Recapturing the sounds and sonic experiences of the hunter-gatherers at Ajvide, Gotland, Sweden (3200–2300 cal BC)

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Abstract

The rich and well-preserved osteological material from the archaeological complex of Ajvide, Gotland (3200–2300 cal BC), provides favorable prerequisites for studying prehistoric sounds and soundscapes. The archaeological excavations at the site have uncovered tubular bone artifacts and concentrations of animal tooth pendants that resemble whistles and rattles, the earliest types of sound instruments. The remains of hunted animals, such as seals, boars, dogs and birds, provide a lively picture of the species that were present in the environment. This article aims to evoke the sonic experiences of the people utilizing the site of Ajvide and explore how these hunter-gatherers constructed and responded to their sonic environment. The results of the osteological, organological and soundscape analyses are presented in the form of a scholarly text, samples of studio and field recordings, and a soundtrack that fuses the results together into a nine-minute piece of sound art.

1. Introduction

In the summer of 1986, the Archaeological Department of the University of Gotland, led by professor Inger Österholm, continued an archaeological field school excavation at the Middle Neolithic site of Ajvide (3200–2300 cal BC) (Wallin & Martinsson-Wallin 2015), situated on the island of Gotland in Sweden (Figure 1, AudioObject 1). Summer weather prevailed, and under the hot sun, the temperature in the pit, surrounded by open fields, rose to a relatively high degree. When an exceptionally dark-colored, 'fatty' activity layer was laid bare and scraped, a palpable, rancid smell reminiscent of train oil[1] filled the air (Österholm 2002a: 174). Chemical analyses showed that large amounts of train oil had soaked and impregnated the soil approximately five thousand years ago, when people were skinning hunted seals and boiling their fat for eating, cooking, illuminating lamps or smearing boats and tent skins (Österholm 1997). The residues of the fatty acids continued to gasify in the heat of the modern sun. During the field schools in 1983–1986 and 1992–2009, other traces of past sensory experiences, particularly auditory experiences, were unearthed as well. Many of the graves found at the Ajvide contained large numbers of animal tooth pendants, which seemed to have been attached to people's clothing (Burenhult 2002: 43–46). When the bearers of these clothes were still moving, the pendants would have rattled against one another (Rainio & Mannermaa 2014b). A number of worked bird bone tubes resembled a type of whistle or bird call instrument and could be played as such when set between the lips (Österholm 1998; 2008: 42–43). Owing to the calcareous soil on Gotland, the bone material from Ajvide is extremely well-preserved and contains several tons of animal debris (Burenhult 1997b; 2002). These bones, mostly originating from different seals, fish, wild boar (*Sus scrofa*) and birds, give a lively picture of the species present in the environment. All of these finds were left behind by people, who were culturally part of the Scandinavian Pitted Ware tradition with a hunting-fishing-gathering economy (Lindqvist & Possnert 1997; Rowley-Conwy & Storå 1997).

[1] Oil derived from the fat of marine mammals.

Figure 1, AudioObject 1: Ajvide site at present. The hayfield sways in the breeze, and Eurasian skylarks (*Alauda arvensis*) sing high up in the air (5 Jun 2015).

Archaeology of the senses views archaeological findings as traces of past sensory experiences (Hamilakis 2011; 2013). Similar to us, people in the past were immersed in smells, sounds, tastes and tactile sensations that shaped the world around them and affected their feelings, moods, acts and thoughts (cf. Tilley 1994; Bradley 1998; Ouzman 2001; Goldhahn 2002; Skeates 2010). Some of these sensations originated in the natural environment, but some of them were man-made. The challenge to the archaeologist is to try to recapture these types of immaterial elements in the material record and thus make life in the past more understandable to us. Combined with new ways of exhibiting the results, the sensory approach also has the potential for making the past more tangible and easily accessible to the public (cf. Moshenska & Dhanjal 2012; Berliner & Nassaney 2015). Since the 1970s, soundscape studies have discussed the role of sounds and hearing in wide cultural, social and environmental contexts (Schaefer 1977; Truax 1984; 1999; Krause 2012). For researchers in this field, it appears evident that ambient sounds, such as geophonies (water, weather), biophonies (animals) and anthrophonies (humans), structure our lives, social interactions and ways we engage with and understand our surroundings. For example, sounds signal important events, mark time, spaces and territories, mask each other and express abstract concepts and ideas. Together, they form complex textures, called soundscapes, which can be observed to carry fundamental information about the community. The community's past interpretation of, reaction to and contribution to these soundscapes can be argued to reflect and manifest its values, hierarchies and categories (e.g., Schaefer 1977: 51–77, 114–115, 181–202). To date, most of the studied contexts are modern or historical (e.g., Corbin 1998; Smith 1999; 2001; Järviluoma, Kytö, Truax, Uimonen & Vikman 2009), and only a few are prehistoric (Mills 2014; Elliot & Hughes 2014; Blake & Cross 2015). While the exclusively material sources provide reasonable opportunities to study musical instruments, scales and practices (e.g., Eichmann, Fang & Koch 2012; Jiménez, Till & Howell 2013), or the acoustics of particular archaeological sites (e.g., Scarre & Lawson 2006; Díaz-Andreu & García Benito 2012; Eneix 2014), prehistoric soundscapes are more difficult to reach.

The present article, which is a collaboration between an archaeologist, a musicologist and a sound artist, is an experimental sensory, particularly auditory plunge into the Middle Neolithic, five thousand years backwards in time. Inspired by the rich find materials of Ajvide on Gotland (Figure 2), it aims to evoke the sounds and sonic experiences of the people utilizing this site and to explore how these elements may have been significant to them. In particular, it seeks to explore the ways in which the hunter-gatherers constructed and responded to their sonic environment. This type of holistic approach, where both ambient sounds and sound instruments are set in their relevant soundscape contexts, is not realizable at very many sites in Europe. The article introduces an innovative set of research and dissemination methods for the emergent field of sonic studies of the past. The sensory elements are recaptured individually by going through excavation reports, conducting osteological and artifact analyses and making playable replicas, type models and studio and field recordings. The latter type of recordings are conducted at contemporary Gotlandic sites, where auditory phenomena can be understood to have remained largely unchanged throughout the past millennia. The results are presented in the form of a scholarly text as well as sound samples that serve to make the information tangible and perceivable. At the end, a nine-minute soundtrack fuses all elements together into a research-based free piece of sound art, providing thus the reader with an opportunity to listen to, or plunge into a Middle Neolithic soundscape. In this way, this case study attempts to stimulate new thoughts and questions about the roles of senses in past societies. Although Ajvide is one of the most extensively excavated and thoroughly documented Stone Age sites in Northern Europe, analyses and interpretations of its findings are still in progress. Several crucial questions, such as the relative dates of the different activity areas, the details of the burial practices and the nature of the entire site complex, still remain open. Due to these gaps in knowledge, the present study tries to operate on a general rather than a detailed level, basing its arguments on the results of the latest publications.

