Wild West Frisia : the role of domestic and wild resource exploitation in Bronze Age subsistence

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Title: Wild West Frisia : the role of domestic and wild resource exploitation in Bronze Age subsistence
Issue Date: 2016-11-10

4. Reconstruction of subsistence: Hunting

4.1 INTRODUCTION

In this chapter, the role of hunting in subsistence farming is evaluated. Although hunting is not normally associated with farming life, its contribution to subsistence is investigated in order to confirm or contradict its importance in the Bronze Age. This investigation is achieved by a re-evaluation of the available old and new data. In the introduction to this chapter, an overview of the previous research and ideas on hunting in the Bronze Age is provided. Since no clear inconsistencies between recent data and the current model exist, only the general statements related to the current model are reiterated, each followed by a number between brackets. These numbers are presented as the starting main components which are challenged in this chapter. It is good to note that throughout this chapter, the general term hunting incorporates the capture of fish (*i.e.* fishing), birds (*i.e.* fowling), and wild mammals (*i.e.* game hunting), unless further specified. Possible collection of fungi, molluscs, amphibians, and reptiles is not included in this thesis, although it is by no means denied that the hunting of these organisms may have aided subsistence as well.

4.1.1 Previous research

Hunting has formed an integral part of human subsistence for hundreds of thousands of years. People hunted animals and gathered plants, thus maintaining their livelihoods. With the onset of farming however, people could control the animals and plants they consumed in a more direct manner, via cultivation and husbandry. These new subsistence strategies, making their definite appearance in the Neolithic, are often viewed as replacements for hunting and gathering. From this time period onwards, the amount of wild animal bones found at settlements seems to decrease rapidly (Louwe Kooijmans 1993, 78, figure 6.6). Late Neolithic farmers are progressively portrayed as becoming more rigid self-sufficient farmers who start to disregard wild resources in favour of mixed farming (1). Especially in the western Netherlands, these people are characterized as people that "started (..) to live with their backs to nature" (Louwe Kooijmans 1993, 80), a statement which is mainly based on the fewer numbers of wild animal bones uncovered in comparison to previous periods. This trend of decreased numbers of wild animal bones found at settlements is also observed in the Bronze Age. Both in the western Netherlands in general, as in West Frisia in particular, the occurrence of remains of wild animals in this period is linked directly to their relative (economic) importance for subsistence (2) (IJzereef 1981, 110-111; Louwe Kooijmans 1993, 80-3; Buurman 1996, 193; Roessingh & Lohof 2011, 210; Brinkkemper 2013, 186). Following this reasoning, since remains from wild mammals (*i.e.* game) and birds (*i.e.* fowl) are scarce throughout the Bronze Age, although fish remains are comparatively numerous (Louwe Kooijmans 1993, 104), hunting and fowling were assumed not to have been practiced, but fishing remained of some importance (3). Large game was apparently only hunted on a very opportunistic basis, without specialisation or concentration on a particular species or the surrounding available richness (4) (Louwe Kooijmans 1993, 81). Clearly, the above examples illustrate the current view of hunting within a Bronze Age farming community: hunting was either not practiced at all, or only on a very opportunistic basis, thus signifying the full reliance on and confidence in domestic animal production.

4.1.2 The proxies and the sites

The current view on hunting within a farming community is re-evaluated by gathering and combining the data from the old as well as the more recent excavations for analysis. The new approach of creating an expectation and comparing it to the analysed data is also applied in this chapter. Both were achieved by using a combination of different proxies, including ethnography, ecology, biology and archaeology (section 4.2, 4.3, and 4.4). Furthermore,

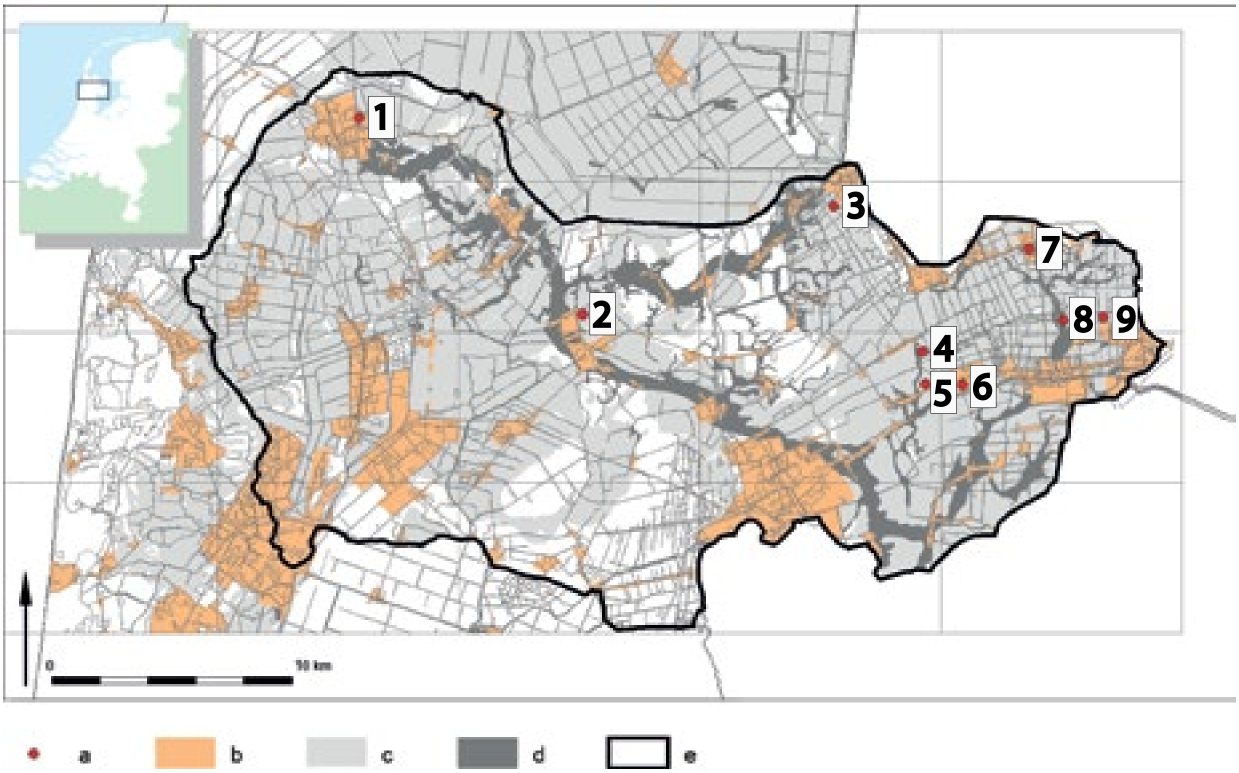


Figure 4.1. Overview of the sites of West Frisia that yielded wild animal remains. 1: Schagen de Hoep-Noord; 2: Hoogwoud Opmeer; 3: Medemblik Schepenwijk II; 4: Zwaagdijk 1961 and Zwaagdijk Oost; 5: Westwoud; 6: Hoogkarspel Tolhuis and Hoogkarspel Watertoren; 7: Andijk Zuid and Noord; 8: Bovenkarspel Het Valkje; 9: Enkhuizen Kadijken; a: location of an excavated site; b: present-day urban areas; c: tidal marsh deposits; d: creek deposits; e: outline of present-day West Frisia.

the critical evaluation of the processes affecting the wild animal bone data and their resulting influence on the consecutive interpretation are given considerable attention (section 4.4.5). By examining hunting in detail, important aspects have come to the forefront which are missed when writing broad summarizing overviews of a practice. These aspects together with the results of the analysis are combined to form a new model for hunting in Bronze Age West Frisian subsistence (section 4.5).

The information on the sites used in this chapter which yielded wild animal remains are shown in Figure 4.1 and Table 4.1, including their location, name, date, dating method, and sieving mesh size. Since not every site contained remains of each animal group (*i.e.* fish, birds, and small and large mammals), Table 4.1 additionally shows which animal groups were found, as well as the references related to each group. Finally, throughout the text, site names are addressed by their first name only, unless further specification is necessary to avoid confusion between different sites from the same location.

4.1.3 Main current model components

The main components of the current view of hunting, which are challenged in this chapter, are as follows:

(1) Bronze Age people are self-sufficient full-time farmers with no apparent need for wild resource exploitation.

(2) Frequency of wild animal remains can be linked directly to the relative (economic) importance of hunting in aiding subsistence in Bronze Age farming communities.

(3) Hunting of mammals and birds was not practised in the Middle and Late Bronze Age, but fishing remained of some importance.

