The Consideration of taphonomy in Australian Archaeological Practice

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The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. The Material has not been previously submitted, either in whole or in part, for a degree at this or any other university.

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I certify that I have read the final draft of this thesis and it is ready for submission in accordance with the thesis requirements as set out in the School of Social Science policy documents.

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Abstract

There is an apparent and alarming paucity of Australian taphonomy specific publications and a paucity of incorporation of taphonomic observations in Australian literature. The consideration of taphonomy in Australia is investigated through a literature review of international and Australian publications. The standard of education in Australia and the perspectives of Australian Archaeologists on the topic are investigated through a questionnaire. The questionnaire was designed to compliment data obtained from a critical literature review. Although the sample size gathered was rather small, it can provide qualitative data on the perspectives of a sample of Australian Archaeologists. The results of the survey and the literature review showed that the majority of participants feel there is a need for greater consideration of taphonomy in Australian Archaeology, the teaching of taphonomic issues needs to be intensified at Australian Universities, more research and experimentation is required into taphonomic processes in Australian Archaeology and the implication of these processes. Taphonomy has been widely studied elsewhere in the world, there has however been too few publications concerning taphonomic issues in Australian literature and the concerns a few academics have expressed seem to have gone unanswered.

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Chapter One: Introduction

Introduction

Based on the principles of superposition and association, a basic tenet of archaeology is that archaeological material located within the same stratum or layer is deposited within the same relative time period. The law of superposition asserts the upper units of the deposit are younger and the lower units are older (Harris 1989), the law of association asserts that an artefact is contemporary with the other objects within the same stratum (Orser 2004). One of the first things students are taught in archaeology courses is the importance of context. The interpretation of the spatial and temporal position of an artefact is dependent on the context in which it is found. If there were no processes in operation that could disturb the strata after deposition, the archaeological record would be a fossilised 'snap shot' of a particular period, and the interpretation of archaeological evidence would be as simple as the above assumption. Unfortunately, archaeological deposits are rarely undisturbed, with a myriad of forces known to cause post-depositional disturbance to the archaeological record.

Taphonomy is the study of the processes that cause this. The very definition of taphonomy has been the subject of much heated debate for decades. The term "taphonomy" originated in the 1940s as part of the sub-disciple of palaeontology. The Russian palaeontologist Ivan Efremov defined taphonomy as:

> "… the study of the transition (in all its details) of animal remains from the biosphere into the lithosphere, i.e. the study of a process in the upshot of

> which organisms pass out of the different parts of the biosphere and being fossilized, become part of the lithosphere" (Efremov 1940,85)

Taphonomy in a palaeontological sense applies only to the transition of a living animal, through death to fossilisation. As a discipline, palaeontology focuses only on those processes that affect bone. Some archaeologists have also argued that taphonomy can only be applied to skeletal remains, and that site formation processes should be viewed as a separate subject. Solomon (1990:29), for example, interpreted the principal interest of taphonomy as being the application of interpretations of faunal remains found in archaeological sites (see also discussion in Lyman 2010). In contrast, Hiscock (1990b:35) has presented a different view of taphonomic research, stating that, "From an archaeological perspective the definition and scope of taphonomy has been unnecessarily narrow and negative." Hiscock (1990b) has suggested that principles of taphonomic investigation could be applied to organic material other than bone, and also extended to a wider variety of archaeological evidence, such as stone artefacts, hearths and buildings. The position held within this thesis follows that of Hiscock, whereby taphonomy is applicable to all artefacts and organic material in archaeological deposits.

The earliest recordings of observations of post-depositional processes where those of Darwin in the 1800s, who observed the part that worms had to play in site formation at Stonehenge (cited in Atkinson 1957:219). Almost a century later the archaeological record was still being referred to as "fossilized results of human behaviour" (Childe 1956:1). Twenty years later, Wood and Johnson (1978) were stressing the importance of taphonomic processes. The

terminology had changed from fossilized record to dynamic soil systems. Wood and Johnson (1978:318) define nine processes of pedoturbation (soil mixing):

- Faunalturbation: Animal burrowing, scratching removal/ introduction of artefacts;
- Floralturbation: Plants: root growth/ tree fall;
- Cryoturbation: Freezing and thawing activity;
- Graviturbation: Mass Wasting: solifluction, creep;
- Argilliturbation: Swelling and shrinking of clays;
- Aeoturbation: Activity of Gas, Air and/or Wind;
- Aquaturbation: Water activity;
- Crystilisaturbation: Growth and Wasting of Salts; and
- Seismiturbation: Earthquake related.

Just over thirty years later it seems that taphonomic processes were still being neglected by many archaeologists. For example, Allen and Hewitt (2010:1) have stated that Australian archaeologists are not greatly troubled by some of the post-depositional disturbance processes operating in other parts of the world. As a result, direct discussions of taphonomic processes in Australian sites have been infrequent. This raises a series of important questions for Australian archaeology. How are taphonomic processes considered in Australian archaeological practice? In this context, it is important to ask whether the necessary taphonomic research has been conducted in Australia. How has this research been implemented in the practice of archaeology in Australia?

Aims

The aim of this thesis is to evaluate how taphonomy is considered by Australian archaeologist practices. This aim will be addressed by the following methods:

1. Determine the position of taphonomy in the published Australian archaeological literature;
2. Compare the position of Australian taphonomic literature to International literature standards through a critical literature review; and
3. Determine the perspectives of Australian Archaeologists on the importance of understanding taphonomic processes.

Rationale

The justification for this research is the apparent paucity of taphonomy-specific publications in the Australian archaeological literature combined with a paucity of incorporation of published taphonomic observations by Australian archaeologists (although see Hiscock 1990a; Allen and O'Connell 1998, 2003 and 2004; Bird *et al*. 2002; Thorley 2004). A few academics in Australia have expressed their concerns over the lack of taphonomic consideration in Australian archaeology; however, they seem to have gone unanswered (Hiscock 1990b; Allen and O'Connell 2003; Cole 2006; Allen and Hewitt 2010).

A number of researchers have highlighted the basic questions that must be addressed in the investigation and interpretation of all sites: "Have any changes taken place in the stratification of the soil? Have any of the artefacts been displaced in any way? What are the underlying causes of any disturbances that have taken place?" (e.g. Araujo and Marcelino 2003:433; Rolfsen 1980:110; Villa 1982:286). Over several decades, a small number of Australian

archaeologists have made similar points (Allen and O'Connell 1998, 2003; Huchet 1990; Walters 1984), although it is apparent that in 2008 taphonomy was still being highlighted as an issue that has received insufficient attention in Australia.

Hiscock (2008) highlighted the failure of twentieth century archaeologists to make the investigations of site formations their highest research priority (Hiscock 2008:37). Two years later, and again Allen and Hewitt (2010:1) were concerned that direct discussion of taphonomic processes in Australian sites had still been infrequent. The consideration of taphonomy needs to be examined to determine if there has been adequate attention given to it in archaeological sites and to identify research that still needs to be performed.

Thesis Organisation

Given the nature of this thesis as a combined literature review, collection of primary data and critique, there is a necessity for a clearly defined structure. The following is a short overview of the thesis, reflecting the structure of the thesis and the focus of the chapters themselves.

Chapter two consists of the literature review. It is a critical review of a sample of the international literature and an intensive review of the Australia specific literature. Chapter three outlines the research methods. It elucidates the construction of the survey set up, and identifies the survey questions in detail relative to the broader literature. The methods of analysis are also outlined in Chapter three. Chapter four is the results chapter. It provides an overview of the survey responses and an analysis of the survey results. Chapter five is the final chapter. It brings together all the information from the previous chapters and discusses the findings. Consideration will then be given to the prospect of further research that has been

deemed necessary based on the results of this research. This chapter will also form the conclusion to the thesis.

Chapter Two: Literature Review

This chapter presents a review of the published literature that deals specifically with issues of taphonomy and site formation. Rather than an exhaustive review, it deals with some of the most relevant Australian literature and an example of several international studies to highlight the specific issues relevant to this thesis and to serve as a comparison to the Australian literature.

International discussion and research

Although the earliest research concerning taphonomic processes; specifically bioturbation caused by worms was published in the 1800's by Charles Darwin, (as stressed by Atkinson 1957), archaeologists did not continue investigations into worm bioturbation and a range of other taphonomic processes until the late 1950s. Around the same time as Atkinson's (1957) ground breaking work, a different school of thought was developing about the nature of archaeological deposits. Only a year before Atkinson's (1957) article on worms and weathering, Vere Gordon Childe (1956) had published a book that famously stated:

> "The archaeological record is constituted of the fossilized results of human behaviour, and it is the archaeologists' business to reconstitute that behaviour as far as he can and so to recapture the thoughts that behaviour expressed." (Childe 1956:1)

Childe's (1956) text implied that the archaeological record is a static, 'fossilized' record of human behaviour, with little to no consideration of post-depositional disturbance and information loss through decay. This position is in clear opposition to that taken by Atkinson (1957) in his work on weathering and worm activity affecting archaeological sites. Decades after

Atkinson's (1957) article, Darwin's work on worm bioturbation and the issues of taphonomic processes in general still had not been utilised satisfactorily (Johnson 2002). For example, as recently as 2006 archaeologists have been publishing their concerns regarding the need to pay more attention to taphonomic and site formation processes (Rick *et al.* 2006).

The majority of the published literature has focused on taphonomic processes affecting bone, with Lyman (e.g. 1994, 2004, 2007 and 2010) being a major contributor to the zooarchaeological literature in this area. A range of other examples of similar work focusing on faunal remains (e.g. Mountain 1990; Chase *et al.* 1994; Cameron 1999; Stiner 2002; and Powell 1995) have emphasised, like Lyman (1994), that taphonomic analyses have come to the forefront in zooarchaeology over the last twenty years. Similar analyses were not commonly applied to a broader range of material (including inorganic material) found in the archaeological record over that same period, presumably due to the narrow definition of taphonomy in use.

An avenue that has been explored internationally that has not been adequately incorporated in Australian archaeological research is the broad study of the effect of multiple taphonomic processes. From these studies, informative lists have been created with descriptions of how these processes work, and what likely effect they can have on a sites (see for example Kidwell and Holland 2002; Johnson 1990; Rolfsen 1980; Villa 1982; Wood and Johnson 1978). Wood and Johnson's (1978) seminal article, investigated and explained various processes of disturbance and site formation. Their list of pedoturbations consisting of nine processes, is the most complete list that has been formulated and published on this specific topic.

Although post-depositional disturbance processes were identified much earlier internationally (Darwin's 1800s work, see Atkinson 1957) further research and incorporation of taphonomic research has been slow, as has the consideration of inorganic material.

The debate over the very definition of taphonomy and what it should encompass has been raging for decades. It was not until 1990 that Hiscock (1990b) started proposing, and trying to provide evidence for, taphonomic processes affecting non-organic material in sediments. Hiscock (1990b:35) stated that, "from an archaeological perspective the definition and scope of taphonomy has been unnecessarily narrow and negative". Hiscock (1990b:44) postulated that all archaeological material in the sediment should also undergo transformation similar to those that affect bone, and concluded that there are similarities in the transformational processes acting on bone and those that alter stone. He also cautioned however, that there may be some processes that only affect bone and organics, an example possibly being acidic pH levels within a deposit. Although it was noted that the same may be true for processes that only affect stone, no specific examples were provided. Wright (1990) concurs with Hiscock's sentiments that taphonomic principles are applicable to inorganic remains. In contrast, Solomon (1990:29) and Lyman (2010a) have proposed that what archaeologists do is not what the term taphonomy means. Solomon (1990) has stressed that the principal interest in taphonomy lies in the interpretation of faunal remains found in an archaeological setting, a statement in line with the views of Lyman (2010a:1), who has emphasised that taphonomy concerns only the transition of biological organisms from living to non-living.

International taphonomic literature:

The scope of taphonomic research internationally is too broad and too numerous to examine in its entirety within the limitation of this work. A selection of international research will be examined here to provide a comparative sample with the Australian experimental literature. Research into the effect of taphonomic post-depositional processes on shells, other midden materials and maritime remains have been conducted by archaeologists and palaeobiologists such as, Brett and Baird (1986), Gutierrez Zugasti (2011), Zuschin and Stanton (2001) and Zuschin *et al.* (2003). Many experiments have also been conducted on faunal materials that have contributed to the understanding of taphonomic processes. For example, Weisler and Gargett (1993) investigated the taphonomic processes leading to the mixing of cultural and non-cultural material in deposits, the effect scavenging animals have on the archaeological record, as well as cultural processes such as burning. These processes are highlighted as they all potentially have an impact on the interpretations that can be made from the archaeological record. A further example of this comes from the work of Spennemann (1990), who investigated the role of pigs and dogs in the taphonomy of modern and archaeological faunal assemblages from Tonga. By observing the portion of faunal material that is fed to and removed from rubbish piles by scavenging animals, this study identified that a range of material absent from the archaeological record is not necessarily absent from the diet. This research has raised questions regarding the reliability and usefulness of MNI calculations as a measure of relative abundance, and by extension the interpretation of faunal material recovered from archaeological sites. This emphasises the importance of distinguishing between cultural and non-cultural material, interpretations will be limited if there is any doubt over the various processes that contributed to the formation of the site. It is equally as important to distinguish

between processes that added material to the site from those processes that potentially removed material from sites.

There has been some impressive work done on experimenting with faunalturbation internationally. The main focus in the American research has been on the pocket gopher (e.g. Bocek 1986; Erlandson 1984; Pierce 1992). In the late 1980s rodent activity was a much recognised and lamented component of post-depositional disturbance, the effects were however unquantified (Bocek 1986:589). To address this issue, Bocek (1986) conducted an experiment to quantify the effects of disturbance by the gopher, and based on ecological data and understanding of burrowing behaviours, the extent of rodent disturbance was able to be estimated. Similarly, Araujo and Marcelino (2003) conducted an experiment to qualify and quantify the effect armadillos can have on archaeological sites. This experiment demonstrated that some commonly held assumptions about the impact of armadillos were true; for example armadillos can move artefacts up or down within the stratigraphic profile and they can mix cultural horizons (Araujo and Marcelino 2003). This experiment also quantified the magnitude of this impact, however, it left room open for further investigation with more systematic measuring of individual numbered pieces that would allow for more accurate quantification artefactual of movement (Araujo and Marcelino 2003).

As mentioned previously the effects of bioturbation caused by worms was first investigated in the 1880's by Darwin (see Atkinson 1957), it was further investigated by Atkinson (1957). The detrimental affect worms have on the archaeological record was then not investigated further

again until Stein (1983). More research has continued to occur as recently as Nest (2002) and Balek (2002).

More recently, there have been numerous experiments specifically on the effects of taphonomic processes on lithics. For example, Edward (1995) utilised conjoin analysis to establish spatial and temporal movement across a dense activity floor that had accumulated slowly over a very long time scale. Cahan and Moeyersons (1977) also used conjoin analysis of lithics to demonstrate vertical movement through different stratigraphic layers, but added further information through the use of this method by setting experiments to test the effect of wetting and drying of sediments leading to the downward movement of stone artefacts. Gifford-Gonzalez *et al.* (1985) conducted an experiment to demonstrate that human traffic (trampling) across a site can cause downward movement of microdebris and larger pieces within the subsurface of loose sandy substrates, similar to experiments that were conducted by Stockton (1973) in Australia. This field of research has demonstrated that lithics can and do move through various substrates, even in seemingly well stratified deposits. The implications of this research relate to the establishment of site integrity, a general caution regarding assumptions of stratigraphic integrity and for interpreting sites.