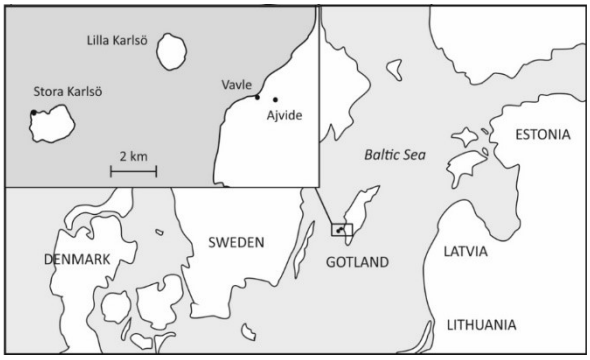


Figure 2: The location of the Ajvide site on Gotland, Sweden.

2. Study methods

The article is the result of many years of cooperation between the osteoarchaeologist Kristiina Mannermaa, the archaeomusicologist Riitta Rainio and the sound artist Juha Valkeapää. In 2000, Mannermaa became acquainted with the Ajvide site by participating in the field school excavation arranged by the University of Gotland. A couple of years later, she conducted osteological analyses of the bird bone material found at the occupation site and graves, identifying bones from 30 different bird species (Mannermaa & Storå 2006; Mannermaa 2008). In addition to the osteological analyses of fish, mammal and human bones by several other authors (Lindqvist & Possnert 1997; Rowley-Conwy & Storå 1997; Storå 2002; Olson 2008; Bergstedt 2012, Lundén 2012; Gustavsson 2015), these analyses underlie the environmental reconstructions below. In 2011, Mannermaa and Rainio visited the University of Gotland and

conducted an osteological and organological study of 47 worked bird bone tubes, which excavators Österholm (1998; 2008: 42–45, 115) and Göran Burenhult (1997a: 20, 65; 2002: 34, 98–99, 109, 116–117) had published as whistles or flutes. Although perforations in some of the tubes revealed that these artifacts could not have functioned as whistles or flutes, the unperforated tubes conceivably appeared to be wind instruments (Mannermaa & Rainio 2013; Rainio & Mannermaa 2014a). In particular, the extraordinary two-piece tubes could be paralleled with traditional birdcalls used in North America (Rainio 2016). During the same visit, a sample of 53 animal tooth pendants was also investigated to test the hypothesis that these functioned as rattles. According to these results, 72 % of the pendants showed use-wear that suggests this type of instrumental use (Rainio & Mannermaa 2014b). Playable replicas and type models of both birdcalls, rattles and tools from the site were made from fresh animal bones, teeth and lithic raw materials and recorded at the University of Helsinki Music Research Laboratory using two AKG C 460B or Neumann KM 183 microphones.

In the summer of 2015, to have an idea of the local circumstances, Rainio made field recordings at the site of Ajvide and its surroundings as follows: the fishing station of Vavle and the island of Stora Karlsö. The equipment there consisted of two Neumann KM 183 microphones, a Zoom H6 portable recorder, an Amprobe SM-20 sound level meter and a hand-held GPS for mapping the recording points (Figure 3). The sound material was analyzed with Spectutils spectrum analysis tools (Lassfolk & Uimonen 2008) to plot graphical representations of the captured soundscapes. The material also formed the basis for the sound installation "Bone Garden", which Valkeapää and Rainio (2015) constructed for the Turku New Performance festival in Turku, Finland. For this installation, Valkeapää mixed a selection of the studio and field recordings together into an eight-minute soundtrack, also adding a couple of supplementary sounds (Linjama 2009). The Bone Garden was an attempt at a "Stone Ageish sound installation in three parts". In addition to a listening room, it included a dark material room, where visitors could touch, smell and feel the Stone Age, and a participatory "disco" room, where the visitors could try on tooth rattles and dance with them (cf. Välimäki, Hewitt, Kela & Krappala 2016). For this article, a new, broader version of this soundtrack, an evocation of the past soundscape, was designed and prepared by Valkeapää.

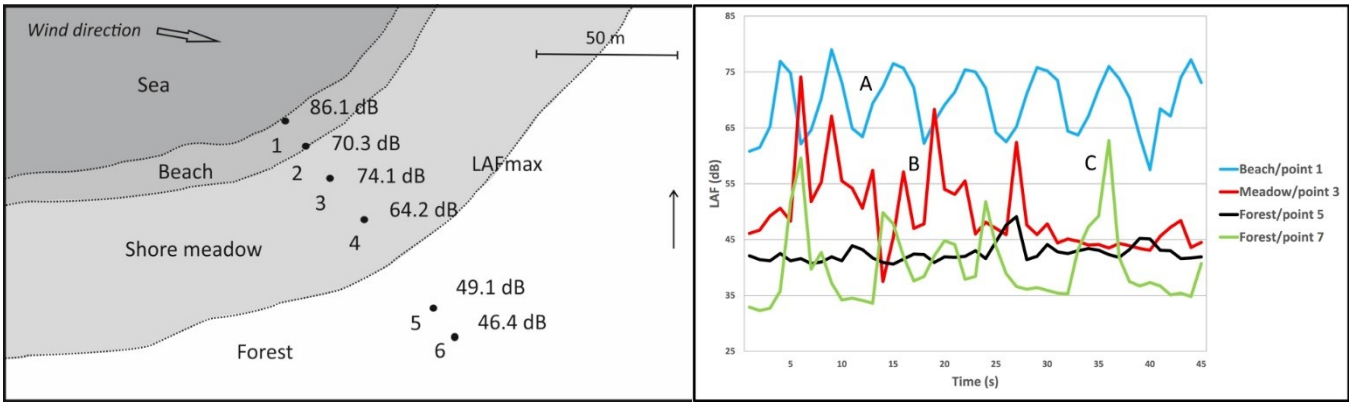
Figure 3: Recording equipment during the fieldwork on Gotland. The island of Lilla Karlsö is in the background (1 Jun 2015).