(4) Large game was only hunted on a very opportunistic basis, without specialisation or concentration on a particular species or the surrounding available richness in the area.

Although the above main components are mostly constructed for the Bronze Age in the western Netherlands in general, they also inherently apply to West Frisia and the West Frisian data is therefore employed to challenge these main components.

4.2 METHODS

A combination of methods is presented here, which together is employed to evaluate the role and praxis of hunting in Bronze Age West Frisia. In order to understand the praxis of hunting as a whole, the different activities related to hunting are discussed separately (Table 4.2). A detailed analysis of these different parts shows the complexity of hunting, as well as the possibilities for its integration with farming practices. For the creation of an expectation of hunting practices (section 4.3), each of the basic components of hunting (*i.e.* preparation, hunting, processing, and storage and long-distance travel) is analysed in order. Each hunting component in turn is discussed separately for each animal group concerned (fish, birds, and small and large mammals) when analysing the West Frisian data (section 4.4). In this manner, it becomes clear what the scope, logic and importance of different hunting activities is, how they are executed, what the possible reflection of these activities in the archaeological record may be and which aspects of hunting may in fact remain invisible to archaeology.

The analysis of hunting incorporates the use of four main disciplines: ethnography, biology, ecology, and archaeology, which are elaborated upon in this section.

4.2.1 Ethnography

The ethnographical work by Murdock (1981) was employed to create a general idea of the importance of hunting for the subsistence of small-scale mixed subsistence farmers. A selection was made of the available culture groups researched by Murdock (Appendix A1.4), so that only cultures that most closely resemble the assumed Dutch Bronze Age situation remained. The selection criteria were: more than 50% of the food economy needed to consist of crop and animal husbandry (*i.e.* full-time farmers); the type of agriculture needed to be intensive agriculture on permanent fields with short fallow (cf. Chapter 6); crops needed to consist of cereals (cf. Chapter 6); settlement size needed to be relatively small, consisting of homesteads, hamlets, or compact settlements (cf. Roessingh in prep); animal husbandry should be focused on bovine animals (cf. Chapter 5).

More specific information on hunting practices in small-scale farming communities was obtained via detailed ethnographical studies summarized by Kent (1989). In these studies, the effects of hunting in a sedentary society, as well as the cross-cultural social organisation of hunting are highlighted. Kent aims to understand pan-cultural view of the role of hunting, hunters, and meat in groups with disparate economies and organizations (Kent 1989, 1). These examples provide information on the praxis of farming as well as on the mobility of hunting farmers.

4.2.2 Ecology

The possible locations and seasonality of hunting are analysed with the aid of ecology, which, as a discipline, researches the interaction between organisms and their environments. Habitat preferences of the animals uncovered at the excavated sites (Europese Vogelgids Online 2012; Nederlands Soortenregister 2015; Marine Fish Map 2016; Vissengids 2016; Soortenbank Nederland n.d.) provided information on the possible locations people visited for hunting, as well as indirect information on mobility. It is assumed that the animals present on the settlement were hunted by people, and because people are assumed to be full-time farmers, it is assumed that hunting occurred in relatively close proximity to the settlements in order to remain combinable with farming practices (cf. Chapter 3, section 3.3).

4.2.3 Biology

The main biological sub-discipline consulted for the analysis of the praxis of hunting was behavioural biology. Behaviour of animals can be animal group

Table 4.1. Information on the sites of West Frisia used for the analysis of hunting.

Site location	Toponym	Excavated	Date	Dating method	Sieving mesh size	Reference (s)
Andijk	Zuid and Noord	1973	1500-1100 cal BC	14C-dating and pottery typology	unknown	Mensch & IJzereef 1975 (mammals) Aal 2016 (mammals)
Bovenkars-pel	Het Valkje	1974-1978	1500-800 cal BC	14C-dating and pottery typology	1.0-2.0 mm	IJzereef 1981 (fish, birds, mammals)
Enkhuizen	Kadijken	2007-2009	1500-800 cal BC	14C-dating and pottery typology	4.0 mm	Zeiler & Brinkhuizen 2011, 191-216 (fish, birds, and mammals)
Hoogkarspel	Watertoren	1973-1978	1500-800 cal BC	14C-dating	unknown	Clason 1967 (mammals)
Hoogkarspel	Tolhuis (DEF)	1964-1969	1500-800 cal BC	14C-dating and pottery typology	unknown	Smits 1978 (mammals) Suwijn 1981 (mammals)
Hoogwoud	Opmeer	2004	1300-1100 BC	pottery typology	4.0 mm	Beerenhout 2005, 43-50 (fish) van Dijk 2005, 36-43 (birds and mammals)
Medemblik	Schepen-wijk II	2007	1450-800 cal BC	14C-dating and pottery typology	1.0 and 4.0 mm	Beerenhout 2010, 105-20 (fish) Groot 2010a, 83-104 (birds and mammals)
Schagen	de Hoep-Noord	2003-2004	2200-1600 cal BC	14C-dating	1.0, 2.0, 5.0 mm	Zeiler *et al.* 2007 (fish, birds, and mammals)
Westwoud	1988	1988	1400-800 cal BC	AMS-dating	0.5-1.0 mm	Buurman 1996, 107-56 (fish, small mammals)
Zwaagdijk	1961	1961	1500-1100 cal BC	14C-dating and pottery typology	unknown	Clason 1964 (mammals)
Zwaagdijk	Oost	2003	1500-1100 cal BC	14C-dating	unknown	Halici & Buitenhuis 2003, 155-88 (mammals)

Table 4.2. Basic activities related to hunting.

Preparation
locating worthy hunting spots
gathering/making tools/equipment/bait
Hunting
setting of catching equipment
(passive hunting)
checking catching equipment (passive hunting)
active hunting
collecting (passive or active hunting)
Processing
short-term (gutting, cooking, etc.)
long-term (drying, salting, smoking, etc.)
Optional
storage
long-distance travel

or even species specific and can provide a wealth of indirect indications for hunting (Europese Vogelgids Online 2012; Nederlands Soortenregister 2015; Marine Fish Map 2016; Vissengids 2016; Soortenbank Nederland n.d.)): the preferred food of an animal can give information about the use of possible baits or lures; reproduction and migration of animals can give insight into seasonality, availability and abundance. In turn, these preferences and seasonal activities of animals can be further translated into different appropriate catching techniques for each animal species, which may have varied from season to season. It is assumed here that the behaviour of animals, including feeding, breeding, and migration, has remained the same or at least comparable from the Bronze Age to the present.

4.2.4 Archaeology

Direct indications for hunting practices, such as the availability or presence of hunting gear, were explored in both the Dutch and north-western European archaeological Bronze Age data at large.

4.3 CREATING AN EXPECTATION OF HUNTING PRACTICES

As mentioned in the previous section, the role of hunting in small-scale mixed subsistence farming communities was first investigated with the use of the studies of Murdock (1981) and Kent (1989). An analysis of the subsistence of the selected farming communities from different cultures described by Murdock has revealed that in these recent societies, hunting (plus fishing) adds on average 11% to subsistence (Appendix A1.4). So, it is clear that hunting is still being practiced in relatively recent small-scale mixed subsistence farming communities. However, Murdock is vague on what is meant by a contribution to subsistence, only stating that values reflect: “the estimated relative dependence of the society on each of the five major types of subsistence activity” (Murdock 1981, 92). This dependence may therefore reflect hunting for consumption purposes, use of raw material, or both. Furthermore, a small percentage in the data compiled by Murdock may also signify practices that are perhaps not carried out often, but may in fact form very important aspects of subsistence. Sadly, this is not clarified either.

The research performed by Kent specifically examines the role of hunting in small-scale farming communities (Kent 1989). Many of the articles in her work underline the overlapping, complementary, and interdependent nature of wild resource exploitation and farming (*e.g.* Kent 1989, 45), and the special role hunting and meat still play in such small communities, even regardless of the necessity of this practice for subsistence.

Overall, hunting seems to be an integral part of many small-scale farming communities, but it remains unclear what the exact contribution to subsistence is. Also, it is (yet) unsure whether the above communities are directly comparable to the Bronze Age situation (Chapter 8, section 8.7.1). Therefore, in this section, each of the subsequent steps involved with hunting is carefully analysed, in order to create an expectation of hunting in the Bronze Age. This analysis will have to reveal the possible role hunting may have played in Bronze Age communities.