Discussion and research in Australia:

In comparison with overseas archaeologists, Australian researchers did not begin taphonomic discussions in any great detail until the late 1980s and into the early 1990s. Although Walters (1990:21) stated that, “Taphonomy is a pre-requisite to any discussion of what has taken place in the concrete landscape” there have been very few publications dealing directly with taphonomy, and the term “taphonomy” was often not specifically used (Solomon 1990).

Haynes (1990) suggests that a possible reason for this is the tunnel vision of most publications, that are focused on providing examples that explicitly support the researchers' hypotheses. As such, the published research is essentially biased, and any relevant facts are more conveniently ignored than argued against. Almost twenty years following the work of Haynes (1990), a select few academics are still highlighting the failure of archaeologists to make investigations of site formation a priority (e.g. Hiscock 2008:37and Cole 2006:52).

The main discussion on taphonomy in the Australian literature stems from those issues concerning the assessment of site chronologies and site formation processes. Several researchers have previously examined published work to contest the reliability of radiometric ages, based on the grounds that disturbance processes have likely affected site integrity (e.g. Hiscock 1990a; Allen and O'Connell 1998, 2003, 2004). As with the discussions on the importance of taphonomy, these debates have been ongoing for decades starting in the early 1990s with Hiscock (1990a) and continuing through the twenty first century (e.g. Bird *et al.* 2002; Thorley 2004; Field *et al.* 2008). The main debate in Australia stems from claims of very early ages for initial occupation in Sahul, with several publications actively attempting to disprove early dates on the grounds of post-depositional disturbance and a lack of strength of association. Hiscock (1990a), for example, examined ages based on thermo luminescence (TL) and radiocarbon samples within the Malakunanja II rockshelter site, it was concluded that it was not possible to argue for agreement between these different dating methods with such large uncertainties, and it was predicted that artefacts could have moved 30-40cm down the profile based on the TL dates. Hiscock (1990a:122) stresses the importance of understanding the relationships between dating samples and cultural material, and as such, simply obtaining

old dates is not the only consideration. Issues such as the post-depositional movement of artefactual material are highlighted, particularly where the deposit is principally composed of sandy sediment, and movement of artefacts up to 30-40cm can be estimated over a 20-40000 year time scale (Hiscock 1990a:123; see also Stockton 1973). Allen and O'Connell have also examined the earliest dates for occupation in Sahul (Allen and O'Connell 1998, 2003 2004). Unlike Hiscock (1990a) who examined just one site, Allen and O'Connell have assessed the available information from a range of sites with early age estimates. Allen and O'Connell (1998:137) examined published material for discrepancies in data that conflict with the notion of steadily increasing age with depth, and a standard method they utilise to conduct the analysis is to compare radio-carbon and TL dates. When a discrepancy is highlighted, based on the available site information, they speculate as to what post-depositional processes may have affected the site. Some processes discussed by Allen and O'Connell (1998) include the contamination of samples rather than disturbance, trampling and bioturbation causing downward movement of artefacts and/or dating material, and the wetting and drying of the sediments that could increase the effect of bioturbation. Allen and O'Connell (1998) emphasise that just because a site appears well defined it is not necessarily free from disturbance processes, such as downward movement of artefactual material. Kenniff Cave is specifically highlighted as an example, where conjoin analysis of lithic material demonstrates the displacement of archaeological material through a seemingly well stratified deposit (Allen and O'Connell 1998; Richardson 1992). A key issue in these discussions has recently been highlighted by Field *et al.* (2008:99-100), who suggest that one of the main contributing factors to the ongoing contention over early age estimates for human occupation in Australia is that

few sites have either been excavated systematically or reported in such a way that allows for a rigorous assessment of the of stratigraphic context of dating and cultural material.

Another key location in debates surrounding colonisation and population expansion in Australia, the Willandra Lakes area in New South Wales has been discussed by archaeologists relative to various taphonomic issues. Shawcross (1998:186-187) asserted that the integrity of the sites located in this region were being questioned as early as the 1970's, but there have been few publications on taphonomic issues focussed on this particular area. The few publications that have emerged highlight a range of taphonomic issues, for example Walshe (1998), Shawcross (1998) and Hiscock and Allen (2000), who have highlighted fluvial sorting, trampling, burrowing, scavenging and burning at Lake Mungo specifically. The published work from the Willandra Lakes highlights the need for more taphonomic experimentation and consideration of the effects these processes can potentially have on archaeological deposits in open contexts. Further to this, such investigations have the potential to refine the interpretation of some of Australia's earliest sites.

There have been very few projects conducted in Australia that have specifically focused on the effects of taphonomic processes, although some researchers have investigated wind, water and soil as taphonomic agent. Sand, wind and water can corrode and weather submerged shipwrecks, as well as exposing and damaging open sites on land (English 1990; Littleton 1999). The destructive nature of the composition of the soil that makes up archaeological sites has been the focus of some limited studies. This research has found that the pH of the soil itself plays a crucial part in the preservation or destruction of faunal and other organic material

(Piper 1990; Langley *et al.* 2011). In combination with root activity, these processes can etch bones and erase evidence (erasing fine cut marks), they can create false evidence of cultural modification of particular materials (root etching resembling cut marks) and destroy the material altogether (bone does not preserve well in highly acidic conditions). This research has stressed that these processes need to be taken into account when interpreting sites with high acidy and root activity (Piper 1990; Langley *et al.* 2011).

Several researchers have identified taphonomic processes at archaeological sites to specifically reconstruct the activities and processes that formed the site. By closely examining all the artefactual material, the depositional context and geological information, researchers have been able to identify the site type and establish, for example, whether changes in subsistence practices or if taphonomic processes caused the artefactual patterns observed at a site (Field 1999, 2006; McConnell and O'Connor 1999). These studies demonstrate the need for taphonomic investigations that facilitate the examination of multiple possible formation processes.

The reliability and usefulness of estimates of relative abundance based on differential destruction of faunal material and visibility in an archaeological context is an issue that has been investigated in Australia as well as internationally. One issue is investigations have shown that estimates of relative abundances may not be a true representation of everything that was consumed at a site. A way this has been investigated is to observe the activity of a modern group of people. By monitoring the faunal remains (food scraps) that are added to the rubbish pile, it is possible to calculate the percentage of these scraps that remain on the rubbish pile,

and become part of the deposit. Scavenging animals such as dingoes, dogs and pigs affect this percentage by removing material (Walters 1984; Piper 1990). Both studies indicated that dingoes, dogs and pigs play a significant role in bone alteration and loss (Walters 1984; Piper 1990). Another issue with estimates of relative abundance that has been investigated in Australia, is whether the material in an archaeological site are of a cultural origin, determining of the origin of archaeological material can drastically change the interpretation of an assemblage. There have been several investigations into determining the origin of deposited material. Some of the animals that have been identified as contributing to the faunal assemblages at sites in Australia are dingoes, birds (specifically owls), Tasmanian devil and other carnivores (McNiven 1990; Walshe 1999, 2000; Gould *et al.* 2002). These examples highlight the need for taphonomic processes to be taken into account when interpreting sites as the identification of taphonomic processes can greatly change the interpretation of sites.

As noted above, bioturbation is a significant taphonomic process that can cause substantial damage to the association of dating material and artefacts, however very limited research has been conducted in Australia. There are a few cases where bioturbation and faunalturbation have been neglected by Australian archaeologists as potential taphonomic processes even though there is evidence within the general area of the archaeological site that these processes could be in operation. An example is Yam Camp Rockshelter where Huchet (1990) then later Morwood and Dagg (1995) both note the presence of a termite mound, although no interpretation of taphonomic alterations are posed. Similarly, McNiven *et al.* (2009) at Kabadul Kula, Torres Strait, noted evidence of bioturbation, sediment mixing and size sorting consistent with downward movement though no interpretations are postulated that take these processes

into consideration. The effect the termites could have had on the ages of material in these sites is not acknowledged in either of these examples. Faunalturbation is an issue that seems to be largely ignored in Australian archaeology. One such example, is Bird and Frankel (2001) who excavated a site disturbed by rabbits, with any material classed as burrow fill excluded from further analysis, however the presence of rabbit remains are noted in the faunal analysis. It would appear that just excluding the burrow fill was not completely effective in excluding material altered by rabbit burrowing activities from the analysis. The investigation and experimentation on faunalturbation in Australia is limited, some investigation and experimentation into bioturbation has been conducted in recent years. Venn (2008), investigated the effects of bioturbation and searched for ways to identify ant and termite activity through an experiment on soil movement. Venn (2008:14) took samples from *in situ* ant and termite nests from central Queensland to test the efficacy of methods in differentiating ant and termite impacted deposits from unaffected deposits. Venn (2008) established diagnostic criteria to determine the presence of ant and termite activity in Australian soils and sediments. These criteria can potentially be utilised by researchers to identify the presence of bioturbation at archaeological sites, and needs to be taken into account in the interpretation of sites formation and chronologies.

Australian Experiments and Applied Taphonomic Research:

A cross-section of the experimental research that has been conducted in Australia will be presented in this section. Walters (1984) investigated the pre-burial phase of bone discard, by monitoring the disposal zone to calculate the rate that bone was scavenged or incorporated into the surface layers, criteria for indentifying scavenger scatters could be formulated. This

study highlighted the need for further taphonomic research, and cautioned against the use of MNI as a measure of relative abundance as its use created a substantial underestimate of the meat consumed. Only three percent of the bones discarded survived the six month study (Walters 1984:397). Focussing on material deposition rather than accretion, Dwyer *et al.* (1985:2) conducted an investigation into how Bower birds' nesting activity affects the interpretation of sites. They theorised that Bower birds collecting stone artefacts could produce a small scale density increase and/or bias in size and colour classes (and by implication, potentially raw material types). Bower birds collect objects to adorn their nests, when the organic components of the nests decompose, a collection of lithics remain on the surface that could be interpreted as reflecting human activity. Material was collected from a nest that had been abandoned for less than six months. Although the results indicate that the artefacts were not biased for weight or length classes, they did show a preference for quartz-like artefacts (Dwyer *et al.* 1985:3, 6). The study did not result in any criteria for identifying remains of a Bower bird nest as opposed to an activity floor, and as such this experiment is limited in terms of its application within further research. In contrast, Geering (1990) analysed owl pellets from a deposit in Tasmania to establish criteria to distinguish material deposited by owls from material altered by humans, such as digestive damage, that is easily recognisable and is not affected by post-depositional breakage (Geering 1990:142).

An area of taphonomic research that appears to have received more attention is the taphonomic agents that act on shells and the effect these processes have on the interpretation of sites, possibly as an extension of the general zooarchaeology focus of taphonomic research. For example, Robins and Stock (1990) questioned why a certain species of shell was absent

from the archaeological record in shell midden deposits in southeast Queensland. Several taphonomic processes were identified as possibilities. Tests of extreme heating in camp fires to replicate disposal in fires were conducted, then the burnt shells were subjected to mechanical stress to simulate the effect of dynamic sand movement and other natural taphonomic processes on Moreton Island. The results showed that shells disposed of into a fire then subjected to mechanical stress were less likely to yield detectable remains (Robins and Stock 1990:89). Robins and Stock (1990:90) concluded that archaeologists should be focused on whether or not a site can provide information about the economy of the people in the past, thus introducing taphonomy as the baseline of the investigation.

Lilley *et al.* (1999) also conducted experimental research to address questions arising from shell middens. This research aimed to investigate whether materials on ocean beaches reflect past aboriginal behaviour (midden) or recent geological processes (chenier). It was hypothesised that foraminifera (amoebae) that live in seawater should be present in any deposit laid down or reworked by seawater, and should not be found in middens not inundated by seawater (Lilley *et al.* 1999:10). This emphasised that the understanding of the site is of particular importance. Three deposits were tested, one of the three tested positive for foraminifera, the other two tested negative and were interpreted as being cultural in origin (Lilley *et al.* 1999:13). The tests for foraminifera identified that the middens were of cultural origin and reworking by seawater had therefore not affected the integrity of the deposits. This study provided useful criterion for identifying the depositional agent of shell deposits, thereby distinguishing cultural and non-cultural shell deposits.

Two other shell midden experiments that deal with fragmented and disarticulated shells are those undertaken by Ulm (2006) and Faulkner (2010). Ulm (2006:65) conducted a conjoin analysis on bivalves, conjoin analyses having long been employed to assess the integrity of archaeological deposits (see Koike 1979). No comparable studies on open coastal midden sites have been conducted in Australia despite explicit and implicit references to this site type as being potentially problematic stratigraphically. The aim of the experiment was to establish the degree of site integrity by examining the vertical distribution of conjoinable shells through a stratigraphic sequence. Valves were manually paired and the distance between the valves in the deposit was gauged, the results demonstrated that 98% were less than 20cm apart and 76% were less than 10cm apart (Ulm 2006:69). These results of minimal movement reinforce the proposition that the structural properties of the matrix of a midden, constructed of closely interlocked shells, prevents significant post-depositional movement (Ulm 2006:70).

Faulkner (2010) conducted an experiment comparing predicted shell size from fragmented remains to shell sizes of complete shells. Metrical data that relies on the measurement of complete shells is problematic due to small sample size, and analyses based on only whole shells leaves a degree of uncertainty as to whether the observable patterns are biased in favour of size classes as a result of destructive taphonomic processes, that is large size classes may survive better under certain taphonomic processes whereas smaller classes may not or vice versa (Faulkner 2010:1942). The results of the analysis show that the mean size for *A.granosa* valves is not significantly different from fragmented samples. The successful application of methods outlined in this experiment has the potential to increase the understanding of both

taphonomic processes and prehistoric mollusc exploitation through the utilisation of larger sample sizes (Faulkner 2010:1948, 1051).

Ten years after Hiscock (1990) published his article on taphonomy, Robins (1999:93) was again stressing that the definition of taphonomy was still unnecessarily restrictive. Robins (1999) conducted an experiment on the effects of trampling on a surface artefact scatter. Painted pieces of rock were laid on the surface where cattle would trample them, the experiment was set up in 1985 and excavated in 1988 (Robins 1999:96). Fewer stone artefacts were located than were laid down. The most significant change being attributed to erosion acting on the pieces themselves and the surface under them. The dynamics of post-depositional disturbance reflected not only the changes in the number of identifiable artefacts, but also changes to artefact size and type distribution. This work by Robins (1999) demonstrated that trampling by live stock can considerably alter the patterns of distribution of cultural material. There was, however, no mention of observation periods, with the only exception being reference to the original set up and the final collection of data. To ensure replicability of results it would have been beneficial to measure the rate of deflation of the surface overtime and note the local weather patterns to investigate the role periods of wetting and drying played.

Conjoin analysis is commonly conducted to assess site integrity in Australian Archaeology. It has been used on stone (Stern 1980; Richardson 1992) and shells (Ulm 2006) as well as traditional taphonomic experiments on bone (Asmussen 2009). Stern (1980) conducted a very small scale trampling experiment to measure vertical movement. A weight was dropped onto a sediment surface in a pot that had artefacts distributed at measured depths in homogenous sediment,

with a variety of sediments types being tested in this way (Stern 1980:118). A conjoin analyses was also conducted on lithics recovered from Native Well Queensland, to establish if there was significant vertical movement (Stern 1980:100). Both experiments by Stern demonstrated that lithics can move down a stratigraphic sequence, and conjoin analysis is a useful method for testing and quantifying post-depositional vertical movement. Richardson (1992) also conducted a conjoin analysis of lithics from a sandstone shelter, and concluded that extensive post-depositional movement of the artefacts had occurred. Richardson (1992) did not only establish vertical movement at the Kenniff Cave site. Richardson (1992) also established vertical movement through a 'well stratified' site.