3. Wind and waves on the beach

Today, the site of Ajvide is situated approximately one kilometer inland from the western coast of Gotland, in the middle of fields. However, in the Middle Neolithic, the sea level was 11–13 meters higher than it is at present (Burenhult 1997b: Fig. 3; Gustavsson 2015: Fig. 9). White limestone gravel that submerged most of the Ajvide site approximately five thousand years ago indicates that its position at that time was very close to the shoreline (Burenhult 2002: 31). Furthermore, a pebbly rock floor found on the western side of the site suggests that many of the activities occurred directly on the beach (Burenhult 2002: 31; Österholm 2008: 18). Although a small island protected the site from the southwest, the position appears to have been exposed to the sea. The fishing station of Vavle by the present coastline offers an opportunity to recapture some of the sensory reality of Ajvide during the Stone Age. This seaside station is similarly exposed to the sea and has somewhat similar sea bottom and altitude contour lines. Dominant winds blow from a westerly direction, that is, from the sea. Shore zones consist of a pebble or sandy beach 10 meters in breadth, a shore meadow 50 meters in breadth, and an open windswept pine forest that goes further inland as far as the Ajvide fields. The historical station of Vavle was not continuously occupied but visited during a few intensive weeks in spring and autumn, when fishermen gathered there. At the station, they had simple huts for their gear, nets and boats (cf. Jonsson & Lindquist 1987: 33–35).

Figure 4, AudioObject 2: Fishing station of Vavle by the present coastline. Waves hit the pebble beach, pebbles and shells rattle, and a common tern (*Sterna hirundo*) cries (1 Jun 2015).

During the field recording at Vavle, the wind speed was only moderate (7 m/s), but the ambient noise level was still remarkable (Figure 4, AudioObject 2). A westerly wind wailed and hissed inside the ears and raised waves that hit the shore with booming crashes and a constant rumble. The sound pressure level (L_{AFmax}) on the beach rose to 86.1 dB, on the shore meadow to 74.1 dB and in the pine forest – 100 meters away from the waterline – to 46.4 dB (Figure 5). The waves created a rhythmic pattern, where the broadband noise of water filled the audio space at regular 5–7-second intervals, masking all other environmental sounds (Figure 6). Between these crashes, the rolling pebbles and shells emitted a clear rattling sound (Figure 7, AudioObject 3). Moreover, in the meadow zone, the wind grew into blasts that flapped sleeves and trouser legs, most likely because this zone was situated higher, two meters above sea level. In the forest, the wind calmed down so much that singing birds, such as willow warblers (*Phylloscopus trochilus*) and barn swallows (*Hirundo rustica*), became audible. Only approximately 500 meters from the coastline was the sea finally out of earshot. Now, warblers sang their descending whistles in the foreground.



Figures 5, 6: Measured sound pressure levels in different shore zones and recording points (1–7) at the fishing station of Vavle. Recording point 7 is located 500 meters away from the waterline. A) Rhythmic pattern created by the waves; B) blasts of wind; C) repetitive whistles of a willow warbler (*Phylloscopus trochilus*) (1 Jun 2015, +20.5 C).

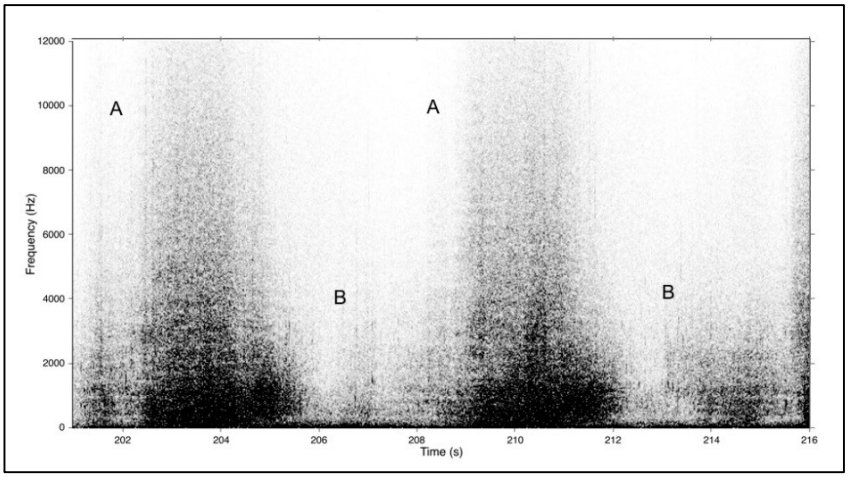


Figure 7: The sonogram of a soundscape clip from the Vavle beach. A) Broadband noise of the waves fills the audio space at regular intervals; B) rolling pebbles and shells rattle during ebbing.

AudioObject 3: Scooping up shells on the Vavle beach (1 Jun 2015).

As the locals say, the Baltic Sea here is rarely calm, and the constant roar seems to be very much part of this place. It has most likely characterized the coastline since the Middle Neolithic, the time of occupation of the Ajvide site. From a psycho-acoustic perspective, a loud or noisy[2] soundscape such as this is not necessarily the most comfortable or healthy soundscape. On the beach, one cannot hear anything else but the sea, and one has any idea of what is happening behind one's back. The acoustic horizon is close to zero (cf. Truax 1999). On the shore meadow, one must raise one's voice and shout to be heard, a bit like gulls, terns and other shorebirds, which have developed harsh cries that can carry over the marine environment. Separating meaningful signals from background noise is energy-consuming and tiring, and human brain activity has been shown to be greater in noisy rather than quiet environments (Krause 2012: 155–175). The adverse effects of such a strain include irritation, nervous tension, fatigue, blood pressure elevation and hearing damage after prolonged exposure. On the other hand, the broadband rhythm of the waves, where the sound pressure level fluctuates, recalls the breath of living organisms and can be regarded as soothing and relaxing. For hours after the recording, the rhythm of the waves still rang in the ears.

[2] In this article, the words "noise" and "noisy" are used to denote sounds and soundscapes that have high sound pressure levels. They do not refer to sounds that were somehow unwanted or unpleasant for prehistoric people.