4.3.1 Preparation

Hunting requires careful planning and knowledge of the locations where a preferred prey resides, as well as of the seasonality of its movements to or from specific locations. This knowledge is essential for capture. Such types of knowledge include the habitat preferences of animals and different types of animal behaviour. Animal behaviour related to food, migration, and reproduction can be very helpful for a hunter in determining when an animal is absent or present, as well as provide information on what bait can be suitable for each preferred animal species. In order to be prepared for the hunt, a hunter needs to combine all his knowledge on the preferred prey. Reconstructing these preparatory steps thus involves analysing both animal preferences and animal behaviour.

Below, an overview is given of indications for hunting location and seasonality per animal group, as well as possible bait required for hunting these animals, all based on animal behaviour and preference for certain habitats. The other subject related to the preparations for hunting, involving the creating of tools or gathering of bait, is discussed in Chapter 7: Wild plant gathering.

Hunting location: habitat preferences

The preferred habitats of animals can also be interpreted as the locations where the animal was most likely caught. An overview of habitat preferences is therefore able to provide information on the range of different types of locations visited for hunting. Different animal groups however, have different preferences for their environment and possess varying degrees of informative resolution: fish can show indications for water type and salinity, birds provide a general overview of possible hunting locations, small mammals (*i.e.* smaller than hare (*Lepus europaeus*)) show a very local picture, and large mammals mainly give information on the amount of cover available in the surroundings (cf. Chapter 2). Furthermore, each animal group possesses individuals which may travel longer distances, with varying habitat preferences along this route. Such aspects need to be taken into consideration when interpreting hunting location. In general, however, the presence of different habitat types will already provide insight into the practice of hunting and the different opportunities and challenges each environment will have created. Moreover, when multiple animal groups show generally similar habitat preferences, this will give a stronger indication for a potential hunting location.

Seasonality: reproduction, migration, and animal group specific behaviour

Fish

Two types of animal behaviour that can give insight into seasonality are reproduction and migration. Reproduction of fish occurs during certain months of the year, when they are spawning in shallow waters. This period enables hunters to catch fish that are normally inaccessible.

The other major seasonal period for catching fish is migration. During migration, some fish species travel *en masse* to or from the sea, thus forming a target for fishing with potentially high yields.

Other, more general trends in seasonal fish behaviour can also be observed. For example, fish species from the open sea travel closer to shore in summer, and juveniles may even travel into estuaries looking for warmer and/or sheltered surroundings (Vissengids 2016). Fish normally living in (deep) open sea water can therefore become more accessible during summer months. During winter months, most freshwater fish are less accessible because they become lethargic due to a severely slowed-down metabolism, and saltwater fish are less accessible because they reside in the deeper parts of the sea.

From the above examples, it is clear that seasonal behaviour of fish can provide a lot of information on possible fishing strategies depending on location, the time of year, and the species targeted.

Birds

Breeding season is an important period for all birds, since appropriate nesting sites need to be located. In this season, birds are finding mates, courting, building nests, brooding, and feeding their young. Especially brooding and feeding periods require most of the bird's attention and keep it bound to the nest or busy gathering food. Knowledge of preferred nesting locations enables the hunter to exploit nests by catching either the brooding parental birds and/or by collecting their eggs (Serjeantson 1998, 24).

Another important season related to bird behaviour is migration. Birds either remain resident in an area throughout the year, or travel south to escape harsh winter conditions. Migration usually occurs twice a year, when they travel between their breeding grounds and winter habitats. The Netherlands, and especially the north-west, is still an important mid-way location on many migratory routes of birds (van Roomen *et al.* 2013). Some birds however, are resident and do not participate in migration at all, being adapted to withstand the climate in a specific area throughout the year. A third group of birds can be considered consisting of seasonal guests, only using an area as a temporary resting location on their travels further north or south.

Thus, the presence of certain species on a site can give a firm indication of the seasonality and practice of fowling, as well as the potential availability of different kinds of bird resources.

Another, bird-specific, form of seasonal behaviour is moulting. Moulting (of birds) is the shedding and replacing of old feathers. This replacement occurs multiple times in the life of a bird, which costs the bird a large amount of energy. One form of moult occurs when birds replace feathers to obtain a bright plumage for mating season, but this effects only a limited number of feathers (All about birds 2015). Since these feathers are only available for short periods of time and may consist of colours not normally observed in a species, they may form a specific target for hunting. The hunt for birds especially for their feathers in general is known as plume hunting, something which has been practiced up until recent times in many parts of the world (*e.g.* Ehrlich *et al.* 1988; Swadling 1996).

A second form of moult is also potentially very interesting for a hunter. Waterfowl, such as ducks, geese, and swans, have developed a manner of moulting that involves replacing all their wing feathers simultaneously. This means that moulting can occur in a relatively short time, but also that it renders the bird totally flightless for four to six weeks (Serjeantson 1998, 25; Roots 2006, 152; McCleery 2007, 86). This flightless period differs slightly from species to species but mainly occurs during summer, which enables the hunter to catch aquatic birds relatively easily during this time.

Finally, other, more general opportune periods for hunting birds may include the autumn and winter. In autumn, birds are well-fed and in good condition (Serjeantson 1998, 25), and become even more interesting targets for hunting for consumption reasons. In winter, some birds are more conspicuous and tend to flock together in larger numbers. In addition, since food is scarce, birds will have to venture into more open areas to forage, thus increasing their vulnerability to capture (Serjeantson 1998, 26).

Mammals

Breeding and birthing seasons are also busy periods in the life of a mammal. During these periods, a suitable mate needs to be found and, when the young are born, they need to be protected and fed. Due to these activities, mammals often appear more out in the open and will become less attentive towards possible dangers. Therefore, during these periods it may be relatively less complicated to locate and capture a mammal (Twisk *et al.* 2010).

As for the other animal groups, the second seasonal mammal behaviour which can be taken advantage of by hunters is migration. Many mammals can migrate for longer distances to search for a mate, to forage, or to avoid harsh weather conditions. The destination of these travels, as well as the general route taken, are often the same. When these locations or travel routes are known to a hunter, migratory mammals could also become a relatively easy target for capture.

The third major type of seasonal mammal behaviour is group formation. Whereas some mammal species always occur in (small) groups (*e.g*. red deer (*Cervus elaphus*), hare, wild boar (*Sus scrofa*), and fox (*Vulpes vulpes*)), others only appear in groups during certain times of the year (Twisk *et al.* 2010). For example, roe deer (*Capreolus capreolus*) and elk (*Alces alces*) will form groups in winter, especially in areas where there is little cover by trees (Kenniscentrum Reeën 2005). In such seasons, when animals are already more conspicuous due to the absence of foliage, group formation could provide an excellent opportunity for the hunter to catch (several) individuals.

Bait: food preference and foraging

Fish

Knowledge of the food preference and foraging (*i.e.* food finding) behaviour of an animal can be an important part in understanding what type of catching equipment and bait is appropriate. For fish, diet can include either vegetative matter, insects, other animals, or a combination of these (Vissengids 2016). Bait can thus be chosen according to the specific food preferences of the targeted species, although some types of fish may not respond to bait at all because they do not feed during specific periods of the year. Migratory species for example, usually show different feeding behaviour depending on whether they reside in freshwater or saltwater environments. Salmon (*Salmo salar*) for instance, a true predatory fish, does not feed whilst residing in fresh water (de Laak 2007). Another exception is eel (*Anguilla anguilla*), which can even show two different feeding patterns within one medium (fresh water) depending on its age. Juvenile eel resides in freshwater for several years and actively hunts for food. When it has reached maturity, it migrates back to the sea in order to spawn and does not feed any longer.

Thus, for some fish species, a combination of knowledge of food preference and seasonal behaviour is necessary for selecting appropriate catching equipment and bait.

Birds

Food preference and foraging behaviour of birds can also provide essential knowledge about appropriate catching strategies and use of bait or lures. Birds can roughly be divided into two groups based on their foraging behaviour: predatory birds and non-predatory birds.

One type of predatory bird, the bird of prey, hunts by flying across their hunting grounds in search of prey, which they attack in or from the sky. Other predatory birds include birds that catch insects and other invertebrates (in the air or in/on the ground), or birds that hunt for fish from the water (as opposed to birds of prey, that hunt for fish from the air).

Non-predatory birds are basically vegetarian, feeding on plants in and around water or grazing on fields. The food preference and foraging behaviour of birds therefore gives information on applicable bait and effective catching strategies depending on preferred food type and location.