Asmussen (2009) tested vertical movement by conjoin analysis of bones. She also analysed the mean specimen size and scatter plots of weight and width to rule out distribution by trampling, yet there is not an explanation provided as to the significance of these measurements in determining if trampling has affected this site. Asmussen (2009) dealt with several post-depositional taphonomic processes, one of the aims being to establish whether burning of bones was a cultural phenomenon or a taphonomic process. The results showed that the majority of faunal specimens were unintentionally burned when on the surface or buried in sediment near fires (Asmussen 2009:534). This experiment may indicate that evidence for cooking in some Australian rockshelter sites may be over-estimated due to post-depositional modification from subsequent hearth fires (Asmussen 2009:535).

Corkill (2001) conducted the only experiment in Australia that investigates the impact of intermittent flooding on a rockshelter site. An experiment was conducted to gauge the impact

the flooding has on surface artefacts, green glass flakes were numbered and scattered on the ground surface, over the course of five years the number of visible flakes disappeared (Corkill 2001:46). This would imply that intermittent flooding of rockshelters can alter surface scatters of artefacts. Similar results were obtained in trampling experiments in Rockshelters by Stockton (1973). There were other taphonomic concerns that were highlighted by Corkill (2001), such as the possibility of varying pH levels in flood water altering the rate of decomposition of organic components in the site; further research could be conducted to address these concerns.

Conclusion

Although post-depositional taphonomic processes were identified as early as the 1800s by the likes of Charles Darwin, further research and incorporation of taphonomic research has been relatively slow. The same can be said for Australian Archaeological practice where discussions on taphonomy did not begin in any great detail until the early 1990s. As recently as 2010, Allen and Hewitt (2010) have been voicing their concerns over the lack of consideration taphonomy receives in Australia.

A few areas of research have been investigated internationally that have not been investigated in Australia, specifically. Internationally there has been broad studies of taphonomic processes in general such as Wood and Johnson (1978). Another more specific area that has been neglected in Australian archaeological practice is faunalturbation. No examples, of research into the role of native animals in taphonomy in Australia were identified during the course of this research. Bioturbation by insects on the other hand has been investigated by researchers such as Venn (2008), who investigated the negative implications of ants and termites on archaeological sites in Australia. Internationally bioturbation by worms, and the detrimental

effect they can have on the archaeological record, has been investigated since the 1950s by Atkinson (1957) and have continued internationally as recently as Balek (2002).

Two areas of research that have been popular internationally and in Australia relate to the reliability of relative abundance calculations. Investigations into how faunal material entered deposits from rubbish disposal and the percentage that remained after a set period of time (Weisler and Gargett 1993; Spennemann 1990; Walters 1984). The second area of research is identifying culturally and non-culturally deposited material (Weisler and Gargett 1993; McNiven 1990; Walshe 2000; Gould *et al.* 2002). The implication of these two areas of research is if a future archaeologist excavated the site, the relative abundance measure would only be three percent of the actual material consumed at the site.

Lithic studies in relation to taphonomic processes are another area that has received attention internationally and in Australia. For example, researchers such as Cahen and Moeyerson (1984), Edward (1994) and Hiscock (1990) have investigated the effect of taphonomic processes on lithics. The effects of trampling on archaeological sites have been investigated by researchers such as Stockton (1973), Gifford-Gonzales *et al.* (1985), Stern (1980), Shawcross (1998), Robins (1999), Hiscock and Allen (2000). Both these areas of research have the potential to skew age interpretations of sites by questioning the reliability of dating material based on association.

Although in Australia there have been some limited studies on taphonomy there are several gaps. Areas that are lacking in Australia, for example, are broad studies of processes like Wood and Johnson (1978) and faunalturbation studies on native animals. Both these areas have been shown to be important in the international literature in this review. Publications of broad

studies of processes would be a positive step in increasing the awareness of taphonomic processes in Australia.

Chapter Three: Survey Questionnaire Methods

Introduction

To address the specific aim of this research, an online survey was conducted to provide data on the different perspectives of Australian Archaeologists on the topic of taphonomic research. As such, the different sections of the questionnaire could be targeted at the different aspects of the research question and aims. Section one focused on the demographic of the participant in regards to occupation and experience with archaeology. Section two focused on individual experiences of identifying various processes of post-depositional disturbances. Section three focused on the importance of taphonomic processes in Australia and section four focused on taphonomic education in Australia.

Previous surveys of Australian Archaeologists

The general methodology of the survey was derived from the 2005 study *'Australia Archaeology in profile: a survey in working Archaeology 2005'* carried out under the auspices of the Australian Joint Interim Standing Committee on Archaeology Teaching and Learning (Ulm *et al.* 2005). This survey was broad and encompassed all aspects of the discipline, the results enabled a profile of attitudes of the professional Archaeologist community to be created.

The sample size for the data gathered by the 2005 survey provided an amount of information that was considered the basic requirement for informed decision making (Ulm *et al.* 2005:11). The survey was based broadly on two previous studies involving questionnaires on archaeology in the United States and United Kingdom. The specific questions from these surveys themselves had limited relevance to Australian archaeology, the more generic questions devised for the 2005 Australian survey were adapted from the previous surveys and questions that are more

specific were developed for the Australian scene (Ulm *et al.* 2005). The survey resulted in 301 valid responses from the 1152 blank surveys that were mailed out to members of the Australian Archaeology Association and other professional archaeologists. This response rate is considered a large sample size for a study of this nature (Ulm *et al.* 2005:12).

In contrast, Gibbs *et al.* (2005) conducted a survey aimed at investigating the level of archaeological training of Australian graduates. The format of the questionnaire was an open structure rather than a simple tick box structure (Gibbs *et al.* 2005:24). The questionnaire received 55 valid responses, and as such the results of the questionnaire were determined to be limited by the small sample size and the unstructured nature of the questionnaire (Ulm *et al.* 2005:11). In the report of findings from this survey it was admitted that this questionnaire was hastily put together the day before distribution at a conference, and the participants were also limited to those in attendance (Gibbs *et al.* 2005). While Gibbs *et al.* (2005) concur that the response rate was less than ideal, they argue that data collected still provides a sample of the relative strength of different responses (Gibbs *et al.* 2005:25).

Survey questionnaire methods

The questionnaire for this project, titled "Taphonomy in Australian Archaeology" was developed using the same methods as the 2005 questionnaire by Ulm *et al.* The specific questions from Ulm *et al.* (2005) were not directly relevant to this project, their methods for constructing the survey however were followed. Although the focus of Ulm *et al.* (2005) was not on taphonomy it was the most recent example of an Australian survey. An equivalent consultative process to the one used by Ulm *et al.* (2005) followed by a pilot study was adhered to. The Consultative process began with an initial set of questions formulated from the

International and Australian specific literature as discussed in chapter two. The questionnaire was submitted to the School of Social Science ethical review panel (SSERP), (clearance number [H10/2011]).

To comply with the University of Queensland ethical guidelines there were several requirements for this study relating to the methods of data collection, the phrasing of survey questions and with data storage. As the data was required to be collected with informed consent, an information page was included at the beginning of the survey with a section detailing the requirement for researchers to adhere to the ethical standards of the University. A statement was also included that stated by completing the survey they acknowledged informed consent and they understood the aims and benefits of the project (see Appendix A).

Once the project had ethical clearance the questionnaire was compiled electronically, with the Survey Monkey website (www.surveymonkey.net) used as an easily accessible alternative to paper surveys. There are many positives to the electronic medium, any archaeologist working anywhere (with internet access) could theoretically fill out the survey online without having to take the time to fill out a paper form then post it back. The online method works out to be relatively cost-effective ($50USD for the two months). Once completed, the survey data is already in an electronic format, effectively removing the risk of incorrectly transcribing the data from hand written responses. The electronic format encourages participants to complete every question, a prompt is displayed requiring them to complete the questions before proceeding if they have left the page blank (see figure 3.1). This also allows for quick analysis of completed

surveys, and those surveys that had been left incomplete (by participants choosing to leave the session) are quickly identifiable.

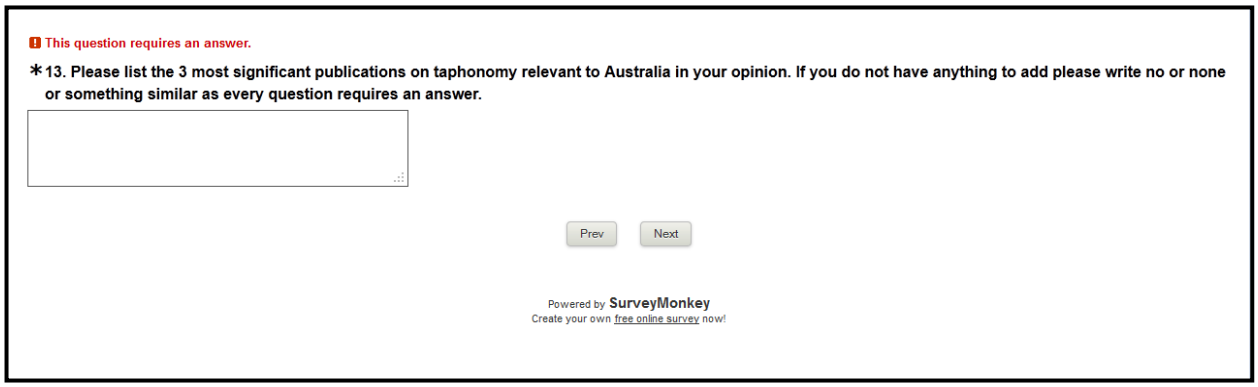

Figure 3.1 Example of the prompt that is displayed when a question is left blank

Once set up, a pilot study was undertaken, with the questionnaire survey link sent to fifteen University of Queensland Honours students. The Honours students were given a week to complete the survey and return any feedback. The majority of the feedback was then incorporated into the questionnaire, feedback that required changes to the logic of the questions or that was not possible within the limitations of the website structure were not incorporated. Once all the final changes had been made to the project, a link to the questionnaire was advertised on the Australian Archaeological Association email list by Dr Lynley Wallis (President of the Australian Archaeological Association).

The Ulm *et al.* (2005) survey contained 38 questions, the questionnaire for this project, had a reduced number of questions of only 22. A more concise questionnaire was opted for to encourage a high completion rate, with the survey estimated to take ten to fifteen minutes to complete. The structure of the survey questions were a mix of tick boxes and short answer, with an option to elaborate on 'other' answers (figure 3.2). In a structure similar to the 2005

questionnaire (Ulm *et al.* 2005:12), the questions were divided into four broad sections (refer to Appendix A for a complete list of the questions).

The four sections were each designed to address a different aspect of the aims of this project to assist in answering the research question. The list of questions originated from information published by Wood and Johnson (1978) on taphonomic and post-depositional processes, and these questions were further refined relative to the Australia specific literature. Section one, consisting of the first three questions, details demographic questions about occupation, experience and field of study of the participant. The survey was distributed on the Australian Archaeology Association email list, and as such the occupation of the participants was anticipated to cover academic archaeologists (lecturers and post doctoral researchers), contractor heritage/archaeology consultants, Research Higher Degree students (PhD and Masters) and Honours students. A further section was included for participants that didn't belong to any of the above categories (Figure 3.2).

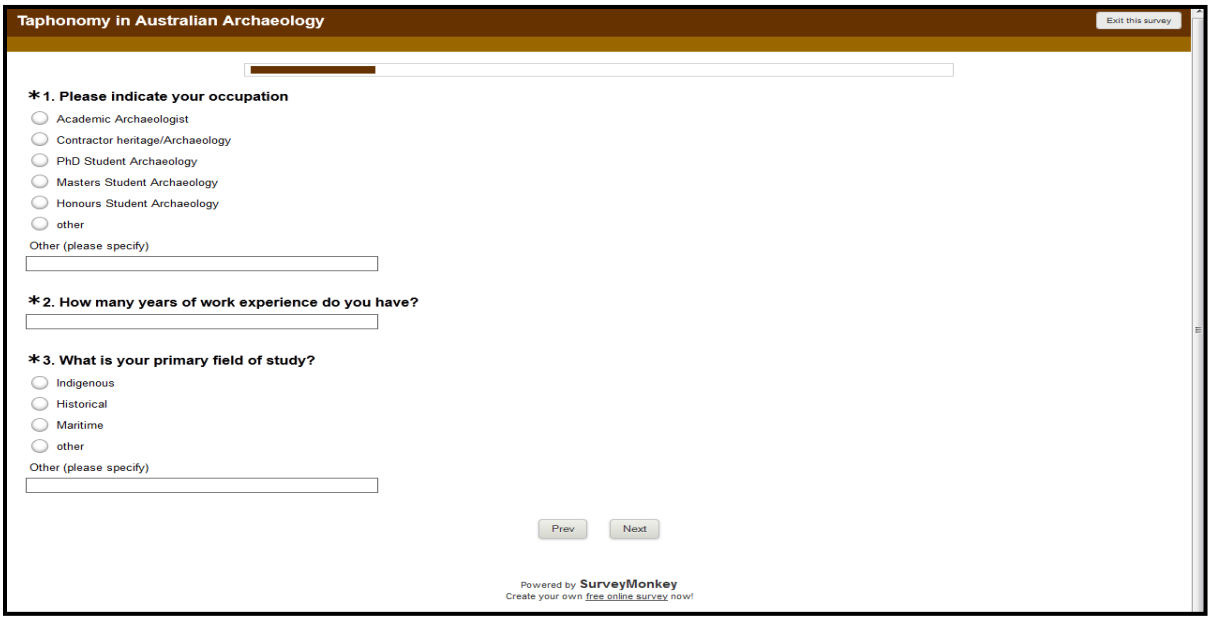

Figure 3.2 Screen shot of the second page of the questionnaire requesting demographic information

Within section two, questions four to ten were concerned with individual experiences of identifying various processes of post-depositional disturbances, including knowledge of the defined list of processes of pedoturbation, (figure 3.3). This section directly relates to information gathered from the broader international literature, with seven questions specifically about post- depositional disturbance. Questions four, five and six draw from a list of processes of pedoturbation from Wood and Johnson (1978:318). Wood and Johnson (1978:318-347) was chosen as it provides a list of processes that can affect an archaeological site, as well as detailing what damage these processes could potentially cause. While it is true that some of the processes on the list are not likely to affect a large number of sites across Australia, such as cryoturbation that is freeze thaw actions, there are no comparable works in Australia. These questions were designed to provide data on how taphonomic issues are positioned in the literature by evaluating how well participants of the survey recognised the various processes. These questions could also potentially illustrate how archaeology is taught at university; students should be able to at least indicate that they recognise what these processes are if they have had sufficient exposure to literature concerned with taphonomic processes.