4. Bird islands

After hearing the loud soundscape at Vavle, it is not surprising that the Middle Neolithic occupation at Ajvide is not considered to be of a permanent nature. Because hearths, clear patterns of post-holes and other indications of dwellings are missing, the site appears to have been a temporary camp, used periodically for fishing and hunting (Norderäng 2008: 23; Wallin & Martinsson-Wallin 2015). The actual dwelling site may have been located farther inland. The large quantities of animal bones suggest that Ajvide served as a place where the hunted animals were drawn onto the shore and further processed. On the basis of up to one-meter thick deposition, this use must have been very intensive (Burenhult 2002: 31–32). Most of the bones originate from cod (*Gadus morhua*), herring (*Clupea harengus*), wild boar, ringed seal (*Pusa hispida*) and harp seal (*Pagophilus groenlandicus*), but grey seal (*Halichoerus grypus*), domestic dog (*Canis familiaris*), red fox (*Vulpes vulpes*) and European hedgehog (*Erinaceus europaeus*) are also present (Lindqvist & Possnert 1997; Rowley-Conwy & Storå 1997; Olson 2008). Thirty identified bird species include the razorbill (*Alca torda*), common guillemot (*Uria aalge*), black guillemot (*Cepphus grylle*), great cormorant (*Phalacrocorax carbo*), whooper swan (*Cygnus cygnus*), common eider (*Somateria mollissima*), long-tailed duck (*Clangula hyemalis*) and other waterbirds; white-tailed eagle (*Haliaeetus albicilla*), mew gull (*Larus canus*), great black-backed gull (*Larus marinus*), crow (*Corvus corone*), palearctic oystercatcher (*Haematopus ostralegus*) and other shorebirds; and the wood pigeon (*Columba palumbus*), European nightjar (*Caprimulgus europeus*), Tengmalm's owl (*Aegolius funereus*), northern goshawk (*Accipiter gentilis*) and other forest birds (Mannermaa & Storå 2006). Bones of smaller species, such as songbirds, have not been found at Ajvide. Auks, that is, razorbills, common guillemots and black guillemots, seem to be the most common family of birds at all depths of the cultural layer (Mannermaa & Storå 2006: Fig. 3).

This faunal assemblage gives an idea of the various biotopes and biophonies surrounding the hunters using the Ajvide site. The wood pigeon and the European nightjar could be heard hooting and purring in the open coastal forests[3] near Ajvide (AudioObject 4), and ducks, gulls and waders could certainly have been hunted in the vicinity of the site. For hunting auks, however, the hunters had to visit the islands of Stora Karlsö and Lilla Karlsö located approximately seven and four kilometers, respectively, off the west coast of Gotland. These largest bird mountains in the Baltic Sea formed a favorable breeding area for auks, which prefer nesting on steep rock cliffs along the shore. Such cliffs are common on the Karlsö islands but absent in the vicinity of Ajvide or elsewhere on Gotland. It is probable that the Middle Neolithic hunters conducted organized hunting expeditions to Stora Karlsö and Lilla Karlsö, not only for catching auks but also for fishing cod and hunting seals, cormorants, swans and ducks (Mannermaa & Storå 2006: 445). Worked flint tools, bone harpoons and Pitted Ware ceramics found on Stora Karlsö bear witness to such expeditions (Schnittger & Rydh 1940).

AudioObject 4: A European nightjar (*Caprimulgus europeus*) purrs in the summer night on Gotland (27 May 2015) (Litsgård 2015).

Even today, 14 500 pairs of razorbills, common guillemots and black guillemots breed on the rocky cliffs of Stora Karlsö (cf. "Stora Karlsö"). The soundscape at densely packed colonies, where nesting pairs are in bodily contact with their neighbors, is lively (Figure 8, AudioObject 5). The birds purr, croak, growl, bark and flap their wings when flying back to their home ledge, greeting their neighbors, performing appeasement displays, squabbling with each other or driving away gulls and other predators. The sharp smell of fish wafts around the cliff face. Swarming insects attract common house martins (*Delichon urbica*), who chirp and feed in flight. Quacking mother eiders lead their young in the water. Although the biophonic score appears to be crowded, each species has its own bandwidth or temporal slot and can therefore be distinctly heard (Figure 9). This type of versatile, balanced soundscape is typical of old stable habitats that have been developing slowly (Krause 2012: 82–105). In this case, the habitat appears to be at least five thousand years old, most likely even older. (cf. Mannermaa & Storå 2006: 445–447).

[3] Because of its coastal position, the Middle Neolithic site was probably surrounded by open windswept forests, more or less similar to those on the present coast. Accurate information about the vegetation around the site has been obtained from charred vegetation remains found in a hearth dated to the Bronze Age. Yields of seeds from, e.g., white clover (*Trifolium repens*), narrowleaf plantain (*Plantago lanceolata*) and lady's thumb (*Polygonum persicaria*) indicate an open pasture and cultivated landscape. Identified tree species include pine (*Pinus* sp.), willow (*Salix* sp.), birch (*Betula* sp.) and ash (*Fraxinus* sp.) (Österholm 2002b).

Figure 8, AudioObject 5: A breeding auk colony on a rocky cliff on Stora Karlsö. Common guillemots (*Uria aalge*) growl and bark, common house martins (*Delichon urbica*) chirp, and mother eiders (*Somateria mollissima*) and their ducklings quack and peep (2 Jun 2015).

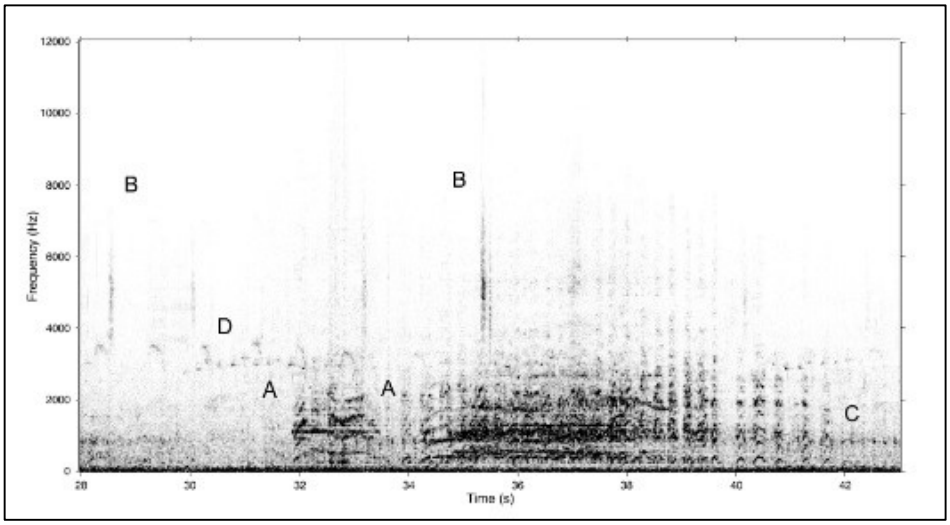


Figure 9: The sonogram of a soundscape clip from Stora Karlsö. A) Common guillemots (*Uria aalge*) growl and bark; B) common house martins (*Delichon urbica*) chirp; C) mother eiders (*Somateria mollissima*) quack; and D) their ducklings peep.