Mammals

For the preparation for hunting mammals, the food preference, foraging location and foraging behaviour of a mammal can be very important aspects as well. Mammals can roughly be divided into the groups herbivore, carnivore, and omnivore. Depending on how they acquire their food, be it by browsing, hunting, or scavenging, an appropriate baiting and/or catching technique can be applied by the hunter, including hunting actively or by using passive hunting techniques such as traps or snares.

4.3.2 Hunting

Hunting most often requires the use of tools or equipment. Which tools and equipment are appropriate for hunting certain wild animals depends on several factors. First, the time available for hunting can influence the hunting techniques applied, which may include active or more passive hunting techniques and inherent types of hunting gear. Second, the animal species and its particular preferences

Table 4.3. Overview of some of the possible active and passive hunting strategies available to people in the Bronze Age based on the US army survival manual, as well as archaeological finds.

	Hunting strategy		References	
	active	passive	recent examples	archaeological examples
Fish	Hooks, nets, spears, clubs, leister[1]	Fish traps/fykes, weirs, nets, baskets	United States 2009, 88-93	Brinkhuizen 1983; Bulten, Boonstra and Arnoldussen 2002, 35-9; Knight 2012
Birds	Bow and arrow, nets, gathering during moulting or nesting	Traps[3], snares[4], nets	United States 2009: 77-8, 80, 83	Mannermaa 2003; Bulten and Boonstra 2013; van der Wal 1952
Mammals	Rabbit stick[2], spear, bow and arrow, sling, club, dogs	Traps, snares, nets	United States 2009, 88-9; Huber 2012, 83	van der Wal 1952; Clark 1966, 54; Jensen 1982, 154; Bulten, Boonstra and Arnoldussen 2002; Bulten and Boonstra 2013

[1] A leister is a hunting tool to capture eel, which resembles a forked spear
[2] A rabbit stick is a throwing stick of arm-length, which is very effective against small game
[3] Traps are designed to catch and hold, or to catch and kill
[4] Snares are traps which incorporate a noose

and behaviour, are, as has become clear from the previous section, very important in identifying the use of appropriate hunting strategies and weapons. In order to clarify which techniques may have been applied in the Bronze Age, direct evidence for hunting techniques may be uncovered through actual finds of hunting gear. Indirect evidence for hunting techniques and seasonality may, as said, be inferred from the wild animal species and their behaviour, but also from (distinct marks on) the wild animal bone material. Finally, the presence of certain types of hunting equipment may be limited to the material and techniques available to a hunter, which can influence the creation of particular hunting gear. All these subjects related to the activity of hunting is discussed for each animal group in this section, but the latter is also discussed in more detail in Chapter 7: Wild plant gathering.

Available active and passive hunting tools and equipment

The distinction between active and passive hunting is mostly made based on time constraints and combinability with other activities. In active hunting, the hunter needs to be present during the entire procedure. It often involves the use of weapons in combination with active waiting (*e.g.* from a concealed or elevated position), stalking (*i.e.* quiet pursuit), or chasing (*i.e.* running pursuit). Active hunting often allows the hunter to select prey of a certain size or species. Passive hunting on the other hand, only requires the attention of the hunter at specific times, mainly during the setting and checking of traps or snares. The less selective nature of this hunting strategy often results in considerable by-catches of less desirable, or even unwanted species.

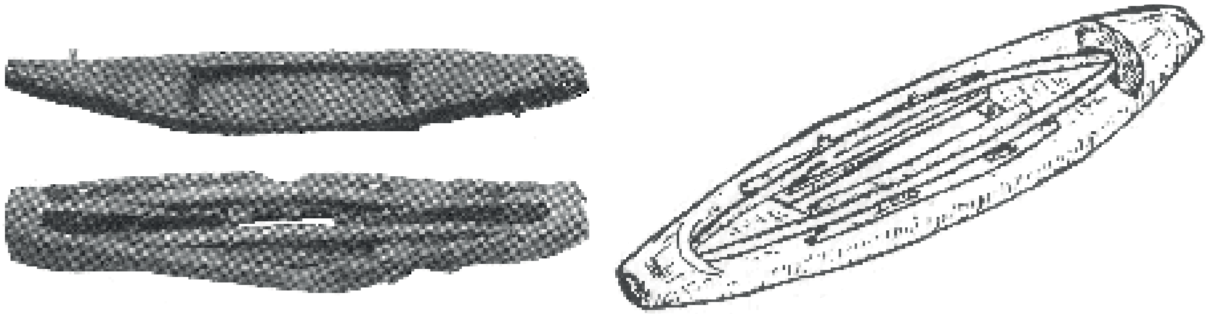


Figure 4.2. Wooden tread traps. Left: two prehistoric tread traps found in Hinge and Nisset Nørremose, Jutland, Denmark (after: Jensen 1982, Plate I); right: modern tread trap for deer from Poland (after: Jensen 1982, 53).

The range of possible active and passive hunting strategies available to people in the Bronze Age was assessed by employing the United States Army Survival Manual (United States Dept. of the Army 2009), as well as overviews of uncovered active and passive hunting gear from archaeological find compilations. The main advantage of employing the US army survival manual was that, in a survival situation, no (seasonal) restrictions to hunting exist, which may be encountered when using other (modern-day) hunting parallels. This manual therefore provided a wide overview of basic hunting techniques which do not require modern tools for their manufacture. The archaeological compilations furthermore, provided an overview of available hunting techniques in the Bronze Age, which could confirm the possibility of the use of certain tools or equipment during this time. Still, it must be emphasized that the overview provided here is kept concise and is by no means a complete list of all the hunting gear ever employed. It is merely presented as a basic overview of possibilities in order to understand differences in hunting techniques and strategies. The different general tools and equipment used for active and passive hunting techniques are summarized in Table 4.3.

Almost all of the hunting tools presented in Table 4.3 are constructed out of perishable organic materials, except for the arrowheads, which are usually made from flint. Therefore, besides these arrowheads (*e.g.* Bulten & Boonstra 2013), hunting tools are not often found archaeologically. Nevertheless, rare finds of Bronze Age hunting gear include a wooden bow (van der Wal 1952), as well as fish traps, fish weirs, fish fykes, and wooden mammal tread traps from multiple locations in the Netherlands and abroad (Clark 1966, 54; Jensen 1982, 154, fig. 49; Bulten *et al.* 2002; Knight 2012; Figure 4.2). The wooden tread traps have only been preserved in bogs and soils along old rivers (Clark 1966, 53; Figure 4.3), limiting the visibility of their original distribution (National Museum Copenhagen pers. comm.). Still, 45 examples of these traps exist, with either single or double fall mechanisms (Rasmussen 1940, 119), and measuring 61 to 122 cm (Clark 1966, 51). These traps have been employed to capture deer and bear (*Ursus arctos*) until recent times in Poland (Moszyński 1929; Rasmussen 1940), indicating their employment for trapping various large game.

All the uncovered archaeological finds indicate therefore that both active and passive hunting was still being practiced during the Bronze Age.

The use of hunting tools and equipment

Possessing the appropriate gear for hunting is essential, as well as the knowledge on how, where, and when it is appropriate to use it on which species.

Fish

General ways exist for capturing particular types of fish in different habitats. Boats are necessary on the open sea for example, possibly combined with baited (hooked) lines for capturing deep-sea fish. In an intertidal environment, flatfish can also be caught using lines with bait, or by spearing them (Brandt 1984). Most saltwater fish and migratory fish can be caught using fish fykes, traps, and weirs (Zeiler *et al.*