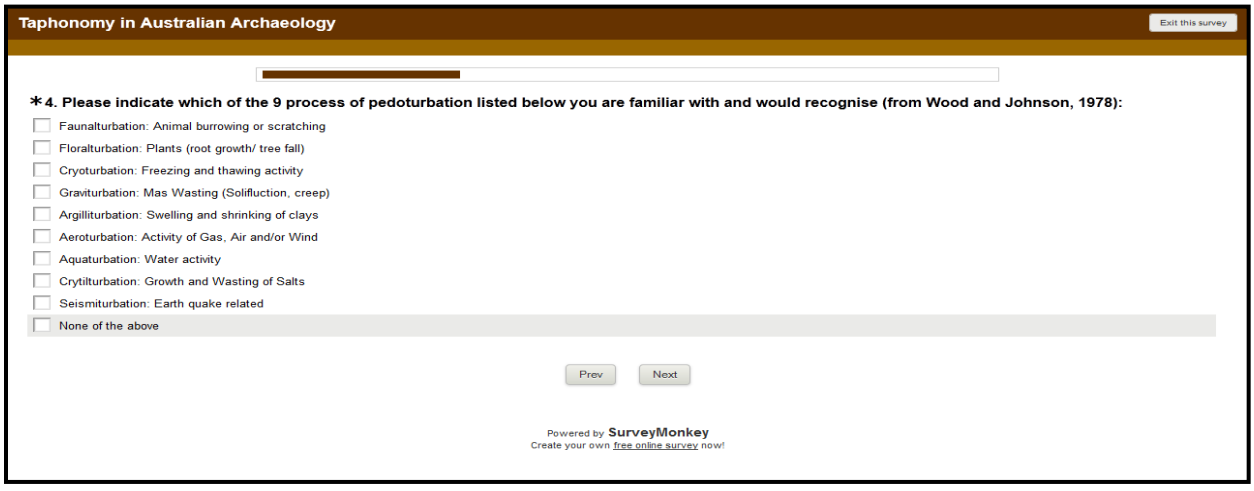

Figure 3.3 The 9 Processes of pedoturbation from Wood and Johnson 1978, 318)

Within section three, questions eleven to fifteen were concerned with the importance of taphonomic processes in Australia, and asked for a list of notable and/or influential papers published on these issues. This section relates to the aim evaluating the position of taphonomy and post-depositional disturbances in Australian literature. Requesting the participants to list three publications on taphonomy provides data on how well known the Australian literature on this topic is, it could also identify the most widely recognised literature that could explain the survey participants position on taphonomy.

Questions sixteen to twenty two in section four, were concerned with the teaching of taphonomy in Australian Universities, asking if there is a need for further research and a space to leave comments about the questionnaire. This section relates to evaluating how taphonomy

is taught in Australian Universities, determining whether there is a specific need to undertake further taphonomic research and what form this research might take (Refer to Figure 3.4).

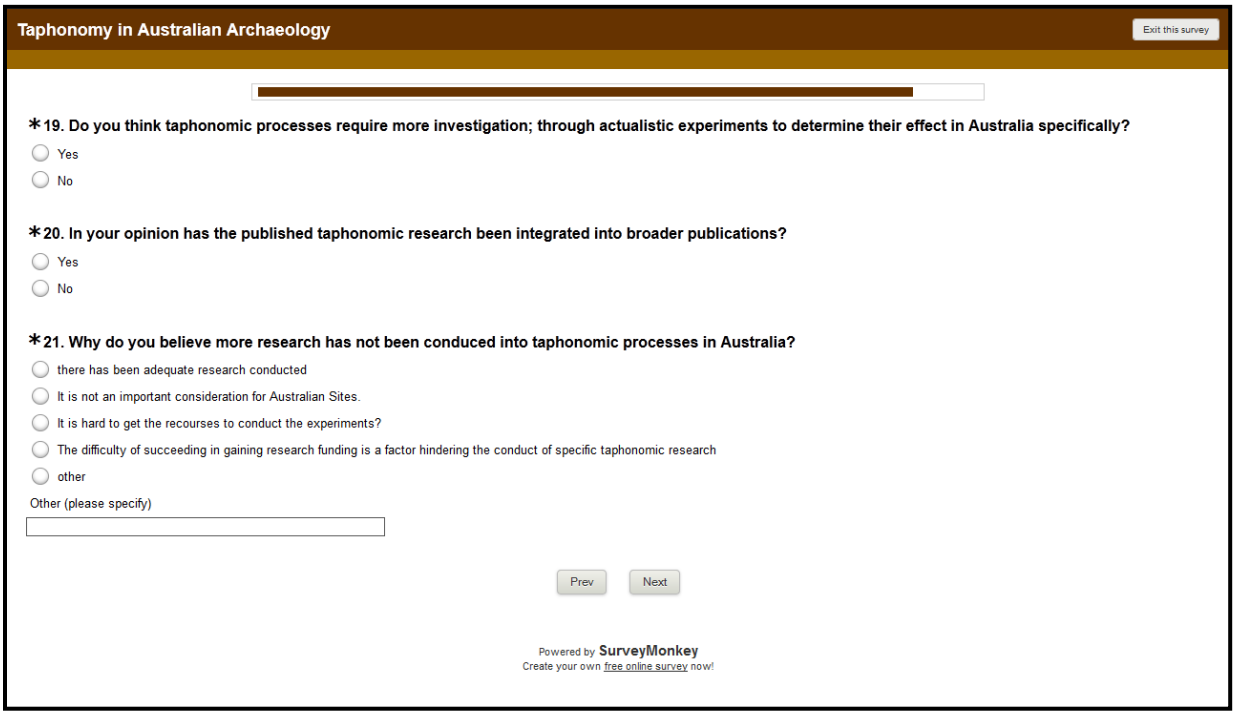

Figure 3.4 Page 10 of the Questionnaire showing section four.

Conclusion

Previous surveys by Ulm *et al.* (2005) and Gibbs *et al.* (2005) have demonstrated the effectiveness of using survey data to address these kinds of research questions, albeit them addressing very different questions. Both studies resulted in the creation of a profile of attitudes on their specific topics. Broader international literature was used to structure and inform the survey questions, where Australian literature is lacking. In the following chapters the survey data from this study will be utilised to establish a profile of the attitudes on taphonomy in Australian Archaeology.

Chapter four: Survey Analysis

Introduction

This chapter will present the results of the questionnaire, as outlined in Chapter three. The chapter is divided into the four sections as described in Chapter three. The analysis will be presented alongside the results. The implications of the results for the discipline will also be considered.

Data extraction and formatting:

All data was collected online using a secure survey website (Survey monkey) and stored electronically. As per the regulations of the ethical clearance guidelines all data collected was de-identified, the survey was designed so that no identifying data was specifically requested. In the case where this information was provided inadvertently during the course of the survey, it was de-identified prior to the analysis by removing any names or email addresses that may have been left in the final comments section by participants.

The analysis of the data will be broad in scope, evaluating each of the four sections separately. The analysis will therefore provide some quantitative data for individual questions, as well as enabling qualitative analyses. Initially, only fully completed questionnaires were to be utilised for this analysis, with incomplete surveys to be disregarded, however due to the small sample size returned it was decided to include incomplete responses as well as any comments sent through email in regards to the questionnaire. The small sample size can potentially limit the extent to which the quantitative data can be utilised confidently. In line with Gibbs *et al.* (2005:25), it is argued, however, that the data collected will still provide a sample of the relative strengths of different responses to the survey questions.

Survey Results and Analysis

The questionnaire was online for approximately two months. In that time, 123 participants started the questionnaire with 81 respondents (66%) completing all 22 questions (for a complete list of the questions refer to Appendix A). The survey results and the analysis of the questionnaire sections will be presented below with the comments from questions 21 and 22 incorporated into the results and the analysis as quotes. A complete list of the comments from question 21 and 22 are in Appendix B.

Section one.

This section is concerned with the occupation of the participants. The majority of participants were contactors (41.8%), followed by academics and students at various stages of education (Table 4.1 and Figure 4.1). The majority of the participants had one to five years of archaeological experience, (Table 4.2 and Figure 4.2) the question did not specify if the experience was field experience or just experience as an archaeologist. Indigenous archaeology as the primary field of study far outweighed the other fields, however, several participants did indicate that they engaged in Indigenous and historical archaeology on an equal basis (refer to Table 4.3 and Figure 4.3).

Academic Archaeologist	18%	22
Contractor	41.8%	51
PhD Candidate	10.7%	13
Masters Student	2.5%	3
Honours Student	11.5%	14
Other	15.6%	19

Table 4.1 Question Occupation 1 results

From the 19 participants who answered 'other' the range of responses included:

4 contractors/consultants, 2 Graduates of Archaeology, 3 Public servants,
3 retired 5 archaeologists

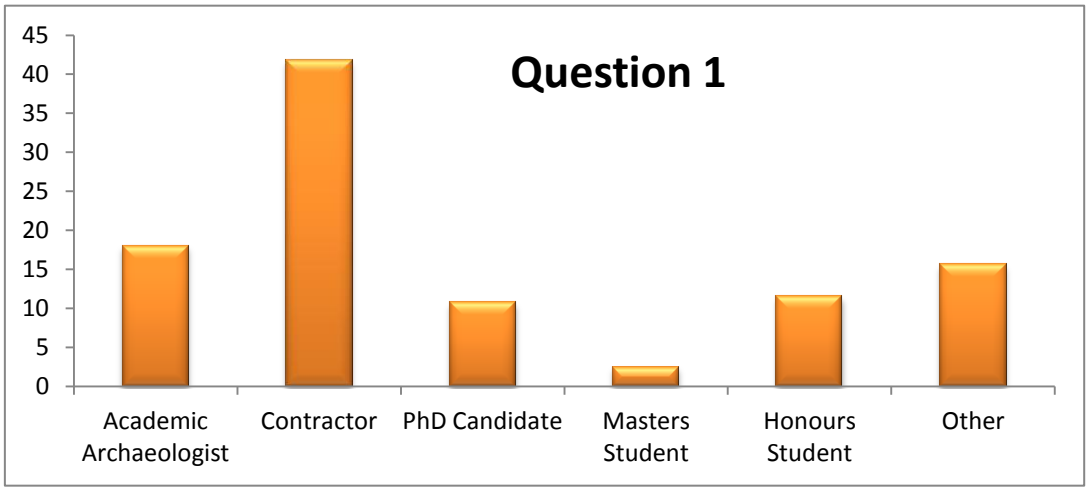

Figure 4.1 Question 1 Occupation results

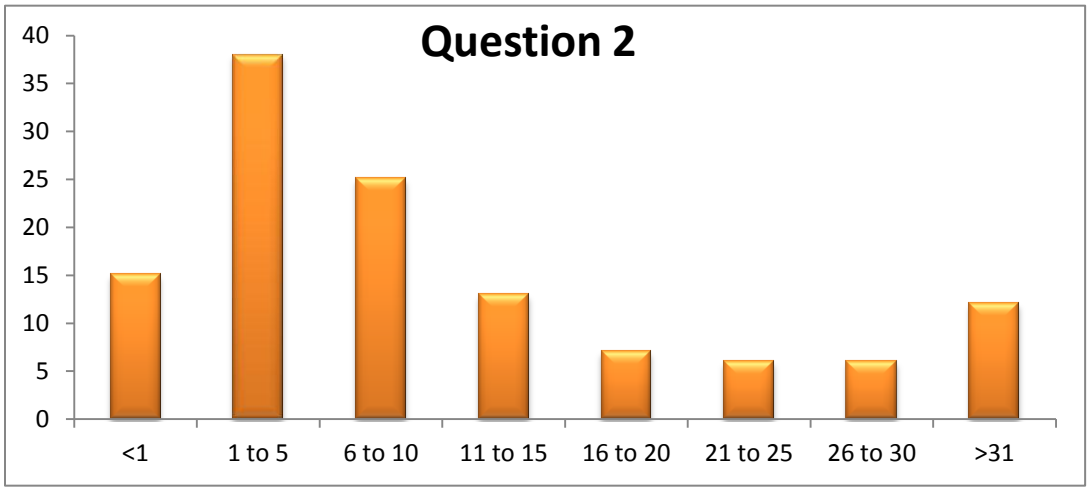

Figure 4.2 Question 2 Experience results

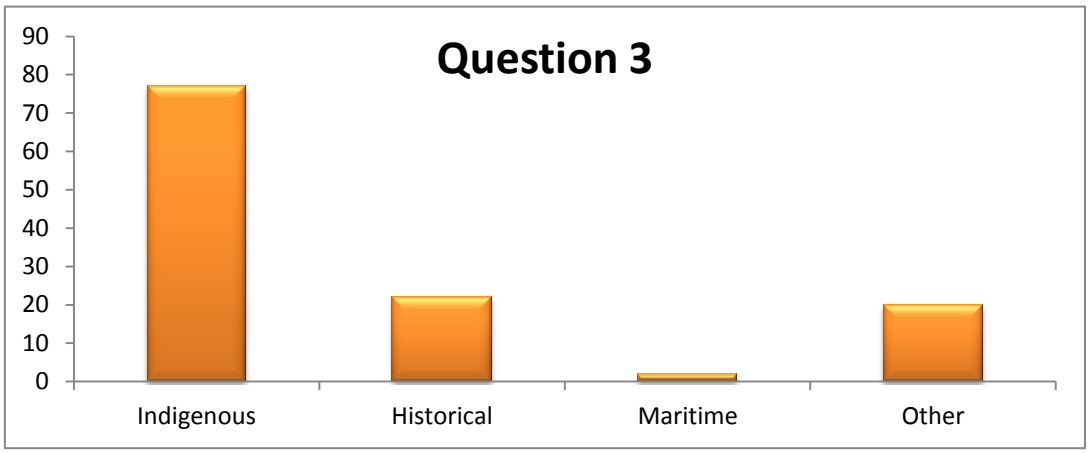

Figure 4.3 Question 3 Field of Study results

Question 2. Years of experience

<1	15	12.29
1-5	38	31.15
6-10	25	20.49
11-15	13	10.65
16-20	7	5.74
21-25	6	4.92
26-30	6	4.92
>31	12	9.84

Table 4.2 Question 2 Experience results

Question 3. Primary Field of Study

Indigenous	63.1%	77
Historical	18.0%	22
Maritime	1.6%	2
Other	16.4%	20

Table 4.3 Question 3 Field of Study results

Others include: Forensic Archaeology (3), Indigenous and Historical equally (4), Prehistory/classical (2), Pacific Islands, Rock Art, Lithics, Zooarchaeology, Archaeobotany and residue analysis.

Section Two.

This section is concerned with the individual experiences of the survey participants with taphonomy. The most widely recognised process of turbation from the list provided is Faunalturbation, with 92.3% of the respondents indicating familiarity with that particular process (Table 4.4 and Figure 4.4). Faunalturbation was also identified as the most relevant taphonomic process in Australian archaeology. Seismiturbation was identified as the least relevant (Table 4.4 and Figure 4.5). There were 6% of participants who indicated that they were unfamiliar with any of the processes of turbation (Table 4.4 and Figure 4.4). This 6% consisted of three contractors with an average of six years experience, three Honours students and a graduate.

Only 6.5% of participants had not observed any processes of turbation in the field.That could potentially be explained by 12.3% of the respondents having previously indicated that they had less than a year's experience in the field. The foremost taphonomic processes that 90.3% of participants indicated that they have observed first hand were faunalturbation and floralturbation (Table 4.4). This result suggests that faunalturbation and floralturbation are the most readily observed even for those survey participants with minimal field experience. aquaturbation was the next most prominent process observed by 77.4% of participants.