Worked bird bone tubes found in several Ajvide graves (nr. 2, 21, 23, 25, 52, 62) could mainly be associated with the hunting grounds of these people. The tubes with carefully ground ends are 3–10 cm in length and predominantly longer than ordinary tubular bone beads in the graves (Rainio & Mannermaa 2014a). Moreover, these tubes do not appear in sets of hundreds, as is often the case with the beads. When replicas of these possible birdcalls are set against the lips and blown as end-blown flutes, they produce high whistling tones at 800–5 000 Hz (Figure 10, AudioObjects 6, 7). The fundamental frequency varies with the tube length. The highest tones resemble the whistle of the black guillemot (cf. Simpson 2016 [http://www.xeno-canto.org/317531]), which in eighteenth-century Greenland was hunted by imitating its sound (Holtved 1962: 80). According to Greenlandic hunters, a swimming guillemot could only be approached in that manner: without whistling, it immediately dived or flew away. Guillemots and cormorants were also hunted by climbing up and down the cliffs and taking breeding or sleeping birds, eggs and chicks alive from their nests (Holtved 1962: 80–81). Interestingly, the same bone tubes can also be played in the opposite manner: by sucking in air through puckered lips. This technique is particularly suitable for the two-piece tubes, where a thin swan (*Cygnus* sp.) radius has been inserted into a broader swan ulna (Figure 11, AudioObjects 8, 9) (Rainio & Mannermaa 2014a; Rainio 2016). In these tubes, the ulna acts as an amplifier, whereas the radius acts as a mouthpiece. The sucked tubes produce bird-like clucks and honks (800–1 000 Hz), which can be viewed as resembling the vocalizations of larger birds, such as swans, geese, hawks or gulls (cf. Linjama 2009 [http://www.xeno-canto.org/164594]). In North America, similar two-piece tubes of a radius and ulna were sucked to call and lure the wild turkey (*Meleagris gallopavo*) (Harlan 1994). When hearing the sound of its own kind, a turkey flew to within shooting distance. The earliest examples of this type of Native American turkey call have been dated to 5700–4700 BC (Lewis & Kneberg Lewis 1961).

Figure 10, AudioObjects 6, 7: Bone tubes made of the radius of a swan (*Cygnus* sp.) and the ulna of a gull (*Larus* sp.) from grave 62 at Ajvide (ID 34711a, 34711b). Whistles produced by playing the replicas as end-blown flutes. Photo by courtesy of Johan Norderäng; the latter sound sample is played by Cajsa S. Lund.

Figure 11, AudioObjects 8, 9: Two-piece bone tubes made of the ulna and radius of a swan (*Cygnus* sp.) from grave 62 at Ajvide (ID 34648, 34649). Clucks and honks are produced by playing the replicas as sucked tubes. Photos by courtesy of Johan Norderäng.

Despite the playability of the replicas, there are no use-wear traces on the original artefacts that would prove that the tubes found at Ajvide were used as sound instruments or birdcalls. However, in our opinion, this usage is the most plausible explanation for these artifacts (cf. also Lund 1988), especially the two-pieced tubes. Over the ages, hunters have modified their acoustic behavior to be able to approach their prey: to prowl quietly or to imitate its sounds. The sound can often be produced with only the mouth, without artificial tubes. Moreover, it is to be noted that birds or animals could also be imitated for ritual or religious purposes, which is common with the musical or shamanistic performances of recent hunter-gatherers and other arctic societies (e.g., Siikala 1978: 99, 107, 115, 134–136, 167–170, 333–336; Morley 2013: 30).

5. Carcasses, hunters and scavengers

As noted above, Ajvide appears to have been a place where hunted seals, birds, fish and boars were drawn onto the shore and further processed. Saw marks and cut marks on the deposited bones indicate that the animal carcasses were skinned, dismembered and filleted there (Mannermaa & Storå 2006: 439–440; Bergstedt 2012: 23–24). This process was clearly performed with sharp flint blades and knives that were found scattered all over the cultural layer (Österholm 2002b: 20; Wallin & Sten 2007: 30). Birds were plucked and fish gutted and scaled with chisels or gouges. After processing, the most useful parts of the carcasses were carried away, and the less useful parts, such as skulls and jaws, were left behind on the shore (Österholm 2008: 28). On the basis of the gnawing marks on some of the bones, scavengers took advantage of the debris (Mannermaa & Storå 2006: 441; Bergstedt 2012: 23–24, 29). Pieces of ceramic found at the site may have formed vessels for transportation, storage, boiling of train oil or food preparation (Österholm 2002a: 176–177; Johansson 2009: 27). Sandstone whetstones might have been used for grinding the edges of harpoons and fish hooks (Norderäng 2002: Fig. 3; Johansson 2009: 25). Although these finds were found all around the excavation area, the amount of bones, ceramics, artifacts and dirt was many times greater in four oval, exceptionally dark-colored areas (Figure 12) (Norderäng 2008; Lundén 2012: Fig. 1; Gustavsson 2015: Fig. 4, 5). In addition, the degree of fragmentation was considerably higher there. It appears as though the bones and artifacts in these so-called activity areas were trodden to pieces and vessels full of train oil boiled over (Österholm 2002a: 174–177), which must indicate an intensive and lively use. The activity areas appear to have been open, 150–200 m^2 large spaces, radiocarbon dated to 2600–2300 cal BC (Wallin & Martinsson-Wallin 2015). One of the areas has large quantities of seal bones and train oil, another area tight concentrations of boar and fish bones, also burnt bones possibly indicating foodrests (Österholm 2002a; Bergstedt 2012: 17–18, 29). Short rows of post-holes on the edges suggest that two of these areas were surrounded by a palisade or fencing, a possible windshield or screen (Burenhult 1997a: 54; Norderäng 2006: 5).