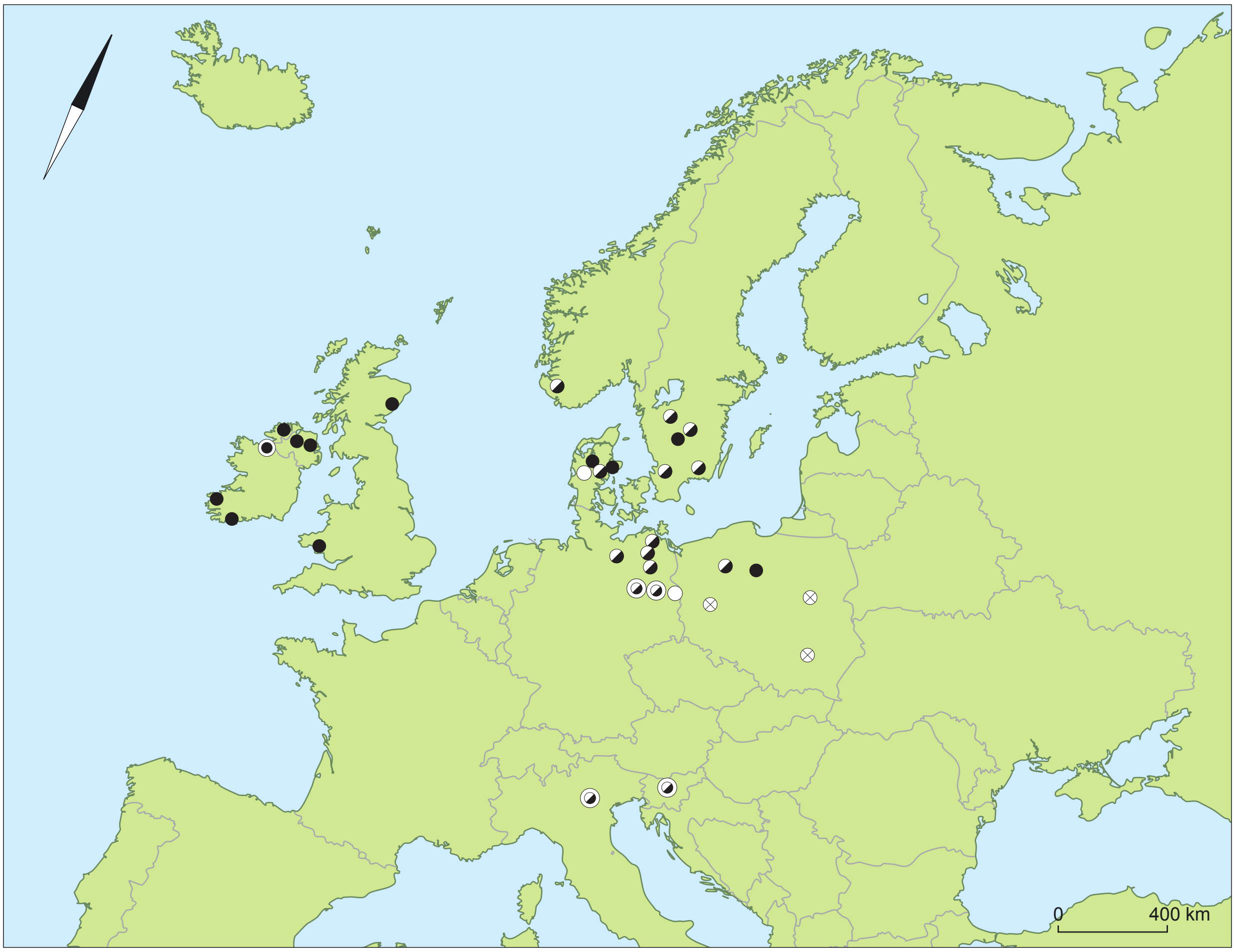


Figure 4.3. Overview of the distribution of prehistoric wooden tread traps found in Europe as well as modern-day parallels. a: traps with unknown mechanism; b: single valve traps; c: three or more single valve traps found together; d: double valve traps; e: three or more double valve traps found together; f: modern survivals of these kinds of traps in Poland, where they were used until the 20th century (after: Clark 1966, 54)

2007). By placing these traps in intertidal streams, fish are trapped at low tide.

Similar techniques are required to catch migratory fish in a freshwater environment, although here, no (strong) intertidal effects occur. Weirs and fykes can, however, still be employed, combined with additional methods such as clubbing or spearing (Lohof & Vaars 2005). Freshwater fish in general can be caught using a range of possible techniques. Carnivorous fish can be caught using bait on hooked lines or in fykes. Throwing nets, baskets, clubs, and spears can be employed to catch spawning fish in shallow waters. Some fish species, such as eel, can be caught in different ways depending on its age. Fykes with bait can be applied on young eel, which still feeds in order to become mature; weirs and nets can be applied to capture mature eel during migration. Finally, an eel "fork" or leister can be used; a tool that is lowered into the water around which an eel will wrap itself (*e.g.* Meurers-Balke 1981; Table 4.3).

Birds

Birds can travel across land, through water, and through the air. Possible catching techniques are therefore very varied, depending on the species, but also on location, and seasonality. Two syntheses of several types of fowling methods have revealed a range of different fowling possibilities, which may also have been used in prehistory for capturing different bird types (Mannermaa 2003; Whitworth 2007, 33-50).

Most birds can be caught using general catching methods such as nets, traps, and snares, depending on their particular food preference and foraging behaviour. Flying birds can be shot using arrows for example. Alternatively, relatively small flying birds such as warblers and thrushes can be caught with nets; even dead birds might have been collected directly after *e.g*. storm surges.

Ground dwelling birds hide in plant cover and can be caught using snares or other, more active forms of fowling. Birds of prey can be captured by for example employing a baited "net of nooses" (Whitworth 2007, 49). Aquatic birds can be gathered, or driven into nets during moulting season with or without the aid of dogs (Mannermaa 2003, 21). In addition, night fowling can be practiced, during which nocturnally active birds are caught by using a light source for disorientation and roosting birds can be taken from the nest by hand (United States 2009, 77).

Mammals

Multiple hunting techniques exist to capture mammals of different size and with different habitat preference. The rabbit stick (Table 4.3) can be employed for prey that freezes as a form of defence, such as small mammals (United States 2009, 88). Other game, such as hare, can also be jabbed with a spear. Bow and arrow allows a hunter to attack from a longer distance, for example to kill large prey or prey that is normally difficult to approach, such as beaver (*Castor fiber*). Slings can be used to hunt small game such as hare, weasel (*Mustela nivalis*) or polecat (*Mustela putorius*). Dogs can also aid in the hunt and can capture mammals such as fox, polecat, and weasel. Other hunting techniques include different types of traps of varying construction, and several variations of snares. Since a wide variety of these types of hunting equipment exists, the interested reader is referred to the Survival Manual (United States 2009).

The use of bait, lures and calls

Baiting a trap or snare can increase the chance of capture, and can even draw animals to the capturing device (United States 2009, 79). The bait used should be familiar to the animal, but not so common that it can readily be obtained somewhere else; *e.g*. salt (United States 2009, 79). Bait can be useful for both active and passive hunting techniques, although not all animals will be attracted to bait to the same extent. Apart from the use of food as bait, animals can also be attracted to certain locations through the employment of lures and calls. When a hunter is able to successfully mimic the sound of an animal species, it will approach the location where the hunter is hidden, thus facilitating capture.

Indications for hunting based on bone material

Archaeologically preserved bone material can provide indirect indications for hunting tools employed and seasonality of hunting. Specific deep cut marks on bones can, for example, be related to the use of spears; shallow cut marks are evidence of the skinning of animals. Skinning of animals for their fur also indirectly implies the use of passive hunting (*e.g*. certain traps), since this practice does not damage the pelt, whereas most active hunting strategies pierce the skin in order to kill the animal.
Seasonal indications for hunting based on bone material, besides the presence of bones from migratory animals, can also include the presence of young animals, which are only present during a certain time of year. In addition, the presence of specific anatomical parts can also provide seasonal indications, for example the presence of skulls of deer with or without antlers still attached, or the special egg-laying bone structures of birds (Gál 2005, 53; Groot 2010b, 70).

4.3.3 Processing

Processing of hunted animals can involve actions performed for short-term use (*e.g*. for cooking) and long-term use (*i.e*. for preserving), which are both discussed in this section per animal group. Subsequently, indications for processing based on archaeological bone material are examined.

Processing for short-term use

Fish

Short-term processing can include several different actions, depending on the culinary use of the animal. If fish is cooked directly after capture, one or more parts of the fish are usually removed first. The minimal processing of the fish would include removing the guts, which are most susceptible to rotting. Alternatively, the head and tail could also be removed. When only meat is desired, fish can be filleted, removing all the bones from the animal. Regardless of the processing method applied, the desired part(s) of the fish can be used in further processing for consumption, which may include multiple techniques, such as grilling, smoking, or making a stew or soup.

Birds

Processing a bird for consumption purposes can occur during or right after capture, or at a later time at the settlement. After killing the bird, it should be plucked or skinned. Further processing can include removing the head, feet, wings, tail, and (optionally) the intestines, leaving only the bones, meat, and skin. When only meat is desired, most bones from the wing and leg parts, as well as the skull is discarded, removing them from the subsequent cooking processes. When bird meat is not consumed immediately, after dressing the carcass it can be kept for 4-7 days at 2-4 °C, its shelf life increasing with lower temperatures (Maas-van Berkel *et al.* 2004, 13).

