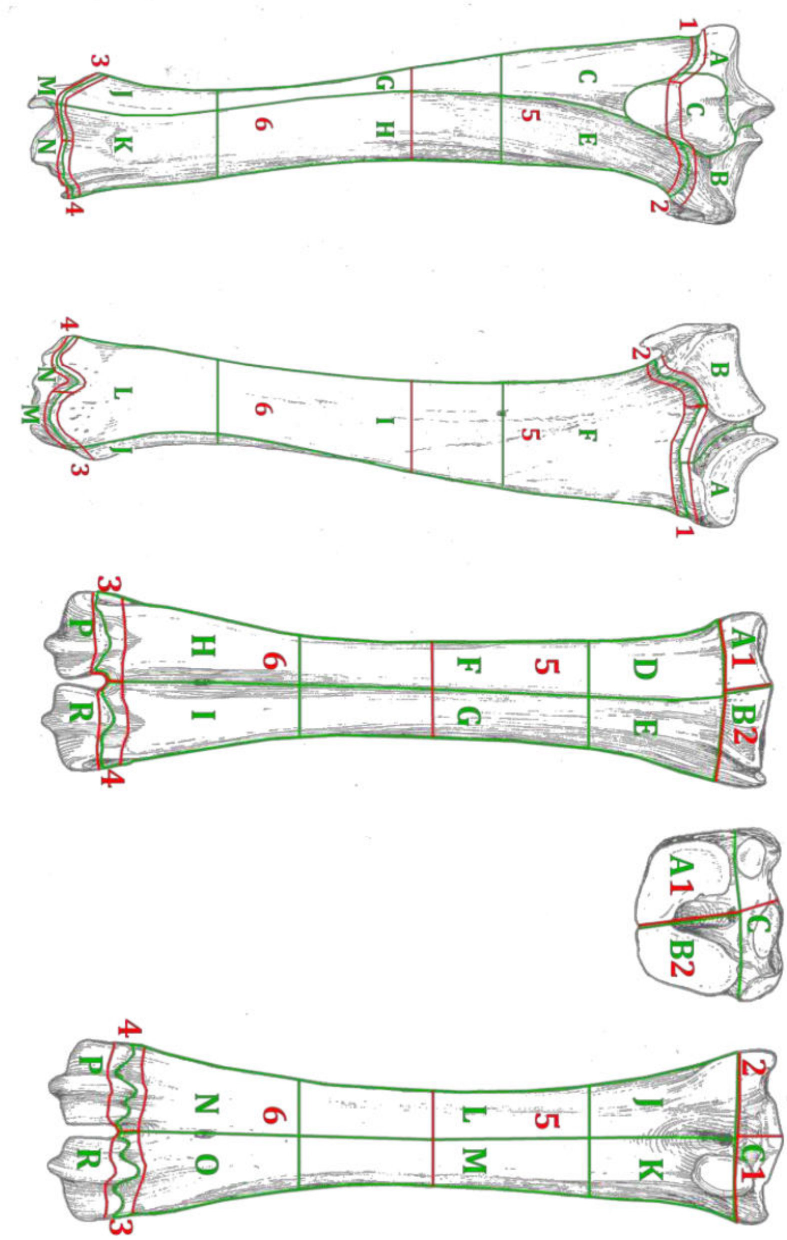

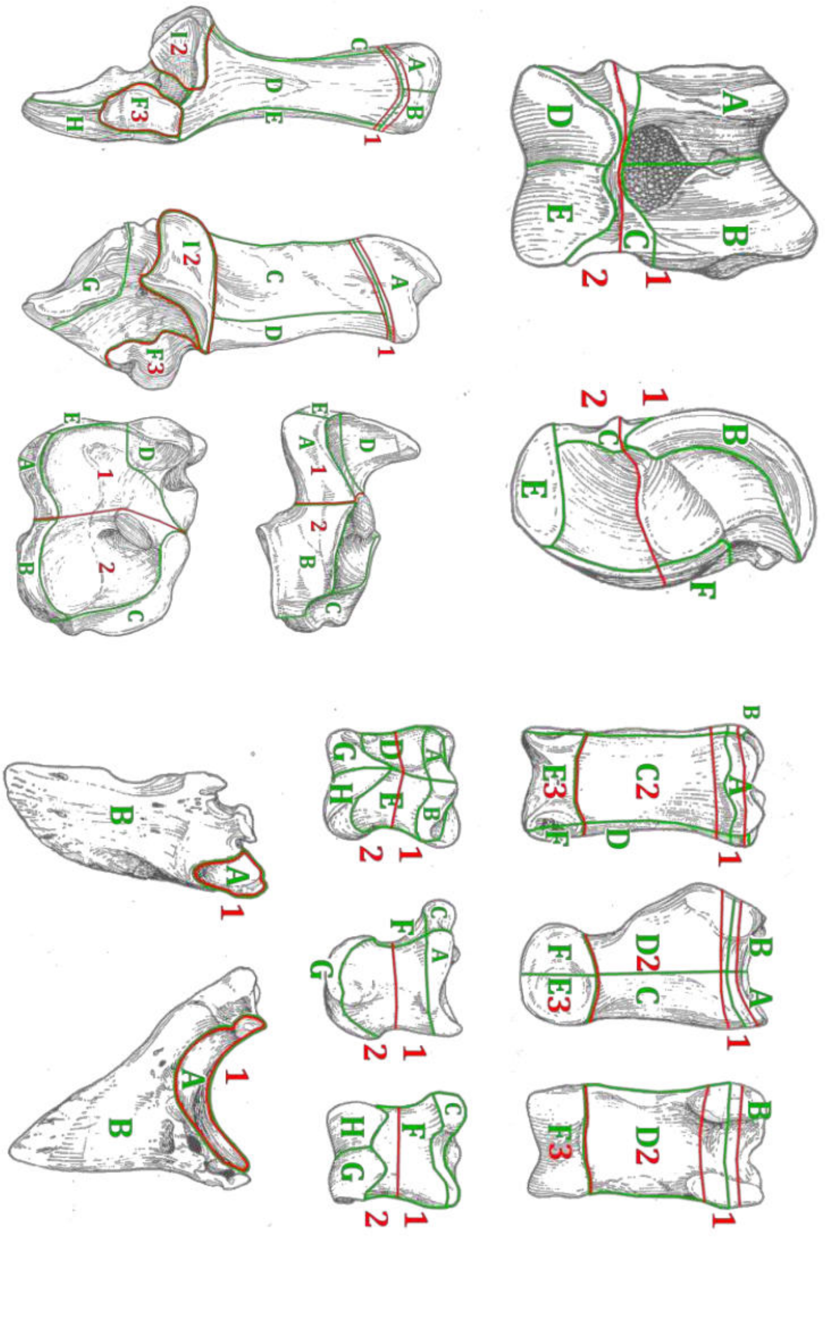