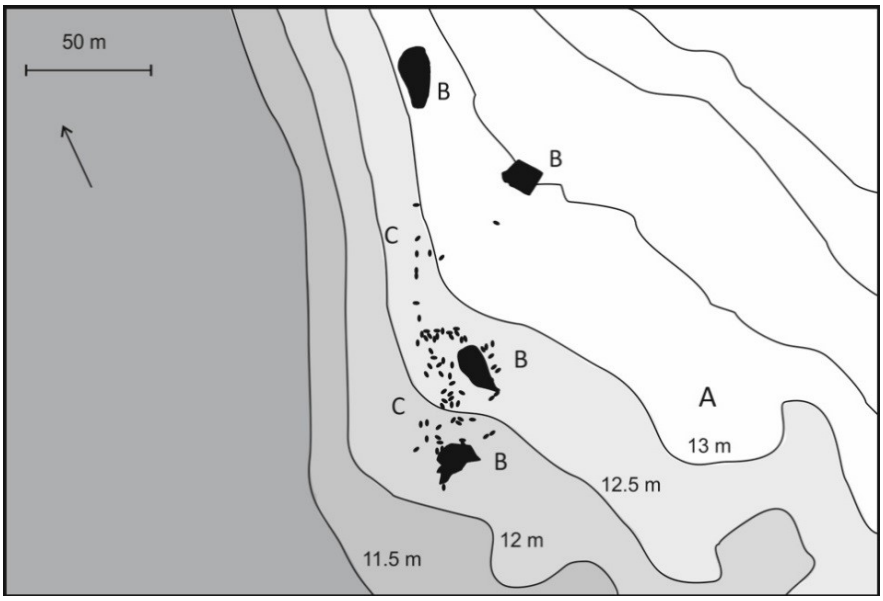


Figure 12: Ajvide site during the Middle Neolithic. A) Reconstructed shorelines 3200–2300 cal BC; B) dark activity areas; and C) excavated burial pits. Redrawn after Burenhult (1997b: Fig. 3) and Norderäng (2008: Fig. 14).

This type of butchering site must have provided intensive sensory experiences. In the middle of the carcasses of the dead animals, people sawed, cut, tore and filleted with flint knives (Figure 13, AudioObject 10), scaled with chisels or gouges (Figure 14, AudioObject 11) and repaired the edges of the used harpoons (AudioObject 12). Others drew more boats or canoes onto the shore and dragged new carcasses. Orders and instructions had to be called out because of the continuous background noise of the sea. The smells of boiling fat, smoke, seaweed and decaying animal parts permeated the air. The carrion and refuse attracted dogs, boars, foxes and other scavengers that gnawed the bones, and would doubtless have growled and fought each other (cf. Lundbye 2012: 59; Wallin & Sten 2007: 37). The most striking creatures, however, were the scavenger birds, which gathered together, flocked and swarmed around the site, scattered trash and screamed (cf. Mannermaa & Storå 2006: 446). Gulls wailed, barked and bugled, crows cawed, and ravens croaked (AudioObject 13). Even white-tailed eagles could be viewed spiraling above the site. According to Gotlandic hunters, scavengers such as these utilized the nineteenth-century seal butchering sites, where the refuse was left for them on purpose (Österholm 2002a: 175; Wallin & Sten 2015: 32). On the other hand, some of the bones accumulated at Ajvide could derive from birds hunted at the site. In eighteenth-century Greenland, gulls and eagles were lured and caught with baits of seal fat (Holtved 1962, 74, 82).

Figure 13, AudioObject 10: Sawing a gull (*Larus argentatus*) ulna and a wild boar (*Sus scrofa*) mandible with a flint blade.

AudioObject 12: Grinding a European elk (*Alces alces*) antler with a whetstone.

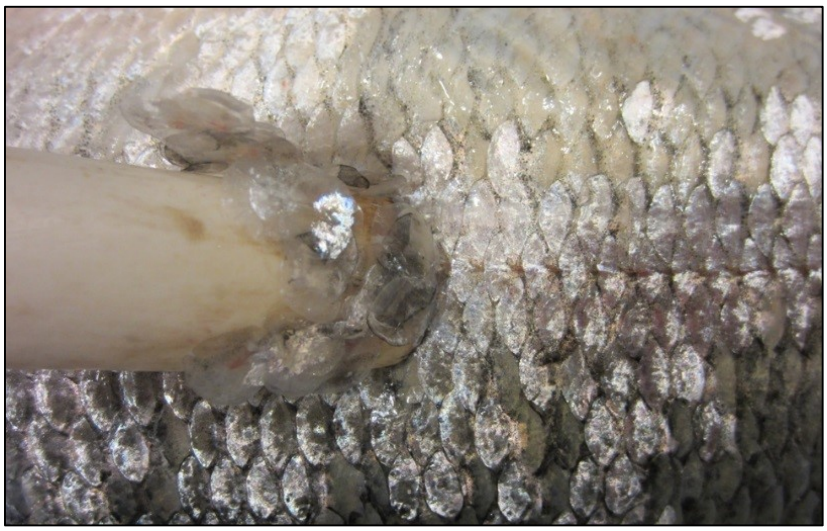


Figure 14, AudioObject 11: Scaling a powan (*Coregonus lavaretus*) with a chisel made of the humerus of a swan (*Cygnus olor*) (cf. Lund, Mannermaa, Rainio, Ringot & Tamboer 2015).

AudioObject 13: Lesser black-backed gulls (*Larus fuscus*) swarming.

The soundscape described above might be characterized as chaotic and crowded. Many things occurred at the site; birds screamed, people shouted, and the sound pressure level must have been higher than the measured level on the noisy Vavle beach. A considerable amount of energy was wasted. This noise, however, was more or less periodic and occurred during major fishing, sealing and fowling expeditions and seasons. On the basis of the deposited juvenile bones, seals were mainly hunted in March–September, birds in May–July and wild boars in September–January (Rowley-Conwy & Storå 1997; Mannermaa & Storå 2006: 447–448; Wallin & Sten 2015: 36). Thus, the seasons overlapped, covering most of the year. In essence, this soundscape was a cultural construct, an end result of the Middle Neolithic hunting and post-processing practices and the huge, accumulated dump. It marked economically and communally important periods or events and could therefore have a special cultural significance. The use of flint and bone tools brought about some man-made sounds, but these sounds were drowned out by the noises of the scavengers that took over the place. However, here, neither the people nor the scavengers acted in their core territory, and there was no need to defend or fight for their own acoustic space, as at home or at a dwelling site. Neither was there need to accommodate an alien acoustic space, as in the hunting grounds. On the Ajvide beach, the people and the animals confronted each other in a neutral zone, a type of no-man's land.