Questions 4 -6

	Indicate Familiarity	Rank Relevance 1 most 9 least. Average:	Have seen first hand
Faunalturbation	92.3%	1.97	90.3%
Floralturbation	86.3%	2.45	90.3%
Cryoturbation	24.8%	7.01	15.1%
Graviturbation	28.2%	5.72	21.5%
Argilliturbation	45.3%	4.73	52.7%
Aeroturbation	45.3%	4.30	48.4%
Aquaturbation	82.1%	2.89	77.4%
Crystilisaturbation	16.2%	7.22	17.2%
Seismiturbation	16.2%	7.78	8.6%
None of the above	6.0%		6.5%

Table 4.4 Questions 4-6 experience with processes of turbation results

Question 8. Which animals have you seen post-depositional disturbance by?

Dogs	25.0%
Rabbits	62.5%
Fox	19.3%
Ferrets	1.1%
Goanna	29.5%
Wombat	25.0%
Insects	76.1%
Could not determine	45%
Have not seen	5.7%
Other	25%

Table 4.5 Question 8 observed animals that have caused disturbance

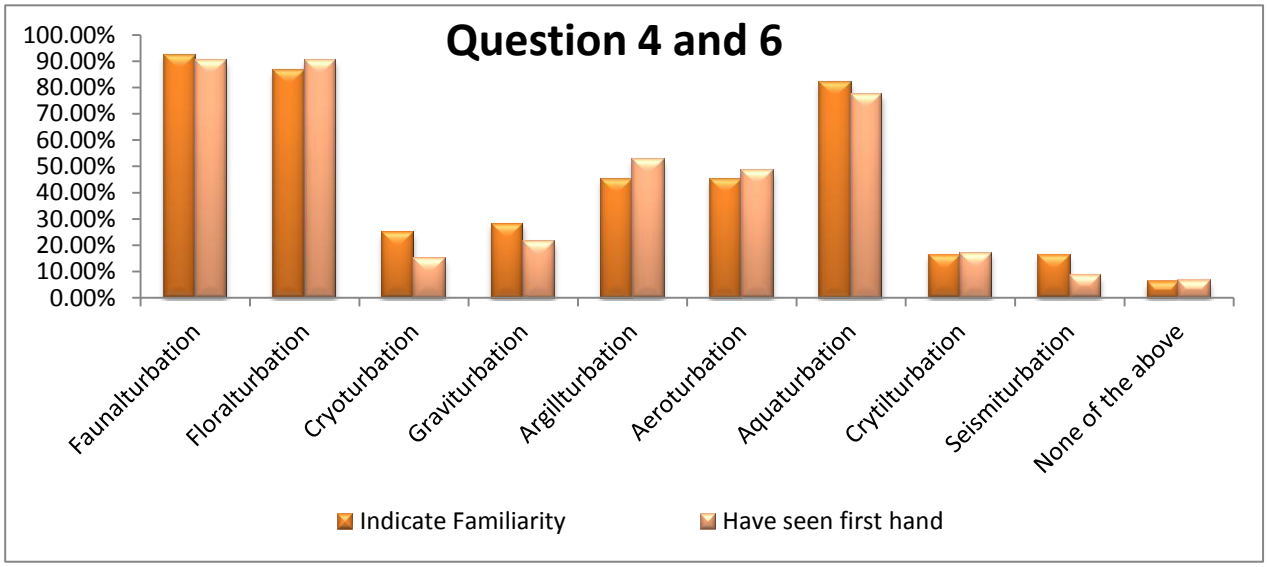

Figure 4.4 Questions 4 and 6 experience with processes of turbation results

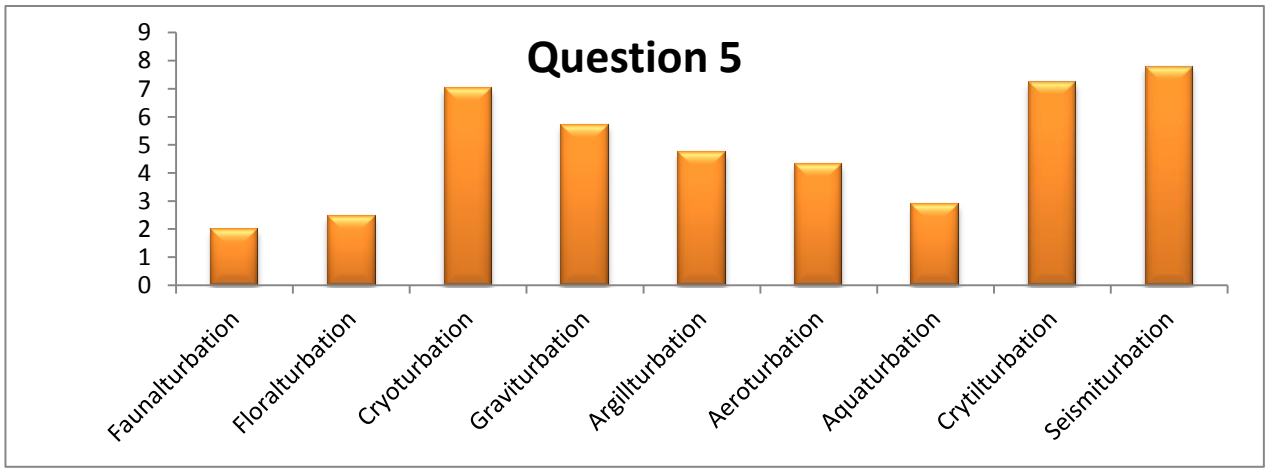

Figure 4.5 Question 5 Ranked relevance results

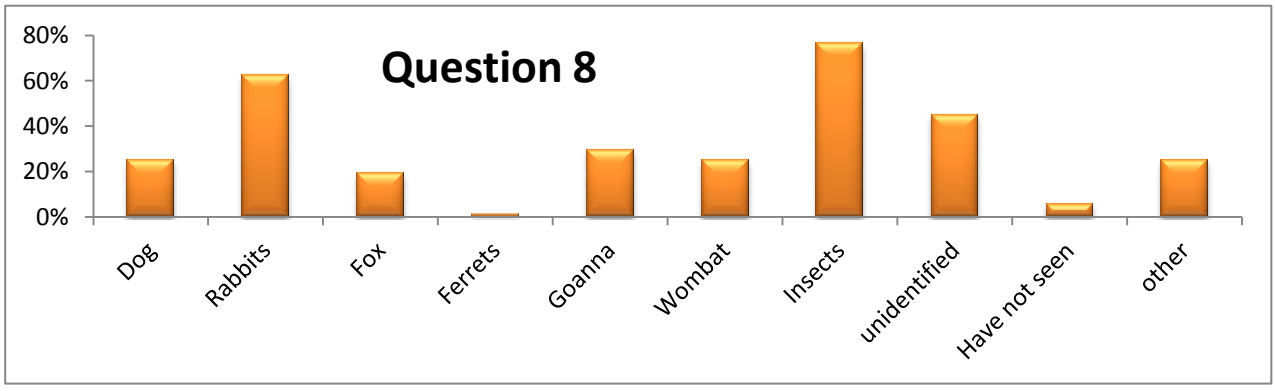

Figure 4.6 Question 8 observed animals that have caused disturbance results

From the participants who answered question 7, 86% have excavated sites with post-depositional animal damage. Of the participants that answered question 8, only 5.7% indicated that they have not seen any faunalturbation (Table 4.5 and Figure 4.6). Participants indicated that they have seen post-depositional disturbance by native and non-native animals. When asked to provide a list of potential animals that could affect archaeological sites, participants listed more native animals than non-native animals (Table 4.6). This would Indicate, that native animals need to be considered when identifying post-depositional disturbance, although this would be location dependant, rural or farming areas with large numbers of non-native stock animals versus areas with minimal to no agriculture.

Question 9. What animals could potentially affect sites? As well as 'others' from question 8.

Rats	Mice	Kangaroo	Bovine	Horses	Cattle	Sheep	Pigs	Tas. Devil
Birds	Cassowary	Chickens	Crabs	emu	Raven	Kites	Goats	Cats
Dingoes	Worms	Termites	Wallaby	Spiders	Camels	Possum	Echidna	Deer
Wedge-tail eagle	Burrowing frogs	Hoofed animals	Sea Turtles	Bush Turkey	Small lizards	Geckoes	Skinks	Crocodiles
Snakes	Macropods	Archaeologists	Humans					

Table 4.6 Question 9 animals with the potential to affect sites

Question 10. How did disturbance affect site integrity?

Not Applicable	6.8%
Destroyed the integrity	13.6%
Some mixing but maintained integrity	59.1%
Integrity was not affected	5.7%
other	14.8%

Table 4.7 Question 10 observed disturbance to sites affected by animals

Common 'Others':

Impact varies from site to site, Occasional impact, Varies from a little to a lot, Top Layers destroyed but low layers maintain integrity

Figure 4.7 Question 10 observed disturbance to sites affected by animals results

Question 10 asked how this disturbance affected site integrity, with the majority of participants answering that there was some mixing but sites or deposits generally maintained their integrity (59.1%) (Table 4.7 and Figure 4.7). A few of the survey participants indicated that question 10 was not specific enough, many participants have excavated more than one site with disturbance so they were unable to answer the question as it was too general. It was recognised via the survey responses that the effects of disturbance vary from site to site, some participants indicated that it varied from a considerable amount of damage to very little, and sometimes these processes destroy the integrity of the upper portions of the deposit, but not the lower layers. Although no specific answer can be determined from this question due to the issues indicated by participants, it does demonstrate that faunalturbation is readily recognised as an element that affects Australian sites.

Section three.

This section is concerned with the importance of taphonomic processes in Australia. The results from question 11 corresponds well with the findings from question 10, with 98.8% of

participants indicating that taphonomic processes are an important consideration in the interpretation of Australian sites, and only 1.2% disagreed with this statement. Although in answer to question 12 only 26.2% of the participants have published information concerning taphonomic damage, this could be interpreted as evidence of the paucity of publications concerning taphonomy in general within Australia, or it is more likely reflective of the participant group, with a high percentage being consultants and students and only a low number being academics.

Question 13. Name three most significant publications on taphonomy.

Schiffer 1976	Binford 1981	Gifford 1981 (2)	Walters 1984 (3)
Hofman 1986	Coventry *et al.* 1988	Stock *et al.* 1990	Hiscock (1990)
Stern Thesis	McBreaty 1990	Solomon 1990 (3)	Attenbrow 1992
Stern 1993	Bednarik 1994	O'Connell & Allen 1995 (2)	Hewit & Allen 2010 (3)
Oakley 2005	Brown *et al.* 2006	Fillios *et al.* 2010	Fanning & Holdaway 2004 (2)
Lyman	Jo McDonald	Sean Ulm	Ian McNiven
Barker	Langeludeka	Richardson	None (50)

Table 4.8 Question 13 Significant publications results

The most prominent articles named by participants as significant are mostly those published during the 1980's and early 1990's (Table 4.8). There appears to be a decades' gap between those significant publications highlighted in the survey responses, as there are fewer articles indicated from 2004 onwards. Eighty-four participants answered this question, 50 of whom answered 'none' or something similar, indicating they could not recall any articles specifically concerned with taphonomy. It is significant that the majority of participants could not name any publications on taphonomy, it highlights the general paucity of publications on the topic, and considering a large percentage of the participants were students (Undergraduates and

Research higher degree), it could also potentially demonstrate their lack of exposure to the topic.

The vast majority of the participants (92.8%) indicated that they feel there is a need for more studies of taphonomic processes in Australia. They also do not believe taphonomic processes have less impact in Australia than elsewhere in the world. This section highlights the perceived importance of taphonomy in Australia, as well as the lack of knowledge of published research from the majority of participants, indicating the need for more focused taphonomic studies in this country and publication of the results of research.

Section four.

This section is concerned with education in Australian Universities on taphonomy. The results of question 15 indicate that there is an understanding that taphonomic processes have as much impact in Australia as they do overseas. Ninety-four percent of participants did not believe taphonomic processes have less impact here than elsewhere in the world. The majority of participants (84.1%) indicated in question 16 that they do not believe there is adequate coverage of taphonomy in undergraduate courses at Australian universities. The participants were almost equally divided between participants who learnt about taphonomy from core courses at university and those who learnt about taphonomy from first hand field experience (Table 4.9 and Figure 4.8). The majority of participants think that taphonomy should be integrated into the core undergraduate courses (Table 4.10 and Figure 4.9). This is exemplified by the following comments from the survey respondents, who indicate that: "*the field of taphonomy is poorly understood and appreciated in Australia due to a lack of integration of this topic into university courses*", also "*Taphonomic studies and teaching need to be complemented*

with geoarcheology and geomorphology". Ninety-six point three percent of participants in question 19 indicated that more actualistic experiments need to be performed. Sixty-three point four percent of participants in question 20 indicate that taphonomic research has not been adequately integrated into broader publications. "*Much more research is needed on taphonomic factors influencing the vertical distribution of cultural materials in sites*".

Question 17. Where did your exposure to taphonomy first come from?

A specific Taphonomy Course	2.4%
Taphonomy was incorporated into other courses	56.1%
Through first hand field experience	41.5%

Table 4.9 Question 17 first exposure to taphonomy results

Question 18. When should taphonomy be taught?

1st Year	4.9%
2nd Year	15.9%
Advanced	4.9%
Core	74.4%
It should not be taught	0%

Table 4.10 Question 18 when should taphonomy be taught results

Question 21. Why do you think more research has not been conducted?