Mammals

The steps for short-term processing of mammals are taken from the US Army Survival Guide (United States 2009), because it is assumed that this reflects the most basic steps required.

Slaughtering and skinning are the first steps in processing a mammal. The animal needs to be bled and cleaned after killing and the intestines need to be removed quickly to prevent spoilage of the meat (Maas-van Berkel *et al.* 2004; United States 2009). Skinning is achieved by cutting the hide at certain locations and subsequently pulling it away from these cuts. The head and feet of the killed animal are usually removed, although the brain can be used for consumption or tanning of hides (Michaud n.d.). Large game is usually hung for several days (depending on the outside temperature) to increase the tenderness of the meat, which can be cut into manageable pieces by cutting along the leg joints. For smaller mammals, such as hare, this is not necessary. When the meat is processed for consumption, it can be cooked, grilled, roasted, boiled, or made into a stew, especially in combination with bones and their marrow (United States 2009, 97) to increase the flavour and nutrient content. Similar to bird meat, game meat can be kept for 4-7 days at 2-4 °C, its shelf life increasing with lower temperatures (Maas-van Berkel *et al.* 2004, 13).

Processing for long-term use

Fish

Preserving fish for later use (*e.g.* for during winter) means that contamination by micro-organisms from the surroundings needs to be prevented. There are several preservation techniques for the preservation of fish with varying storage lives, or the time the fish remains preserved well enough for consumption. These techniques include drying, salting, smoke-drying, and fermentation.

Drying can be achieved by hanging or placing gutted fish on racks, and exposing them to an air-flow (*e.g.* wind). Drying fish should be kept out of direct sunlight (Maas-van Berkel *et al.* 2004, 40), since high temperatures speed up spoilage. For adequate drying, it is important that the surface area of the fish meat is as large as possible, and that weather conditions are favourable (*i.e.* dry and windy) for a prolonged period of time. Fish which are usually dried include low-fat fish such as flatfish (Beerenhout 2010, 118), and small fish (Maas-van Berkel *et al.* 2004, 37). Most large fish will rot from the inside out before wind-drying can be completed successfully. Therefore, these fish need to be salted first to extract as much water content as possible before additional drying can be attempted (Maas-van Berkel *et al.* 2004, 37). Fatty fish, such as eel and herring (*Clupea harengus*), can be dried by smoking. During smoking, fish is hung on lines or poles and is placed in relatively close proximity to a smoking fire. However, it must be kept in mind that the storage life of fish is not considerably prolonged by smoking alone. Therefore, it should subsequently be dried to be suitable for long-term storage (Maas-van Berkel *et al.* 2004, 15, 46-47).

Fermentation is another method of preservation, which requires anaerobic conditions and large amounts of salt. Entire fish are mixed with salt/brine and poured into a container. This container is then stored underground and dug out several months later. Depending on the product of fermentation (*e.g.* sauce or whole fish), the storage life can be several years (Maas-van Berkel *et al.* 2004, 60).

A final form of long-term fish preservation is keeping the caught fish alive in a pond or similar water body nearby, until they are further processed and consumed.

Birds
Preserving bird meat for longer periods of time can be achieved by similar techniques as discussed for fish, such as by salting, smoking, and drying. When properly dried, meat can be kept for months (Maas-van Berkel *et al.* 2004, 43). This means that with the availability of appropriate techniques, bird meat can even be preserved in summer in order to prevent possible food shortages in winter. Alternatively, birds could have been kept alive at the settlement until needed for further processing, for example by clipping their wings; these birds are technically not domesticated, but can still be considered as a form of poultry.

Mammals
Preserving game meat for a longer period of time can be performed similarly to the other animal groups mentioned above. Smoked thin strips of meat will, depending on the duration and temperature of the smoking process, preserve for 1-4 weeks (United States 2009, 97). When this process is combined with subsequent drying, game meat will also keep for several months (Maas-van Berkel *et al.* 2004, 53). Other methods of preservation include freezing and salting.

Indications for processing based on bone material

Fish
Fish bones from an archaeological assemblage can display traces of processing procedures. Chop and cut marks are sometimes identifiable on bones, which can give an indication for short-term processing, such as filleting. Burning or charring of bones are also usually considered to be indications for fish consumption. Unfortunately however, in most assemblages, bones showing burn or cut marks are rare, which is related to the fact that these particular marks increase the susceptibility of bones to taphonomical processes in comparison with bones in an undamaged state.

Birds
Marks on bird bones can also indicate slaughter and subsequent processing activities. Cut and chop marks can be visible on bones as well as burning or charring (Serjeantson 2009, Ch. 6). Besides showing marks, the underrepresentation of certain bone elements present in an assemblage is sometimes considered an indication for slaughter practices (Serjeantson 2009, Ch. 6). However, identification to the species level is difficult for certain types of bird bone (*e.g.* wing bones or vertebrae), possibly creating a bias in bone ratios and thus in subsequent interpretation for consumption.

Mammals
Marks that indicate slaughter of mammals also include cut and chop marks on bones. Indications of subsequent processing for consumption purposes include burning and charring of bones. Furthermore, the underrepresentation of certain bones is sometimes also seen as an indication for slaughter and consumption practices, although again, the possible identification problems and resulting biases mentioned in the previous section should be kept in mind.

4.3.4 Storage and long-distance travelling

The final two aspects related to hunting which are discussed in this section are assumed to be optional activities, since they are not essential for the immediate capture and consumption of animals. However, it must be noted that the term optional is not necessarily related to the relatively importance of these activities for subsistence.

Storage
Fish or meat can be stored for long periods of time, depending on the preservation method applied and the existing storage conditions. Dry storage locations require good ventilation, relatively constant temperature, and low humidity, and are preferably elevated from the ground, also to prevent accessibility by pests (FAO 1990). Dried fish or meat could have been stored at similar locations to other

food stuffs requiring dry storage conditions, such as grain (cf. Chapter 6, section 6.4.4).

Long-distance travel
Long-distance travel for hunting could theoretically have occurred, although it is not assumed that this happened in a farming community (cf. Chapter 3). Appropriate hunting grounds may not be available in the immediate surroundings of the settlements (cf. Kent 1989), and this would mean that people would have to travel further away. Time spent on other activities would have to compensate for this phenomenon accordingly. However, long-distance travel is hard to establish, since the presence of non-local animal species might also be the result of trade with hunters from elsewhere. At the very least, however, such observations can provide direct or indirect indications of the interactions between people and their (further) surroundings.

4.3.5 Summary and additional main components

The analysis of the activities related to hunting with the use of multiple disciplines has yielded several interesting notions on the possibilities and role of hunting in farming communities in the Bronze Age. Hunting in general seems to remain an integral subsistence strategy for all researched small-scale farming communities. Preparatory stages for hunting, mainly the locating of appropriate hunting locations, are very important steps in the hunting process. Specific knowledge of the environment, seasonality, and animal behaviour needs to be extensive in order to prepare for the capture of each animal species. The actual type of strategy employed by the hunter also depends on several factors, and can be more active or more passive depending on the time available for hunting, the particular preferences and (seasonal) presence of animals, and the material and techniques available to the hunter to create tools and equipment. Hunting tools and equipment dating to the Bronze Age include fish traps, fish weirs, a bow, arrowheads, and a wooden tread trap, all indicate that hunting still occurred during this time period, both in an active and passive manner. The actual extent of available hunting tools and equipment in the Bronze Age will have been even larger: taphonomical processes will have severely reduced the visibility of hunting gear such as nets and snares, which are expected to have been widely employed for the capture of many different animals. Besides the direct indications for hunting based on the actual presence of hunting gear, specific marks on archaeological bone material can provide information on the hunting technique applied and the seasonality of hunting. Young animal bones or the presence of specific marks on bones can shed light on certain hunting practices such as skinning or spearing. Other marks on bones, such as cut, chop or burn marks, can give insight into how animals were processed after capture for short-term use (*e.g.* consumption). Long-term processing, or preserving wild animal meat until further use, may include techniques such as (smoke-)drying, salting, fermentation, or keeping captured animals alive at the settlement. Storage of such preserved meat and fish requires well-ventilated, elevated locations with relatively constant temperature and humidity. The presence of non-local animals might, finally, reveal indications for the interactions between farmers and people and locations further away from the settlement.

All researched stages of hunting have thus emphasized the elaborate knowledge, skill, and time investment required for hunting and, therefore, the practice of hunting as a whole should not be underestimated. Also, the visibility of some of the tools and practices of hunting is probably very low and might be missed when dealing with an archaeological assemblage.