6. Noise in the graves

The most striking feature of Ajvide is that, apart from a butchering site, it was also a burial ground. Altogether, 85 burial pits, containing skeletons of females and males from all age groups, were found during the excavations (Norderäng 2009; Fahlander 2010; Wallin 2015). The burials were placed in a broad band along the contemporary shoreline, around the exceptionally dark activity areas, which appear to have been used contemporaneously (see Figure 12). Similar ceramics and radiocarbon dates from the burials (2900–2300 cal BC) and the dark areas (2600–2300 cal BC) confirm this point (Österholm 2008: 35–36; Wallin & Martinsson-Wallin 2015). The pits were dug into a layer of animal bones, which indicates that the site had been used as a hunting and fishing camp even earlier (Burenhult 2002). Interestingly, 42 % of the burials contain fragmentary or disarticulated skeletons, only a few parts of skeleton or no human bones at all (Norderäng 2007; Fahlander 2010; Wallin 2015: T. 3.1). Some of the human bones show signs of defleshing. This suggests that some individuals were removed, completely or partially, from the pits after the soft tissue had dissolved and were possibly reburied (Wallin 2015). Alternatively, the corpses were first exposed to the open air, as in so-called platform burials, and only placed in the pits upon reaching a state of decomposition (Norderäng 2009: 20; Wallin 2015). In this case, some of the post-holes found at the site could be the remains of these platforms. Moreover, bones from at least 20–25 additional individuals were found dispersed all over the site, at all different depths of the cultural layer (Lundén 2012; Wallin 2015). These individuals appear to have disintegrated without pits and to have mixed into the accumulated animal bones and other debris. As a whole, the burial ritual at Ajvide is shrouded in mystery, but it seems obvious that it was a prolonged act with several different stages. For a considerable time after death, the dead were still a type of virtual actor in the world of the living (Wallin 2015).

The complete, intact burials provide an insight into the ritual practices performed before interment. Most of the dead were given a rich assemblage of grave goods: harpoons, fish hooks, bone needles, stone adzes and ceramic vessels filled with fish, shells and train oil (Burenhult 2002). In addition, seal and boar skulls and jaws as well as boar tusks were laid into the pit. In one pit, two teeth of the deceased were replaced with animal teeth (Burenhult 1997a: 58). The deceased wore ornaments and amulets, such as hedgehog jaws and cormorant bones on the neck, a hedgehog skin cap on the head, or an arrangement of tubular bird bone beads on the chest (Burenhult 1997a: 56; Norderäng 2006: 8–9). In addition, approximately one-third of the burials contain pendants made of seal, boar, dog, red fox or European elk (*Alces alces*) teeth, even 170 per grave (Burenhult 1997a: 56; 2002). These perforated or grooved animal teeth form rows on the thighs, knees, hips or other body parts of the deceased, and they seem to have been attached to clothing, for example, an apron or skirt hem (Figure 15). According to our microscopic study, the teeth are polished, rounded and full of small pits and scratches (Rainio & Mannermaa 2014b), which indicates that they had been hanging in their loops for a very long period of time and rattling against one another when the bearer was moving. Similar rattles of animal bones, teeth, hooves and shells were used in shamans' dance aprons and drums in the nineteenth-century Eastern Siberia and Pacific Northwest (Konovalov, Gorbacheva, Solovyeva, Sem & Bittner 2006: 164; NMAI 2013). Before ending up in the graves, the rattles of Ajvide must have created plenty of sound. According to our experiments, portable rattles such as these call forth rhythmic movements and, almost automatically, a type of dance (Figure 16, AudioObjects 14, 15) (Rainio, Mannermaa, Girya and Gerasimov 2015). Because of this constant rattle (3 000–40 000 Hz), these aprons, skirts or other garments were not necessarily worn on a daily basis but on certain special occasions, such as celebrations, rituals, ceremonies or other performances. A suitable place for these types of gatherings would have been, for example, the open dark areas in between the graves. In addition

to butchering and boiling, these areas were most likely used for feasting, mourning, commemorating and handling the dead (Wallin & Martinsson-Wallin 2015; Gustavsson 2015: 29). Food remains and concentrations of fragmentary human bones point in this direction (cf. Lundén 2012: Fig. 1). Seals, boars, fish and birds could also be butchered in connection with these rituals. The fences around the areas, 'ritual circles', could serve as a windshield that muffled the sound of the sea.

Figure 15: Animal tooth pendants in a row between the thighs or knees of the deceased in grave 2 at Ajvide. Reconstruction in the Gotland Museum. Photo by courtesy of Johan Norderäng.

Figure 16, AudioObjects 14, 15: Tooth rattle replica made of the front and canine teeth of a wild boar (*Sus scrofa*) by Annemies Tamboer and Riitta Rainio. Sounds are produced by wearing similar rattles made of wild boar, European elk (*Alces alces*), red fox (*Vulpes vulpes*) and grey seal (*Halichoerus grypus*) teeth.

At all events, it appears that a burial ground in the Middle Neolithic sounded very different from our own graveyards. The dead people were not resting in a peaceful, quiet place, where sound use was strictly controlled and regulated, but lay in the midst of action, motion, noise and general fuss. The sea rumbled, scavenger birds screamed, and people shouted and performed their butchering activities. Train oil and the decomposing body parts stunk. Birds pecked at the debris. This restlessness or flux in the soundscape was surely not coincidental but reflected and concretized prehistoric patterns of thought. It reveals that people in the Middle Neolithic categorized, valued and understood things differently. It may be that, in their minds, in common with other hunter-gatherers (cf. Ingold 1994; Willerslev 2007), humans and animals were somehow equal or comparable: in the event of death, their bodies were brought to the same place and allowed to disarticulate together and finally merge into each other. In addition, their sounds merged. This happened at least conceptually, when the hunters, scavengers and mourners time after time filled up the place. Furthermore, the choice of the place and its sonic elements reveal that death was not associated with silence and motionlessness. On the contrary, it was associated with action, motion, sound and energy. Perhaps the idea was to immerse the dead in sound or noise to revitalize or stimulate them, in which case, noise could surely be regarded as so-called sacred noise, representing some divine properties or powers (cf. Schaefer 1977: 49–52, 76, 273; Truax 1999). In this interpretation, the fact that the deceased were frequently provided with rattles might suggest that they were also believed to participate in this sound production: to dance in their graves. The rhythmic movements required to play these instruments, as well as the pulse that they created, are fairly obvious metaphors of life, akin to breathing and the heartbeat and the incessant sound of the waves. This virtual rattle from the graves might not be heard over the rumble of the sea, but it could still be there in the imagination of the living.

7. Discussion

In addition to a mass of different material and immaterial cultural traits, the cultural layer at Ajvide appears to have been filled with information about Middle Neolithic sounds and sonic culture. The deposited animal bones can be regarded as indexes of some of the species present in the environment, including their characteristic biophonies: cries and calls. Similarly, the transgression gravel and the pebbly rock floor in the ground can be viewed as conveying information about ancient geophonies: wind and waves. By setting these separate sounds in their original natural settings, that is, the relevant temporal and spatial contexts, it is possible to outline the sonic environments where people hunted, fished, butchered, feasted and had their final resting place. Unfortunately, the location of the actual dwelling place at Ajvide is unknown (Norderäng 2008: 23). Over the course of time, natural settings at the Ajvide site have undergone great changes, but similar sound environments can still be found and captured on Gotland. At modern Vavle, the seashore, pebble beach and windswept forests must sound more or less the same, except for some mechanical dims and hums that are easily filtered out. On the islands of Stora Karlsö and Lilla Karlsö, the breeding razorbill, common guillemot and black guillemot colonies still flourish and fuss, probably in the same way as in the Stone Age. Having most likely stayed in place for several thousand years, these colonies serve as an example of the astonishingly long continuities found in some natural soundscapes.