There is adequate research	3.7%
It is not an important consideration	11%
It is hard to get resources	15.9%
Funding is an issue	26.8%
Other	42.7%

Table 4.11 Question 21 why further research has not been conducted results

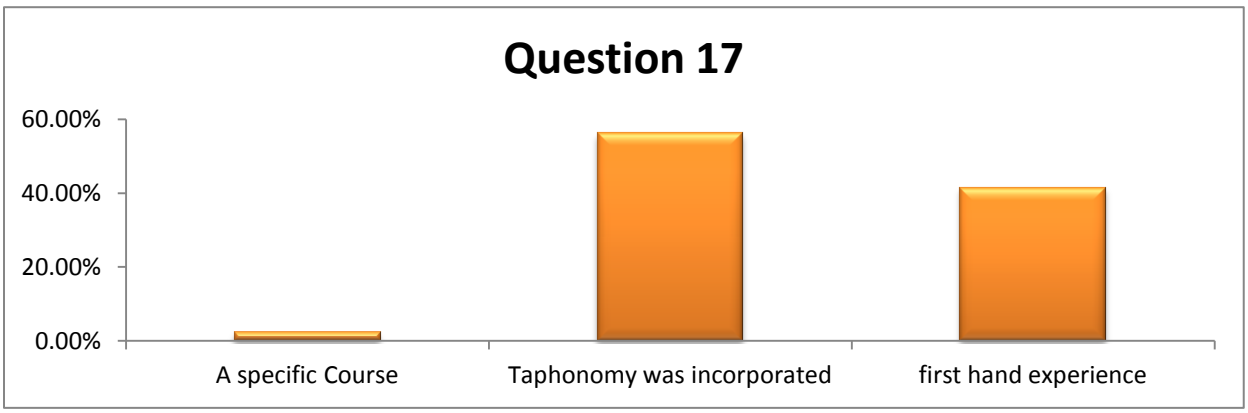

Figure 4.8 Question 17 first exposure to taphonomy results

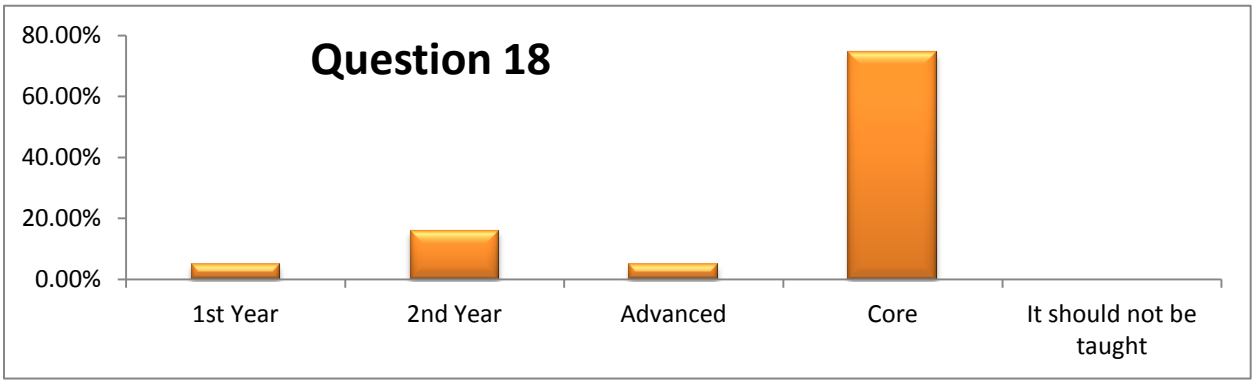

Figure 4.9 Question 18 when should taphonomy be taught results

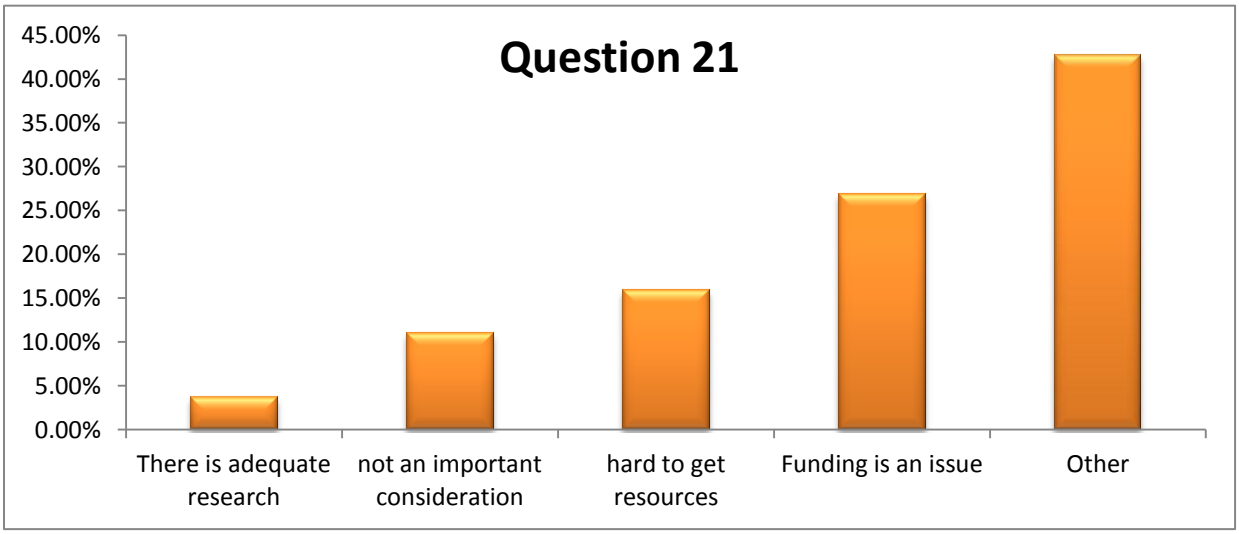

Figure 4.10 Question 21 why further research has not been conducted results

The final two parts (question 21 and 22) of section four address the perceived reasons why more research has not been conducted, as well as providing participants space to note any comments on the questionnaire. A very small minority (3.7%) indicated in question 19 that adequate research into taphonomy has been conducted, one survey participant commented that, "*It has been done - I'm just not sure it's considered enough*". Eleven percent of the participants indicated that taphonomic research is not an important consideration in Australian Archaeology (Table 4.11 and Figure 4.10), this may seem to indicate to these participants that further research does not need to be conducted or that archaeologists can directly interpret material in the archaeological record as a direct reflection of past human behaviour with no degradation, destruction or distortion. The vast majority indicated that taphonomy is often not given adequate consideration as an important element of archaeology; "*Archaeologists do not detail effects in sites or give adequate consideration*". Funding and resources were also indicated as inhibiting factors as well as a lack of understanding and appreciation of the importance of taphonomy in archaeological research. This last point may stem from the perceived lack of adequate integration of taphonomy into university courses as well as "*it [taphonomy] is a second order priority - so gets filtered to Hons level students, who are less well-resourced/supported to publish"*.

The comments that participants provided on the questionnaire can be divided into two general schools of thought. One believes that there is no need to give more attention to taphonomic processes, whereas the other representing the majority of participants, feel the opposite, that far more attention needs to be paid to these issues. Some examples, of reasons why taphonomy does not need more attention is, "*there is no real need for consultants to worry*

about taphonomic processes. The vast majority of sites archaeologists deal with in Australia are stone tool scatters, middens, scar trees and old camp sites.....no taphonomy knowledge is necessary to deal with these types of sites". This comment demonstrates the lack of knowledge this participant has of taphonomic processes, considering the majority of taphonomic research that has been conducted in Australia has been concerned with midden deposits and lithics (Ulm 2006; Faulkner 2010; Hiscock 1990a; Richardson 1992). Another participant commented that some of the processes that were listed in questions 4-6 were not relevant in the part of the country they work in and as such they have no reason to learn about them; "*the questionnaire should ask about what types of areas the answers were directed at ie. what areas of Australia people work in. For example, the part of Australia I work in has no frost action so there is no reason to learn about it as a taphonomic process*". Another participant also states that "*it [taphonomy] is not, by itself, something that will change our broad view of the Aust past"*. This idea has been previously invalidated by several archaeologists who have questioned the dating of early sites based on taphonomic processes. This work has changed the broad view of Australia's past through questioning when Aboriginal people first came to Australia (Hiscock 1990a; Allen and O'Connell 1998, 2003 and 2004; Bird *et al.* 2002; Thorley 2004).

As noted above, the majority of the participants feel taphonomy is very important, that taphonomic processes are critical to the understanding of site formation, although all too often ignored or misunderstood "*Site formation processes are too often ignored by recent graduates doing fieldwork, or inadequately understood. In the commercial field, this has had adverse consequences*" and "*I think taphonomic processes are critical to understanding site formation. I*

think many archaeologists don't consider them enough in their studies". Many of the comments stressed the need for more research into taphonomic processes, with the effects on open sites, stock movement and processes effecting the vertical distribution of cultural materials were specifically mentioned. For example, *"The taphonomy [of] stock movement near waterways (in conjunction with other known processes here such as water movement and natural erosion) would be valuable given that many consultants immediately assume that sites located in difficult-to-plough areas therefore have stratigraphic/taphonomic integrity".*

Conclusion

The vast majority of the results from the questionnaire, including the comments provided at the completion of the survey, reinforces the idea that there is a strong need for more consideration, research, publication and the improved incorporation of taphonomy into education both at an undergraduate and postgraduate level. Only a very small minority disagree with this idea. It seems very likely, considering the small sample size that people who had strong feelings in regards to taphonomic issues chose to complete the survey, and people who were more apathetic on the issue chose not to complete the questionnaire. The results only show the perspectives of a sample of Australian archaeologists who are opinionated on the topic of taphonomy and choose to complete the survey.

The implications for the discipline from the questionnaire results indicate that there is in general a need for greater consideration of taphonomy in Australian archaeological practise. It was indicated that the teaching of taphonomic issues at Australian universities needs to be improved, taphonomy should be taught as a core component in undergraduate degrees. There is need for further actualistic research, as well as more specific taphonomic publications

produced on Australian conditions. The results indicated that taphonomic research also needs to be integrated into broader publications including more detailed recording of stratigraphic integrity and evidence of taphonomic processes incorporated.

Chapter five: Discussion

Introduction

This thesis set out to evaluate the consideration of taphonomy in Australian archaeological practice. Three methods were implemented to address this aim. Firstly, the position of taphonomy in the Australian archaeological literature was determined through a review of published material. Secondly, a critical review of the International literature standards served as a comparison to the Australian literature to compare the position of taphonomic research within the discipline. Thirdly, the perspectives of Australian archaeologists on taphonomy were determined via the implementation of an online questionnaire, also establishing whether further taphonomic research in Australia is required. This chapter will combine the results presented in the literature review of chapter two and the results of the questionnaire in chapter four to address the aim of the thesis.

Discussion

Although post-depositional taphonomic processes were being identified as early as the 1800s by Darwin (cited in Atkinson 1957), the incorporation of taphonomic research at a general level within archaeology has been relatively slow both in Australia and internationally. Publications in the area of taphonomy have been steadily increasing through time, although as recently as 2010 researchers such as Allen and Hewitt (2010) have voiced their concerns of over the lack of consideration taphonomy receives in Australia. The literature review in chapter two identified several areas of research that have been investigated internationally and in Australia, as well as gaps in the Australian literature. An example of two areas of research noted in the literature review as having been popular internationally and in Australia relate to the reliability of

interpretations within zooarchaeology. The first area relates to the observations of how much faunal material entered deposits from rubbish disposal, and by implication, the reliability of relative abundance estimates. To undertake these studies, living sites were observed over a period of time to monitor the amount of faunal material that was added to the rubbish pile, calculate what percentage was removed by scavengers and what percentage remained after a set period of time (Weisler and Gargett 1993; Spennemann 1990; Walters 1984). The implication of this research is if a future archaeologist excavated the site the relative abundance of faunal remains would only be three percent of the actual material consumed and deposited at the site. Following from this, the second area of research has been to differentiate between culturally and non-culturally deposited material (e.g. Gould *et al.* 2002; McNiven 1990; Walshe 2000; Weisler and Gargett 1993).

A few areas of research that have been investigated internationally but have not been investigated specifically in Australia were discussed earlier in this thesis. Internationally there have been broad studies of taphonomic processes, such as that provided by Wood and Johnson (1978). A broad publication on the identification and description of various taphonomic processes in an Australian archaeological context would raise the awareness of taphonomic processes, as well as providing a reference for analytical interpretations of sites. Another more specific area that has been neglected in Australian archaeological practice is faunalturbation, where there has been some impressive work conducted internationally by researchers such as Bocek (1986), Erlandson (1984), Pierce (1992) and Araujo and Marcelino (2003). No examples of research into the potentially disruptive activity of specific native animals in Australia were identified during the course of this thesis. One single article highlighted introduced rabbits as a

disturbance factor in a single Australian site (Bird and Frankel 2001). The survey results also highlighted native and introduced animals as potential causes for disturbance to Australian sites, as well as highlighting the need for research in this area.

From the questionnaire 98.8% of participants felt taphonomic processes are an important consideration in the interpretation of Australian sites. Ninety-two point eight percent indicated that there is a need for more studies on taphonomic processes in Australia. The results also show that 63.4% of participants felt taphonomic studies have not been incorporated into the broader literature in Australia. In addition 50 of 84 participants could not name a single publication when asked to name the three most significant publications on taphonomy. From the results of the literature review and the survey, there needs to be more published research on taphonomy in Australia as well as greater awareness of the existing publications.

The majority of participants (56.1%) indicated that they learnt about taphonomy as part of other courses rather than a specific taphonomy course, while 41.5% indicated that they learnt about taphonomy first hand in the field rather than as part of their undergraduate degree. The vast majority (84.1%) felt there is not adequate coverage of taphonomy in undergraduate courses at Australian Universities. The questionnaire highlighted the perspectives of a sample of Australian archaeologist and the consensus from the majority of participants is that taphonomy requires greater consideration in published literature. Education at Australian universities needs to improve and there is a need for further research.

Future Research

This thesis has highlighted several areas where there is potential for taphonomic research in the future. Based on the results of the questionnaire, 96.3% of respondents believe that there is a need for more actualistic experiments, and 92.8% believe there is a need for more studies on taphonomic processes in general. Some examples of the areas that were indicated as needing further research in the questionnaire are as follows. One participant felt there is a need for further research into the role stock movement has on disturbing and altering archaeological sites, specifically near waterways. The questionnaire and the literature review specifically highlighted vertical movement of artefactual material in open and shelter deposits as being an area that still requires further research. Faunalturbation caused by both introduced and native animals in particular contexts was also specifically indicated as an issue that can have detrimental effects on archaeological sites. Therefore there is a need for studies to quantify the potential effects of turbation activities of native animals, and the literature review also supports this need.

The literature review highlighted decomposition rates of various materials (specifically in relation to soil pH levels) as a critical area that also needs to be researched. Another gap for further research that came from the literature review is that there are no publications of broad processes that can affect Australian archaeological sites. Publications similar to Wood and Johnson (1978), specifically targeted to the Australian scene, are required. These sorts of publications provide overviews and descriptions that are of analytical significance to archaeologists interpreting sites.

Conclusion

This thesis set out to evaluate the consideration of taphonomy in Australian archaeological practice. The analysis presented in this thesis has revealed that more consideration needs to be given to taphonomy in Australia. This thesis has highlighted taphonomy as important in Australian archaeology, and as such, it requires greater consideration in Australian publications and practice. This would include further actualistic research, and the consideration of taphonomic processes when assessing the integrity of archaeological sites. It is apparent, particularly in the consideration of the questionnaire responses, that Australian archaeologists need to be made more aware of taphonomic processes and their consequences. These results provide insights into the perspectives of Australian archaeologists and highlight the significance of further research and education on taphonomy in Australia.

Appendix:

Appendix A

Participant information sheet, including ethical clearance paragraph and statement stating informed consent is accepted by completing the survey.

The consideration of taphonomy in archaeological practice: A survey of Australian Archaeologists

Investigators:
Principal Investigator: Eva Rankmore, Archaeology Honours Student, School of Social Science, The University of Queensland.

Supervisor: Dr Patrick Faulkner, Lecturer, Archaeology Program, School of Social Science, the University of Queensland.

Aim and benefit of the project:
This project aims to investigate how taphonomic processes (site formation and disturbance processes) are considered in Australian Archaeology. These processes are of critical importance in considering the nature of archaeological data, accounting for various factors (natural and cultural) that can distort these datasets, and the interpretation of human behaviour in the past. Part of this investigation involves an online survey of Australian Archaeologists and Archaeological students to determine the different perspectives of taphonomic research. The aims of this research project are to evaluate the position of taphonomy in Australian and international literature, determine the perspectives of Australian Archaeologists on taphonomy in Australia and establish whether further research is required.

Confidentiality and how the findings will be used:
No identifying information will be specifically requested as part of this questionnaire. If this information in inadvertently provided in the course of the survey it will be de-identified prior to analysis. Any possible identifying information will be excluded or taken out of context and grouped for de-identified analysis.

The data will be analysed to establish the perspectives of Australian archaeologists on taphonomy issues. This information will lead to the formation of suggestions for further research and considerations of taphonomy in Australian archaeology.