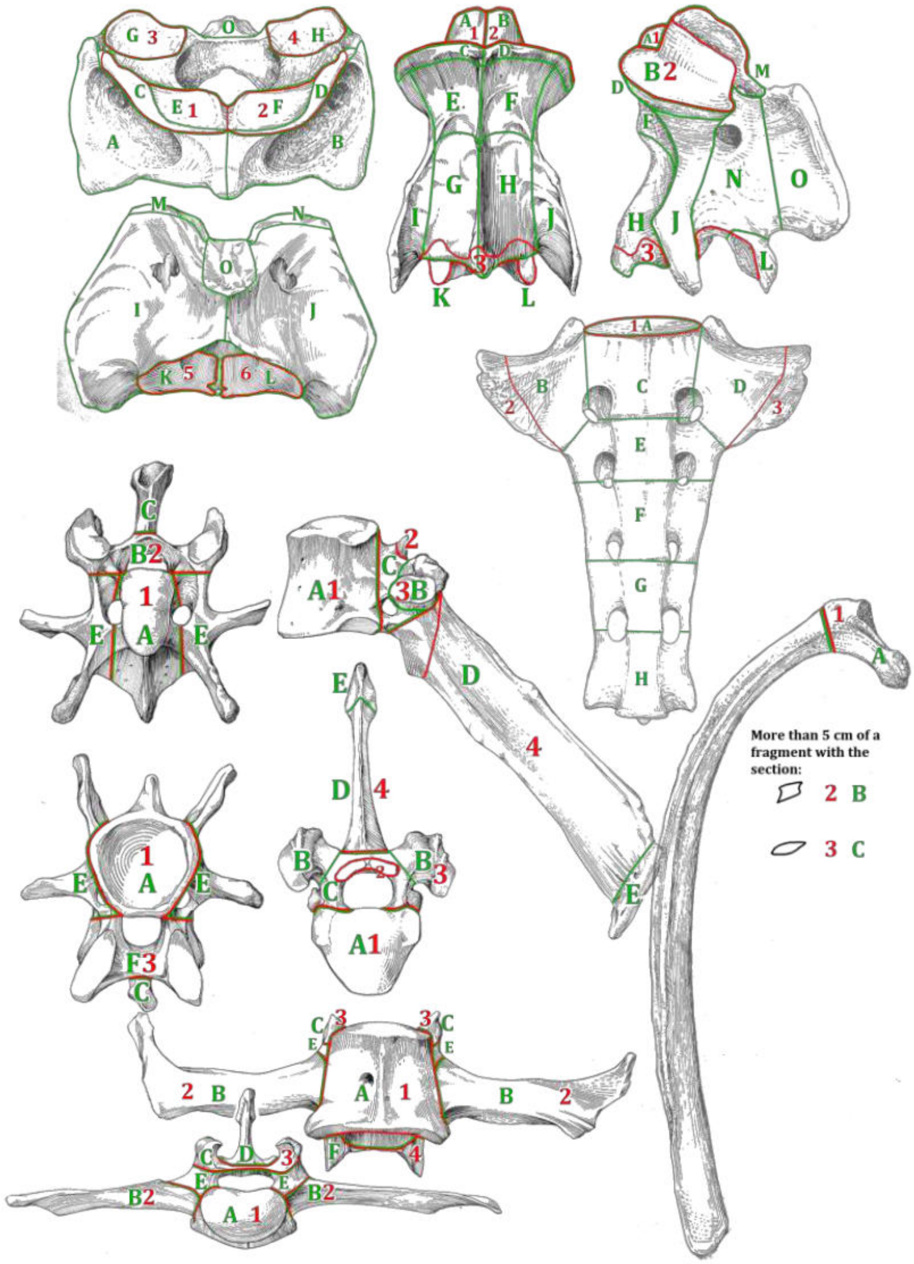
More than 5 cm of a fragment with the section:
2 B
3 C