Although Middle Neolithic biophonies and geophonies may sound familiar to modern ears, anthrophonies are more peculiar. The use of stone and bone tools produced distinct, marked noises that have vanished from the soundscape, along with changing technologies and means of livelihood. In the Stone Age, these sounds announced and characterized the presence and territories of humans, not unlike the territorial calls of animals. Animal tooth pendants and worked bone tubes, however, produced the most peculiar sounds. Their rattle and avian honks represent instrumental sounds that people deliberately brought about and introduced into the environment, sounds that people needed, appreciated, cherished or wished to hear. The honks were mainly imitative or iconic, whereas the rattle was more symbolic and most likely possessed powerful meanings, properties or qualities. By carrying the rattling instruments on clothing, close to the body, these qualities could be associated with the bearer. A rhythmic rattle that made the bearer and his/her movements more audible also added a musical element, a man-made pulse to the soundscape (Figure 17). Although little can be said about the real-life use of this pulse, in the grave, it would seem that it was most likely intended to accompany the dead into the afterlife. The pulse could also be intended to maintain the dead bodies vigorous and lifelike (cf. Nilsson Stutz 2010: 37). Similar rattles are so frequently found in Stone Age graves all over Northern Europe that this imaginary sound could be regarded as the soundmark of the life after death in the Stone Age (cf. Rainio, Mannermaa, Girya and Gerasimov 2015).

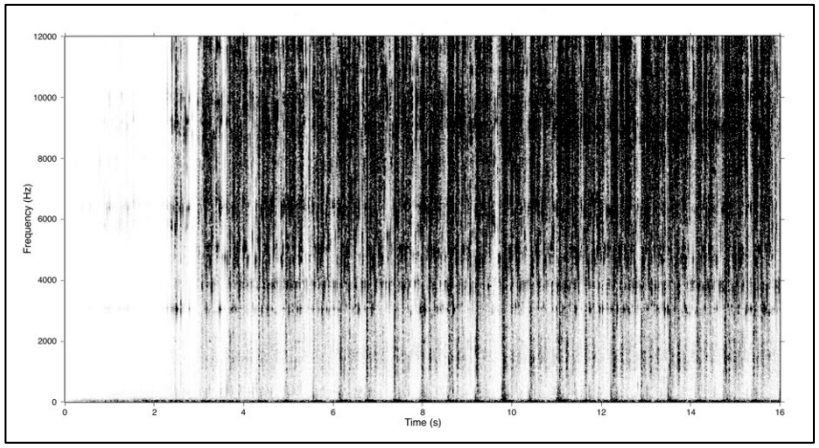


Figure 17: The sonogram of the sound produced by dancing with tooth rattles.

Not only Middle Neolithic anthrophonies but also combinations of anthrophonies, biophonies and geophonies in the soundscape call our attention. On the Ajvide beach, the sounds of skinning, dismembering and filleting mingled with sounds of the feasting, mourning and burying the dead. The cries of scavenger birds, dogs and boars mingled with rhythmic rattle from the graves. These sounds might not always be heard simultaneously but nonetheless repeatedly in the same specially regarded space between the land and the rumbling sea. To us, these combinations may appear disturbing because they mix contradictory elements: the sounds of repulsive, solemn, unclean, elevated, profane and consecrated activities. Therefore, it is probable that the composition demonstrates alternative ways of thinking, hearing and listening. We suggest that in the minds of these prehistoric people, humans, animals, the living and the dead were somehow equal or comparable and their sounds, their smells and body parts mixable (cf. Bradley 1998: 20–35; Fowler 2004: 130–154). The line between life and the afterlife was far from insurmountable or soundproof. The sounds and their spatial organization most likely served to construct these types of fundamental ideas or categories of the conceptual world. Otherwise, they would not have been permitted to fill the same space. Studies of hunter-gatherer rock art sites in Northern

Europe have shown that these ritual sites too were often located in the shore area, where the sound pressure level was high and the sounds of water, air and earth met creating new sounds (Helskog 1999; Goldhahn 2002). In this respect, the shore could have been a place of communication between different worlds, a liminal space that was considered to be meaningful for rituals and communication with the dead and other spirits of the cosmological system.

8. Synthesis

In this article, we have evoked the sounds and sonic experiences of the hunter-gatherer society at Ajvide by studying various archaeological finds, research reports and topography of the site. We have also made the results perceivable by means of replicas, type models and contemporary field recordings. We suggest that studying prehistoric soundscapes not only appeases curiosity but also provides insights into the experiential and conceptual world of the people of the past. It shows that the hunter-gatherers on Middle Neolithic Gotland heard many familiar natural sounds, still within reach on the island, but added in their own that sound more unfamiliar to us. They used the same space for activities that appear solemn and profane to us, which created an extraordinary, mixed and crowded soundscape. Furthermore, they liked to rattle, dance and make rhythm, even after death. All of these conclusions are fairly general and leave space for our imagination. In Gotländskt arkiv, Paul Wallin and Sabine Sten (2007: 37) present their vision of what happened in the dark ritual areas at Ajvide:

"The seals were transported home to the settlement in the same evening. The next morning, they would be butchered on the big altar. [...] As a result of long usage, the butchering site had become increasingly sacred and it was now surrounded by the graves of ancestors. Thus, before the meat and the fat could be separated, the spirits of the ancestors and of the seals had to be honored. In this connection, the head and the lower jaw of the seal were sacrificed on the special sacrificial altar, where the bones were also left until all of the flesh had disappeared. These bones, especially the jaws, were then sacrificed in coming burial ceremonies. Butchering refuse served as food for the settlement's dogs and for wild animals that made their way to the place. When the rituals were over, the fat was boiled into train oil, and the meat was divided between the hunters' families." (Our translation)

Our conception of the auditory reality of these people is presented in the "Bone Garden" soundtrack of Middle Neolithic Ajvide (AudioObject 16). In this synthesis of all gathered information, the sound samples from the previous chapters serve as a departure for imaginative scenarios that follow the hunter-gatherers to their hunting grounds, butchering site and feasting and mourning rituals. The reader is invited to join in.

AudioObject 16: "Bone Garden". The soundtrack of Middle Neolithic Ajvide.

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