Details of Participation and Procedures:
Participation consists of 22 multiple choice and short answer questions. Participants need to answer all questions, incomplete surveys will be disregarded. The survey will take approximately 15 minutes to complete.

Risks or discomfort:

No risks or discomforts are anticipated from taking part in this study. If you feel uncomfortable at any time you are free to withdrawal from the survey. If you decide to quit at any time before you have finished the questionnaire, your answers will not be recorded.

Decision to quit at any time:
Your participation is voluntary; you are free to withdraw your participation from this study at any time. If you do not want to continue, you can simply leave this website. If you do not click the "submit" button at the end of the survey, your answers and participation will not be recorded.

Feedback and contact information:
If you would like to receive feedback please contact the principal investigator via email. Feedback will be provided in the form of a 1-2 page report which will be compiled after the analysis has been completed.

If you have any questions or concerns about this survey please contact Eva Rankmore at eva.rankmore@uqconnect.edu.au or Dr Patrick Faulkner at p.faulkner@uq.edu.au.

Ethical Statement:
This Study adheres to the guidelines of the ethical review process of the University of Queensland. Whilst you are free to discuss your participation in this study with project staff, contactable at eva.rankmore@uqconnect.edu.au, if you would like to speak to an officer of the University not involved in the study, you may contact the chair of the school of social science ethical review panel on 3365 2871.

By beginning the survey, you acknowledge that you have read this information and agree to participate in this research, with the knowledge that you are free to withdraw your participation at any time without penalty.

Taphonomy in Australian Archaeology Questionnaire:

1. Please Indicate your occupation

Academic Archaeologist
Contractor heritage/Archaeology
PhD Student Archaeology
Masters Student Archaeology
Honours Student Archaeology
other

2. How many years of work experience do you have?

3. What is your primary field of study?

Indigenous
Historical

Maritime
other

4. Please indicate which of the 9 process of pedoturbation listed below you are familiar with and would recognise (from Wood and Johnson, 1978):

Faunalturbation: Animal burrowing or scratching
Floralturbation: Plants (root growth/ tree fall)
Cryoturbation: Freezing and thawing activity
Graviturbation: Mass Wasting (Solifluction, creep)
Argilliturbation: Swelling and shrinking of clays
Aeroturbation: Activity of Gas, Air and/or Wind
Aquaturbation: Water activity
Crytilturbation: Growth and Wasting of Salts
Seismiturbation: Earth quake related
None of the above

5. Please rank the importance of processes of turbation to Australia Archaeology using 1 to indicate the most relevant and 9 the least relevant:

Faunalturbation: Animal burrowing, scratching removal/ introduction of artefacts	
Floralturbation: Plants (root growth/ tree fall)	
Cryoturbation: Freezing and thawing activity	
Graviturbation: Mass Wasting (Solifluction, creep)	
Argilliturbation: Swelling and shrinking of clays	
Aeroturbation: Activity of Gas, Air and/or Wind	
Aquaturbation: Water activity	
Crytilturbation: Growth and Wasting of Salts	
Seismiturbation: Earth quake related	

6. Please indicate which of the 9 process you have seen first hand in archaeological contexts (Answer all applicable)

Faunalturbation: Animal burrowing or scratching
Floralturbation: Plants (root growth/ tree fall)
Cryoturbation: Freezing and thawing activity
Graviturbation: Mass Wasting (Solifluction, creep)
Argilliturbation: Swelling and shrinking of clays
Aeroturbation: Activity of Gas, Air and/or Wind
Aquaturbation: Water activity
Crytilturbation: Growth and Wasting of Salts
Seismiturbation: Earth quake related
None of the above

7. Have you ever excavated/observed a site with post-depositional animal damage?

Yes
No

8. Which animals have you seen evidence of post-depositional disturbance by? (Answer all applicable)

Dogs
Rabbits
Fox
Ferrets
Goanna
Wombats
insects
Have seen evidence but could not determine animal responsible
Have not seen animal damage
other

9. What animals can you name that you believe potentially could affect sites in Australia that were not listed in the previous question? If you do not have anything to add please write none or something similar as every question requires an answer.

10. How did this disturbance affect the integrity of the stratigraphy of the site?

Not Applicable
Destroyed the integrity
Some mixing but maintained integrity
Integrity was not affected
other

11. Do you feel taphonomic processes are an important consideration in the interpretation of Australian sites?

Yes
No

12. Have you published information concerning taphonomic damage?

Yes
No

13. Please list the 3 most significant publications on taphonomy relevant to Australia in your opinion. If you do not have anything to add please write no or none or something similar as every question requires an answer.

14. Do you feel there needs to be more studies of taphonomic processes in Australia?

Yes
No

15. Do you feel that taphonomic processes have less impact on Australia sites then else where in the world?

Yes
No

16. Are there adequate coverage of Taphonomy in undergraduate Archaeology courses Australian universities?

It needs to be improved
The coverage is adequate

17. Where did your exposure to Taphonomic issues first come from?

A specific Taphonomy course
Taphonomy was incorporated into other courses
Through first hand field experience

18. When should taphonomy courses be taught?

First Year
Second Year
Advanced
Core (integrated throughout the degree)
It should not be taught at undergraduate university level

19. Do you think taphonomic processes require more investigation; through actualistic experiments to determine their effect in Australia specifically?

Yes
No

20. In your opinion has the published taphonomic research been integrated into broader publications?

Yes
No

21. Why do you believe more research has not been conduced into taphonomic processes in Australia?

there has been adequate research conducted
It is not an important consideration for Australian Sites.
It is hard to get the recourses to conduct the experiments?
The difficulty of succeeding in gaining research funding is a factor hindering the conduct of specific taphonomic research
other

22. Do you have any comments to add? If you do not have anything to add please write no or none or something similar as every question requires an answer.

Appendix B

Question 21: Why do you think more research has not been conducted?

Other:

- “I would say the last 2 are relevant as is it being put in the too hard basket”
- “Archaeologists do not detail effects in sites or give adequate consideration”
- “Lack of interest”
- “Time and resources are an issue; often taphonomic experiments require time periods longer than the year that honours students get; it is also perhaps considered very dry and unappealing to students.”
- “misunderstanding about what it is and its role in archaeological interpretation”
- “not much post graduate interest”
- “Other research interests have superseded it”
- “Only a very small number of people are interested in this topic within the field of Australian archaeology”
- “I've not followed this particular issue closely”
- “Need to collaborate with experts in other fields who may not be interested”
- “the field of taphonomy is poorly understood and appreciated in Australia due to a lack of integration of this topic into university courses”
- “Australia is so big and different process affect taphonomy in various ways across Australia so not enough specific areas taphonomy process have been undertaken”
- “A lack of interest”
- “your possible answers are not very relevant to everyday consulting archaeologist experience.”
- “resources hard to some by”
- “It is a core element of any excavation and interpretation”
- “The resources AND the time!”
- “lack of interest/belief that it is unimportant”
- “It has been done - I'm just not sure it's considered enough”
- “Unsure - I believe that although understanding and recording taphonomic processes are crucial for integrity of data and associated interpretations/theory, taphonomy is usually overlooked in publication because it is 'taken for granted' that it has been considered. As for experiments and funding, researching taphonomic processes is not my area of expertise so I can't really comment.”
- “Working with 'greenfield' archaeology as a consultant, there are plenty of published research articles on ploughshare disturbance, etc. But I have personally come across much less about the effects of the animals, erosion, etc. In these areas, likely because ploughing is quicker and easier to peg for the disturbance when working with a consultant's budget”
- “Not glamorous”
- “Not even well enough understood for many to raise the questions, let alone address them, let alone get a project funded”

- “people don't care about taphonomy”
- “It is not a priority for some researchers, even though it may be important. However it may be difficult to fund specialist input on small research teams. The problem is therefore the structure of research rather than just a matter of funding.”
- “Perhaps it is more a function of trying to delineate complex interactions and so is a complex field of study”
- “Too many environmental zones in Australia to make generalisations”
- “although important may not have been viewed as the highest priority for research or as a by product of other research projects”
- “Important as it is, I think it’s a second order priority - so gets filtered to Hons level students, who are less well-resourced / supported to publish. Who knows what knowledge lurks in 30 years x 10 unis archives of theses.”
- “Reluctance of academics to publish research - Lake Mungo”
- “has not been seen as significant”
- “Most Australian archaeologists don't understand the full potential impacts of taphonomic processes and assume most sites reveal little disturbance. As such, taphonomy is given low research priority”
- “honestly do not know, but it is often ignored”

Question 22. Do you have any comments to add?

- “I think this is a really important topic and I am happy someone is trying to find out why research is not being conducted.”
- “Look forward to seeing the published outcome of the research.”
- “I think there needs to be more research into taphonomical effects on open sites. Open sites in some areas, particularly in the north-west of WA, are affected by erosion caused by water movement, wind and cattle (amongst other things) and there has been no research into these effects on sites.”
- “And it would have been more helpful to have an "undecided" option as well as yes/no - I did not want to answer some of them yes/no so this survey will not accurately affect my opinions.”
- “1. do not confuse taphonomy and site formation processes - definitions are different in their source disciplines & substantive issues raised by each definition are different 2. also note that Schiffer's 'behavioural archaeology' program has a fundamental logical flaw, which explains why it did not develop (see Binford's pompeii premise paper)....hence the importance of disentangling site formation processes from taphonomy and of using each term appropriately 3. also note that the study of how sites form long pre-dates Schiffer's coining of the term site formation processes - it goes back to the inception of the discipline in the late nineteenth century 4. taphonomy is integral to the study of all organic remains preserved in the sedimentary record - but faunal analysis is not taught in all departments - at least, not on a regular basis - and the study of taphonomic processes requires training in palaeontology, geology/geomorphology as well as archaeology - so the dearth of archaeology students

with science backgrounds may help explain why there are fewer studies of bone densities, disarticulation/weathering, landscape taphonomy etc in Australia"

- "Taphonomic processes are not a big consideration in my field of consulting archaeology - I simply record what Indigenous people say is a site and write a recommendation. Taphonomy isn't really relevant in that context. Besides, most archaeology work in Australia is Indigenous archaeology where Indigenous stakeholders have no clue about archaeology or site identification so there is no real need for consultants to worry about taphonomic processes. The vast majority of sites archaeologists deal with in Australia are stone tool scatters, middens, scar trees and old camp sites.....no taphonomy knowledge is necessary to deal with these types of sites."
- "Taphonomy of stone artefacts (how they are made) is more of an interest in Australia (see UNE research - Dr Mark Moore) than taphonomy of sites."
- "the questionnaire should ask about what types of areas the answers were directed at ie. what areas of Australia people work in. For example, the part of Australia I work in has no frost action so there is no reason to learn about it as a taphonomic process."
- "Site formation processes are too often ignored by recent graduates doing fieldwork, or inadequately understood. In the commercial field, this has had adverse consequences."
- "Most field surveys incorporate an element of site disturbance, whether by erosion, cattle etc, flooding, agricultural practices etc. Field reports should identify the causes of such disturbance but in general cannot allow time to be as rigorous as ideally desirable. Other taphonomic process only operate under excavation conditions, i.e. below the surface. Perhaps you could more clearly subdivide the field to make this clear."
- "Taphonomic studies and teaching need to be complemented with geoarcheology and geomorphology."
- "I think taphonomic processes are critical to understanding site formation. I think many archaeologists don't consider them enough in their studies. However, many archaeologists don't even understand stratigraphy so what chance does taphonomy have?"
- "There has been lots of research that incorporates taphonomy as an important part the context of any site. Things like this only get studied at academic levels as a separate research area, so anything that is done in this field can be useful in helping those who do not understand the basic principals of stratigraphy and site formation to put this in perspective"
- "As mentioned previously, it seems less research has been undertaken regarding stock movement in particular, even though as a consultant much of what we look at occurs in farming environments (although other forms of disturbance remain well documented). The taphonomy is stock movement near waterways (in conjunction with other known processes here such as water movement and natural erosion) would be valuable given that many consultants immediately assume that sites located in difficult-to-plough areas therefore have stratigraphic/taphonomic integrity"
- "The questionnaire seems not address the variable understanding people have of where taphonomy begins and ends. Happy to discuss more and help with resources in relation to scavenging."

- “There is work underway. I am in the middle of a 4 year ARC doing experimental taphonomy.”
- “Consulting reports are probably the best documentation of sub-surface effects of taphonomic process - look up Aboriginal Affairs Victoria or Dept of Enviro and Conservation (NSW) to access reports”
- “Repeating an earlier point - yes we should know more about taphonomy and it is essential for making sense of evidence, but it is not a key issue in itself. All students intending to practice should be made aware of it and the issues it reflects but it is not, by itself, something that will change our broad view of the Aust past. I see it being much less apparent among historical archaeologists due to the nature of the deposits they deal with and the questions they ask than among Aboriginal archs.”
- “Taphonomy is an area that is rarely considered yet it is one of the major factors in site formation”
- “Much more research is needed on taphonomic factors influencing the vertical distribution of cultural materials in sites. In particular, the battleship curve vertical distribution of artefacts needs to be better understood.”
- “I think that taphonomy is all too often ignored by Australian researchers. I am only speculating, of course, but I wonder whether it is partially a result of the need to 'show results' and come up with some definitive answer, date, etc.”

Reference List

Allen, J. and G. Hewitt (2010). "Site Disturbance and Archaeological Integrity: The case of Bend Road, an Open Site in Melbourne Spanning Pre-LGM Pleistocene to Late Holocene Periods." *Australian Archaeology* 70: 1-16.

Allen, J. and J. F. O'Connell (1998). "When did humans first arrive in Greater Australia and Why is it important to know?" *Evolutionary Anthropology*: 132-146.

Allen, J. and J. F. O'Connell (2003). "The Long and the short of it: Archaeological approaches to determining when humans first colonised Australia and New Guinea." *Australian Archaeology* 57: 5-19.

Allen, J. and J. F. O'Connell (2004). "Dating the colonization of Sahul (Pleistocene Australia-New Guinea): a review of recent research." *Journal of Archaeological Science* 31: 835-853.

Araujo, A. G. M. and J. C. Marcelino (2003). "The Role of Armadillos in the Movement of Archaeological Material: An Experimental Approach." *Geoarchaeology: An International Journal* 18(4): 433-460.

Asmussen, B. (2009). "Intentional thermal modifications? Analysing site occupation via burned bone." *Journal of Archaeological Science* 36: 528-536.

Atkinson (1957). "Worms and weathering." *Antiquity* 31: 219-233.

Balek, C. L. (2002). "Artifacts in Stable upland Sites and the Role of Bioturnation: A review." *Geoarchaeology: An International Journal* 17(1): 41-51.

Bird, C. F. M. and D. Frankel (2001). "2001 Excavations at Koongine Cave: Lithics and Land use in Terminal Pleistocene and Holocene of South Australia." *Proceedings of the Prehistoric Society* 67: 49-83.

Bird, D. W., J. L. Richardson, P.M. Veth and A.J. Barham (2002). "Explaining Shellfish Variability in Middens on the Meriam Islands, Torres Strait, Australia." *Journal of Archaeological Science* 29: 457-469.

Bocek, B. (1986). "Rodent Ecology and Burrowing Behavior: Predicted effects on Archaeological Site formation." *American Antiquity* 51(3): 589-603.