Finally, based on the ethnographical examples by Murdock (1981) and Kent (1989), an additional main component related to the role of hunting in subsistence was identified. This main component is added to the main components of the current model, and is challenged in section 4.5:

(5) Hunting did not aid Bronze Age subsistence in terms of consumption, but may have been practiced for other reasons which were equally important.

4.4 WEST FRISIAN DATA ANALYSIS

In this section, the data of West Frisia is analysed based on the same basic aspects of hunting identified in section 4.2 and 4.3, including preparation, hunting, processing, and storage and long-distance travelling. Each aspect is analysed separately below for each of the animal groups through a careful examination of the sources of evidence present for hunting in the West Frisian archaeological assemblage. The investigation of fishing, fowling, and hunting game will show to what extent each of these forms of hunting was still practiced in the Bronze Age. In this investigation, the absence of evidence for certain activities is not directly linked to the actual absence of these activities. First, it is thoroughly evaluated whether factors such as taphonomy or archaeological methodology may have affected the assemblage to result in this absence. When the potential effect of these processes is clear, it is obvious that past human practice cannot be connected directly to only what is uncovered at archaeological excavations. By including several disciplines in the analysis of practice in this chapter, other indications for hunting are identified, which are missed by applying only single proxy approaches such as excavation data. Thus, a more detailed view of past practices becomes available.

This, and other aspects of (the analysis of) hunting are discussed in section 4.4.5.4 after the separate analyses of hunting fish, bird and game.

4.4.1 Fish

Fish remains have been uncovered at six locations in West Frisia. These sites can roughly be divided into western sites and eastern sites (cf. Chapter 2). The western sites include Schagen and Hoogwoud, whereas the eastern sites comprise Medemblik, Westwoud, Enkhuizen, and Bovenkarspel (*e.g.* Figure 4.1).

Preparation: location, seasonality, and bait

Location

The locations selected for fishing were analysed based on the water type preferences of the uncovered fish species on each of the sites of West Frisia, as previously presented in Chapter 2 (Figure 2.9, Figure 2.11, and Figure 2.14). The water types preferred by the fish species included stagnant to slow flowing water, open water, fast-flowing water (river), a connection to the sea, and open sea. A preference for stagnant to slow flowing water was most prevalent at all the eastern sites of West Frisia, followed by open water at Enkhuizen and Bovenkarspel, specifically (*e.g.* Figure 2.9). Other habitat preferences of fish found at the eastern sites include a connection to the sea, and, although scarce, for fast-flowing water. This variety of habitat type preferences from the fish present at the eastern sites indicates that people were fishing at various locations in the surroundings of the settlement. In the western part of West Frisia, at Schagen and Hoogwoud, most species display a preference for a connection to the sea or the open sea. Other water type preferences of fish from western West Frisian sites include stagnant to slow-flowing water, open water, and fast-flowing water. Although the ratios of the preferences for certain habitats of fish in western West Frisia differ from the east, also here, the diversity of exploited fishing locations is evident.

Seasonality

The investigation of the seasonality of fishing is primarily based on the periods of the year in which fish are readily available, such as during spawning and migration. During these periods, large fish, such as pike, perch, bream, and eel, can be caught with higher success rates, because they swim close to the banks to spawn or are available in abundance due to mass migration. The results of the seasonality analysis, which include fish from the entire Bronze Age, are summarized in Table 4.4. However, due to the difference in habitat types reflected in fish as well as the difference in time period of the sites, the eastern and western sites are discussed separately.

At the sites in the western part of West Frisia, Hoogwoud and Schagen, the months of April, May, August, and September are represented by the highest frequencies of fish displaying seasonal behaviour. In the first two months, fish could be caught during spawning and/or migration, whereas in the latter two months, solely the period of migration could be exploited. Besides these two periods, another period of the year can be employed for fishing near the coast. During summer, deep-sea

On the right: Table 4.4. Schematic representation of the seasonal behaviour of the fish found at each site. Different groups are denoted by codes based on the availability of several fish species throughout the year. Data used derives from Marine Fish Map 2016 and Vissengids 2016.

Bovenkarspel		January	February	March	April	May	June	July	August	September	October	November	December	Code
Taxa	English name													
Blicca bjoerkna	Silver Bream													
Tinca tinca	Tench													
Abramis brama	Bream													
Alburnus alburnus	Bleak													
Rutilus rutilus	Roach													1
Pungitius pungitius	10-spined Stickleback													
Leuciscus idus	Ide													
Perca fluviatilis	Perch													
Gymnocephalus cernuus	Ruffe													
Esox lucius	Pike													
Siluris glanis	Catfish													2
Gasterosteus aculeatus	3-spined Stickleback	(-)										(-)	(-)	
*Anguilla anguilla**	Eel	*	*	*										3

Enkhuizen		January	February	March	April	May	June	July	August	September	October	November	December	Code
Taxa	English name													
Blicca bjoerkna	Silver Bream													
Scardinius erythrophthalmus	Common Rudd													
Rutilus rutilus	Roach													1
Abramis brama	Bream													
Alburnus alburnus	Bleak													
Perca fluviatilis	Perch													
Esox lucius	Pike													
Siluris glanis	Catfish													2
*Anguilla anguilla**	Eel	*	*	*										3
*Eutrigla gurnardus**	Grey Gurnard	-	-	-	-	-	-	-	-	-	-	-	-	8

Westwoud		January	February	March	April	May	June	July	August	September	October	November	December	Code
Taxa	English name													
Abramis brama	Bream													
Pungitius pungitius	10-spined Stickleback													1
Perca fluviatilis	Perch													
Esox lucius	Pike													
Gasterosteus aculeatus	3-spined Stickleback	(-)										(-)	(-)	2
*Anguilla anguilla**	Eel	*	*	*										3

Medemblik		January	February	March	April	May	June	July	August	September	October	November	December	Code
Taxa	English name													
Blicca bjoerkna	Silver Bream													
Scardinius erythrophthalmus	Common Rudd													
Rutilus rutilus	Roach													1
Abramis brama	Bream													
Perca fluviatilis	Perch													
Esox lucius	Pike													
*Anguilla anguilla**	Eel	*	*	*										3
Salmonidae indet.	Salmon	-	-	-	-	-								5

Hoogwoud		January	February	March	April	May	June	July	August	September	October	November	December	Code
Taxa	English name													
Abramis brama	Bream													1
Esox lucius	Pike													
*Platichthys flesus**	Flounder		*	*	*	*								3
*Anguilla anguilla**	Eel	*	*	*										
*Liza ramada**	Thinlip Mullet	-	-								-	-	-	6
*Dicentrarchus labrax**	Sea Bass	-	-	-	-	-	-	-	-	-	-	-	-	
*Gadus morhua**	Atlantic Cod	-	-	-	-	-	-	-	-	-	-	-	-	7
*Pleuronectus platessa**	Plaice	-	-	-	-	-	-	-	-	-	-	-	-	
*Raja clavata**	Thornback Ray	-	-	-	-	-	-	-	-	-	-	-	-	

Schagen		January	February	March	April	May	June	July	August	September	October	November	December	Code
Taxa	English name													
Perca fluviatilis	Perch													1
Esox lucius	Pike													
Gasterosteus aculeatus	3-spined Stickleback	(-)										(-)	(-)	2
*Anguilla anguilla**	Eel	*	*	*										3
Acipenser sturio	Sturgeon	-	-	-							-	-	-	
Alosa alosa	Allis Shad	-	-								-	-	-	4
Alosa fallax	Twaite Shad	-	-	-							-	-	-	
Osmerus eperlanus	Smelt	-						-	-	-	-	-	-	
Coregonus sp	Whitefishes		-	-	-	-	-	-						5
Salmonidae indet.	Salmon-family	-	-	-	-	-								
*Liza aurata**	Golden Grey Mullet	-	-								-	-	-	6
*Liza ramada**	Thinlip Mullet	-	-								-	-	-	
*Clupea harengus**	Atlantic Herring	-	-	-	-	-	-	-	-	-	-	-	-	
*Dasyatis pastinaca**	Stingray	-	-	-	-	-	-	-	-	-	-	-	-	
*Dicentrarchus labrax**	Sea Bass	-	-	-	-	-	-	-	-	-	-	-	-	
*Gadus morhua**	Atlantic Cod	-	-	-	-	-	-	-	-	-	-	-	-	7
*Platichthys flesus**	Flounder	-	-	-	-	-	-	-	-	-	-	-	-	
*Raja clavata**	Thornback ray	-	-	-	-	-	-	-	-	-	-	-	-	
*Solea solea**	Sole	-	-	-	-	-	-	-	-	-	-	-	-	
*Sprattus sprattus**	Sprat	-	-	-	-	-	-	-	-	-	-	-	-	

behaviour
- spawning
- migration

food consumption
- carnivore

* spawning in deep sea
\- not in/near fresh water

code:	presence:
1	available all year + during spawning
2	available all year + during spawning and migration
3	available all year + during migration
4	available during spawning and migration (summer)
5	available during spawning and migration (winter)
6	available during summer and migration
7	available during summer
8	unavailable near the coast