Brett, C. and G. Baird (1986). "Comparative Taphonomy: A Key to Paleoenvironmental

Interpretation Based on Fossil Preservation." *SEMP Society for Sedimentary Geology* 1(3): 207-227.

Cahen, D. and J. Moeyersons (1977). "Subsurface movement of stone artefacts and their implications for the prehistory of central Africa." Nature 266(28): 812-815.

Cameron, D. W. (1999). "The sinap formation project: Taphonomic studies at Igbek locality 49, Central Turkey". In M. Mountain and D. Bowdery (eds). *Taphonomy: The analysis of processes from Phytoliths to Megafauna. Research Papers in Archaeology and Natural History*.. Canberra, Australian National university. 30: 79-82.

Chase, P., D. Armand, A. Debenath, H. Dibble and A.J. Jelinek (1994). "Taphonomy and Zooarchaeology of a Mousterian Faunal Assemblage from La Quina, Charente, France." *Journal of Field Archaeology* 21(3): 289-305.

Childe, V. G. (1956). *Together the Past the interpretation of archaeological data*. London, Routledge and Kegan Paul.

Cole, N. (2006). "Colouring Stone: Examining categories in Rock Art." *Rock Art Research* 23(1): 51-58.

Corkill, T. (2001). "Rockshelter taphonomy a monitor program in Darling Mills Creek, Sydney." *Australian Archaeology* 52: 46-47.

Dwyer, P., J. Thomson and M. Minnegal (1985). "Odds and ends: Bower Birds as Taphonomic agents." *Australian Archaeology* 21: 1-10.

Edward, P. (1995). "The formation of large sites and their interpretation: evidence from the Pleistocene archaeological record of the East Jordan Valley." *The Artefact* 18: 60-63.

Efremov, I. A. (1940). "Taphonomy: a new branch of paleontology." *Pan-American Geologist* 74: 81-93.

English, A. J. (1990). "Salted meats from the wreck of the William Salt house: Archaeological analysis of nineteenth-century butchering patterns." *Australian Journal of Historical Archaeology* 8: 63-60.

Erlandson, J. M. (1984). "A case study in Faunalturbation: delineating effects of the burrowing pocket gopher on the distribution of archaeological materials." *American Antiquity* 49(4): 785-790.

Faulkner, P. (2010). "Morphometric and taphonomic analysis of granular ark (Anadara granosa) dominated shell deposits of Blue Mud Bay, northern Australia." *Journal of Archaeological Science* 37: 1942-1952.

Field, J. (1999). “The role of taphonomy in the identification of site function at Cuddie Springs”. In M. Mountain and D. Bowdery (eds). *Taphonomy: The analysis of processes from Phytoliths to Megafauna. Research Papers in Archaeology and Natural History.* Canberra, Australian National University. 30: 51-54.

Field, J. (2006). "Trampling through the Pleistocene: Does taphonomy matter at Cuddie Springs?" *Australian Archaeology* 63: 9-20.

Field, J., M. Fillios and S. Wroe (2008). "Chronological overlap between humans and megafauna in Sahul (Pleistocene Australia- New Guinea): a review of the evidence." *Earth-Science Reviews* 89: 97-115.

Geering, K. (1990). “A taphonomic analysis of recent masked owl (Tyto *novaehollandiae castanops*) pellets from Tasmania”. In S. Solomon, I. Davidson and D. Warson (eds). *Tempus Problem Solving in Taphonomy: archaeological and Palaeontological studies from Europe, Africa and Oceania*. Brisbane, University of Queensland. 2: 135-148.

Gibbs, M., D. Roe and D. Gojack (2005). "Useless graduate? Why do we all think something has gone wrong with Australian archaeological training." *Australian Archaeology* 61: 24-31.

Gifford-Gonzalez, D. P., D. B. Damrosch, J. Pryor and R.L. Thunen (1985). "The third dimension in site structure: an experiment in trampling and vertical dispersal." *American Antiquity* 50(4): 803-818.

Gould, R., S. O'Connor and P. Veth (2002). "Bones of Contention: reply to Walshe." *Archaeology in Oceania* 37: 96-101.

Gutierrez Zugasti, F. I. (2011). "Shell fragmentation as a tool for quantification and identification of taphonomic processes in archaeomalacological analysis: the case of the Cantabrian Region (Northern Spain)." *Archaeometry* 53(3): 614-630.

Harris, E. C. (1989). *Principles of Archaeological Stratigraphy*. London, Academic Press.

Haynes, G. (1990). “Taphonomy: Science and Folklore”. In S. Solomon, I. Davidson and D. Warson (eds). *Tempus Problem Solving in Taphonomy: archaeological and*

Palaeontological studies from Europe, Africa and Oceania. Brisbane, University of Queensland. 2: 1-17.

Hiscock, P. (1990a). "How old are the artefacts in Malakuanja II?" *Archaeology in Oceania* 25: 122-124.

Hiscock, P. (1990b)." A study in scarlet: Taphonomy and inorganic artefacts". In S. Solomon, I. Davidson and D. Warson (eds). *Tempus Problem Solving in Taphonomy: archaeological and Palaeontological studies from Europe, Africa and Oceania*. Brisbane, University of Queensland. 2: 34-49.

Hiscock, P. (2008). *Archaeology of Ancient Australia*. London, Routledge.

Hiscock, P. and J. Allen (2000). "Assemblage variability in the Willandra Lakes." *Archaeology in Oceania* 35: 97-103.

Huchet, B. M. J. (1990). " Taphonomic analysis of the faunal assemblage from Yam Camp Rockshelter, S.E. Cape York Peninsula." *Queensland Archaeological Research* 7: 57-72.

Johnson, D. L. (1990). "Biomantel evolution and the redistribution of earth materials and artefacts." *Soil Science* 149(2): 84-102.

Johnson, D. L. (2002). "Darwin would be proud: Bioturbation dynamic denudation, and the power of theory in science." *Geoarchaeology* 17(1): 7-40.

Kidwell, S. M. and S. M. Holland (2002). "The quality of the fossil record: Implications for evolutionary analyses." *Annual Review of Ecology and Systematics* 33: 561-588.

Koike, H. (1979). "Seasonal dating and the valve-pairing technique in shell-midden analysis." *Journal of Archaeological Science* 6(1): 63-74.

Langley, C. Clarkson and S. Ulm (2011). "From small holes to grand narratives: the impact of taphonomy and sample size on the modernity debate in Australia and New Guinea." *Journal of Human Evolution* 61: 197-208.

Lilley, I., D. Brian and S.Ulm (1999). "The use of foraminifera and the identification and analysis of marine shell middens; a view from Australia". In M. Mountain and D. Bowdery (eds). *Taphonomy: The analysis of processes from Phytoliths to Megafauna. Research Papers in Archaeology and Natural History*. Canberra, Australian National University. 30: 9-16.

Littleton, J. (1999). "Taphonomy of Aboriginal burials, Western New South Wales". In M.

Mountain and D. Bowdery (eds). *Taphonomy: The analysis of processes from Phytoliths to Megafauna. Research Papers in Archaeology and Natural History*. Canberra, Australian National University. 30: 69-78.

Lyman, R. L. (1994). "Quantitative units and terminology in Zooarchaeology." *American Antiquity* 59(1): 36-71.

Lyman, R. L. (2004). "Concept of Equifinality in Taphonomy." *Journal of Taphonomy* 2(1): 15-26.

Lyman, R. L. (2007). "What is the 'process' in cultural process and in processual archaeology?" *Anthropological Theory* 7: 217-250.

Lyman, R. L. (2010a). "Paleozoology's dependence on natural history collections." *Journal of Ethobiology.*

Lyman, R. L. (2010b). "What Taphonomy is, what it isn't and why taphonomists should care about the difference." *Journal of Taphonomy* 8(1): 1-16.

McConnell, K. and S. O'Connor (1999). "Carpenter's Gap Shelter 1: A case for total recovery". In M. Mountain and D. Bowdery (eds). *Taphonomy: The analysis of processes from Phytoliths to Megafauna. Research Papers in Archaeology and Natural History.* Canberra, Australian National University. 30: 23-34.

McNiven, I. (1990). "Blowout Taphonomy: non-cultural associations between faunal and stone artefact assemblages along the Cooloola Coast, Southern Queensland." *Australian Archaeology* 31: 67-74.

McNiven, I. J., M. L. Brady and A.J. Barham (2009). "Kabadul Kula and the antiquity of Torres Strait Rock art." *Australian Archaeology* 69: 29-40.

Morwood, M. J. and L. Dagg (1995). Excavations at Yam Camp. *The Archaeology of Aboriginal Art in S.E. Cape York Peninsula, Australia*. M. Morwood, J. and D. R. Hobbs. St Lucia, QLD, Anthropology Museum, University of Queensland: 107-115.

Mountain, M. (1990). "Taphonomic aspects of Faunal analysis from Nombe Rockshelter, highlands of Papua New Guinea". In S. Solomon, I. Davidson and D. Warson (eds). *Tempus Problem Solving in Taphonomy: archaeological and Palaeontological studies from Europe, Africa and Oceania*. Brisbane, University of Queensland. 2: 207-219.

Nest, V. J. (2002). "The Good Earth Worm: How Natural Processes Preserve Upland Archaic

Archaeological Sites of Western Illinois, U.S.A." *Geoarchaeology* 17(1): 53-90.

Orser, C. E. (2004). Historical Archaeology Second Edition. New Jersey, Pearson.

Pierce, C. (1992). "Effects of Pocket Gopher Burrowing on Archaeological Deposits: A Simulation Approach " *Geoarchaeology* 7(3): 185-208.

Piper, A. K. S. (1990). “Can taphonomy aid in the analysis of faunal material from historical archaeological sites?”. In S. Solomon, I. Davidson and D. Warson (eds). *Tempus Problem Solving in Taphonomy: archaeological and Palaeontological studies from Europe, Africa and Oceania.* Brisbane, University of Queensland. 2: 149-157.

Powell, J. (1995). "Fishy business: studies of fishing in the prehistoric Aegean." *The Artefact* 18: 76-79.

Richardson, N. (1992). "Conjoin Sets and stratigraphic integrity in a sandstone shelter: Kenniff Cave (Queensland, Australia)." *Antiquity* 66(251): 408-418.

Rick, T. C., J. M. Erlandson and R.L. Vellanoweth (2006). "Taphonomy and site formation on California's Channel Islands." *Geoarchaeology* 21(6): 567-589.

Robins, R. P. (1999). “Lessons learnt from a taphonomic study of stone artefact movement in an arid environment”. In M. Mountain and D. Bowdery (eds). *Taphonomy: The analysis of processes from Phytoliths to Megafauna. Research Papers in Archaeology and Natural History*. Canberra, Australian National University. 30: 93-106.

Robins, R. P. and E. C. Stock (1990). “The burning question: a study of molluscan remains from a midden on Morten island”. In S. Solomon, I. Davidson and D. Warson (eds). *Tempus Problem Solving in Taphonomy: archaeological and Palaeontological studies from Europe, Africa and Oceania*. Brisbane, University of Queensland. 2: 80-100.

Rolfsen, P. (1980). "Disturbance of archaeological layers by processes in the soil." *Norwegian Archaeological Review* 13(2): 110-118.

Shawcross (1998). "Archaeological excavations at Mungo." Archaeology in Oceania 33: 183-200.

Solomon, S. (1990). “What is this thing called Taphonomy”. In S. Solomon, I. Davidson and D. Warson (eds). *Tempus Problem Solving in Taphonomy: archaeological and Palaeontological studies from Europe, Africa and Oceania.* Brisbane, University of Queensland. 2: 25-33.

Spennemann, D. H. R. (1990). “The role of pigs & dogs in the taphonomy of modern and archaeological faunal assemblage from Tonga”. In . S. Solomon, I. Davidson and D. Warson (eds). *Tempus Problem Solving in Taphonomy: archaeological and Palaeontological studies from Europe, Africa and Oceania*. Brisbane, University of Queensland. 2: 101-107.

Stein, J. K. (1983). "Earthworm Activity: A source of potential disturbance of Archaeological sediments " *American Antiquity* 48(2): 277-289.

Stern, N. (1980). Taphonomy: some observations about its place in archaeology. Sydney, University of Sydney. Unpublished B.A. Honours.

Stiner, M. C. (2002). "On *in situ* Attrition and Vertebrate Body Part Profiles." *Journal of Archaeological Science* 29: 979-991.

Stockton, E. (1973). "Shaw's Creek Shelter: Human Displacement of Artefacts and Its Significance." *Mankind* 9(2): 112-117.

Thorley, P. (2004). "Rock-art and the archaeological record of Indigenous settlement in central Australia." *Australian Aboriginal Studies* 1: 79-89.

Ulm, S. (2006). Bivalve Conjoin analyses: assessing site integrity. *Terra Australis Coastal Themes: An archaeology of the Southern Curtis Coast, Queensland*. Canberra, Australian National University. 24: 65-78.

Ulm, S., S. Nicholas and C. Dalley (2005). "Mapping the shape of contemporary Australian Archaeology: Implications for archaeology teaching and learning." *Australian Archaeology* 61: 11-23.

Venn, C. (2008). Disturbing Effects: Towards an understanding of the impact of ant and termite activity on Australian Archaeological sites, University of Queensland. Unpublished B.A. Honours

Villa, P. (1982). "Conjoinable Pieces and Site formation Processes." *American Antiquity* 47(2): 276-290.

Walshe, K. (1998). "Taphonomy of Mungo B assemblage: indicators for subsistence and occupation for Lake Mungo." *Archaeology in Oceania* 33: 200-206.

Walshe, K. (1999). “A methodology for interpreting patterns of subsistence and occupation

from non-cultural bone debris". In M. Mountain and D. Bowdery (eds). *Taphonomy: The analysis of processes from Phytoliths to Megafauna. Research Papers in Archaeology and Natural History.* Canberra, Australian National University. 30: 63-68.

Walshe, K. (2000). "Carnivores, taphonomy and dietary stress at Puntutjarpa, Serpent's Glen and Intitjikula." *Archaeology in Oceania* 35: 74-81.

Walters, I. (1984). "Gone to the dogs: a study of bone attrition at a central Australian Campsite." *Mankind* 14(5): 389-400.

Walters, I. (1990). "The necessary science of Taphonomy". In S. Solomon, I. Davidson and D. Warson (eds). *Tempus Problem Solving in Taphonomy: archaeological and Palaeontological studies from Europe, Africa and Oceania*. Brisbane, University of Queensland. 2: 18-24.

Weisler, M. and R. H. Gargett (1993). "Pacific island avian extinctions: the taphonomy of human predation." *Archaeology in Oceania* 28(2): 85-93.

Wood, W. R. and D. L. Johnson (1978). "A survey of disturbance processes in archaeological site formation." *Advances in Archaeological Method and Theory* 1: 315-381.

Wright, R. (1990). "Taphonomy its applications and implications for archaeology". In S. Solomon, I. Davidson and D. Warson (eds). *Tempus Problem Solving in Taphonomy: archaeological and Palaeontological studies from Europe, Africa and Oceania*. Brisbane, University of Queensland. 2: 260-271.

Zuschin, M. and R. J. Stanton (2001). "Experimental measurements of shell strength and taphonomic interpretation." *SEMP Society for Sedimentary Geology* 16(2): 161-170.

Zuschin, M., M. Stachowitsch and R.J. Stanton (2003). "Patterns and processes of shell fragmentation in modern and ancient marine environments." *Earth-Science Reviews* 63: 33-82.