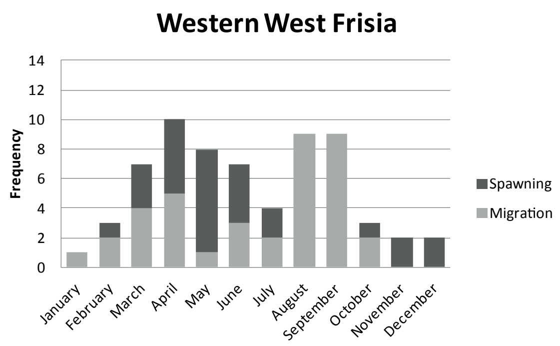


Figure 4.4. Seasonality summary of fish from western West Frisia.

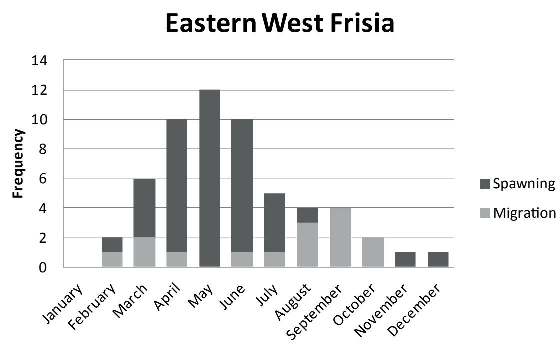


Figure 4.5. Seasonality summary of fish from eastern West Frisia.

fish, such as herring, Atlantic cod (*Gadus morhua*), and sea bass (*Dicentrarchus labrax*), appear closer to the shore (Beerenhout 2005, 44; Zeiler *et al.* 2007: 12, 16), making them more available for capture. Overall, fishing in western West Frisia can occur during the entire year, but during some periods there seems to be a higher abundance and availability of fish than during other periods.

Most of the fish deriving from the eastern sites include freshwater fish that are available all year (Table 4.4, category 1-3). In addition, fish such as catfish (*Siluris glanis*) and eel could be caught during migration, as well as salmon. One species that stands out in the general pattern of the eastern West Frisian sites however, is grey gurnard (*Eutrigla gurnardus*). Grey gurnard normally lives on the seabed, and rarely approaches the water surface, making it a very difficult fish to catch. The combination of its find location (Enkhuizen) and habitat preferences (open sea only) was already shown to be incompatible with the other results found in Enkhuizen and surrounding sites (Chapter 2, 2.4.1.2). It seems that based on its low catching probability, here too, grey gurnard can be considered an outlier.

When the east and west are compared (Figure 4.10, 4.11), it becomes clear that the exploitation of the migratory period of fish is more pronounced in the west, whereas in the east, the focus seems to lie more on the spawning season. Both regions show that fishing could have been practiced during multiple periods of the year, with a broad focus on fishing from spring to autumn in the west, and a focus on spring and early summer in the east.

Bait

Finally, the potential for using bait can be discerned in Table 4.4. Almost half of all the fish species found at every site of eastern West Frisia is predatory. These fish would therefore respond well to the use of animal bait in for example fykes. In Hoogwoud and Schagen, almost all fish are hunters. Therefore, animal bait could have been used to attract and catch these fish. However, it must be kept in mind that some migratory fish do not feed during migration, so alternative hunting techniques must have been employed for these fish (section 4.3.1).

Fishing: tools, equipment, and strategy

Tools and equipment

Archaeological indications for fishing can be direct and indirect. Direct indications for fishing can be the presence of fishing gear on excavated sites. For West Frisia, such a direct indication is represented by the presence of a fyke trap found at Enkhuizen (Roessingh & Lohof 2011, 241-9) (Figure 4.6).

The fyke, measuring around 130 cm, was constructed from wooden twigs bound together by rope. It was presumably used to capture eel, as demonstrated by the dimensions of the original opening of the fyke. Although this fyke is only one direct indication for fishing in the entire area of West Frisia, the craftsmanship reflected in this fyke shows that people were very well able to construct these types of fishing gear. The knowledge and skill required to construct such fishing gear must clearly still have been imbedded in society, no doubt also allowing for the construction of fishing weirs, nets, and baskets. No such examples have been uncovered in West Frisia, but this may be due to the absence of excavations at locations where such gear may be found. It must therefore be a matter of time and context before more of these examples of fishing equipment are found in West Frisia.

Other methods for capturing fish can be reconstructed indirectly via the specific behavioural aspects of the fish species found. The fish species which are most frequently present at the eastern West Frisian sites are eel, pike (*Esox lucius*), perch (*Perca fluviatilis*), bream (*Abramis brama*), and cyprinids (indeterminable) (Table 4.4). Cyprinids can include the species bream, silver bream (*Blicca bjoerkna*), roach (*Rutilus rutilus*), bleak (*Alburnus alburnus*), common rudd (*Scardinius erythropthalmus*), ruffe (*Gymnocephalus cernuus*), ide (*Leusiscus idus*), and tench (*Tinca tinca*). Most of these species can be caught passively using fykes, weirs or nets. Pike, perch, and eel, being hunters, can also be caught actively using baited hooked lines. In addition, pike and perch can be speared or hit in spawning season or caught with a throwing net. The technique used for each species will have depended mostly on the time available to the fisherman and the selectiveness with which he wants to catch a certain size or species of fish (see below).

In the western sites of West Frisia, Schagen and Hoogwoud, fishing is focused more on a saltwater environment. In both sites, the majority of species found belong to the flatfish-family, which includes, amongst others, flounder (*Platichthys flesus*), plaice (*Pleuronectus platessa*), and sole (*Solea solea*). These fish can be relatively easily caught by spearing when they travel to warmer, shallower coastal waters and neighbouring estuaries during summer. Although fewer in number, true saltwater fish have also been caught in western West Frisia, which most likely also occurred during the summer months when these fish, especially the juveniles, seek warmer, shallower coastal waters. For fishing, the location of Schagen seems to have been optimal, because it was situated at the transitional stage between sea and inland waters and could benefit from fish species from both environments. By using (marine) weirs, (marine) fykes, nets, and spears, many of the species found could have been caught during the migration season.

Figure 4.6. Fyke trap from the Enkhuizen Kadijken excavation (From: Roessingh & Lohof 2011, 245, fig. 11.8).

Another rare indirect indication for a specific catching technique was found on a fish bone from Hoogwoud. Here, a cut mark was found on a vertebra of a plaice (Beerenhout 2011). The cut mark was situated on the bone at such an angle that the only plausible cause would be from piercing it from above. A fishing technique which would match this spearing practice is related to capturing flat-fish. It involves wading through shallow water during ebb tide until a flatfish is located by standing on it. The fish is then kept down with the feet and pierced from above. This catching technique, also known as “bottrappen” or “botprikken” in Dutch, was practiced until very recently in The Netherlands (Brandt 1984) (Figure 4.7), and could have been practiced in Bronze Age West Frisia as well.

Strategy

The size of the fish captured can furthermore provide information on whether the fishing strategy employed was active or passive. It seems that at Hoogwoud and Schagen, different practices for capturing saltwater fish were applied, albeit in similar environments. The fish from Hoogwoud were all of rather limited size, indicating that these juvenile fish most likely derived from the nearby estuary, and could have been caught in fykes, weirs, or nets. In Schagen, a broad range of fish species was exploited, including very large specimens such as an Atlantic cod measuring over 70 cm (Zeiler *et al.* 2007). Saltwater fish of these dimensions must have been caught off-shore using boats. So, both active and passive fishing could have been practiced in western West Frisia.

In the east of West Frisia, two sites, Medemblik and Enkhuizen, also show variation in fishing practices. In Medemblik, sieving mesh sizes of 1 mm and 4 mm were used, whereas in Enkhuizen, only 4 mm

Figure 4.7. Examples of "bottrappen"/"botprikken", or the trapping and spearing of flatfish at low tide (Botvisserij Waddengebied 2016 and Vanger 2016).

sieves were used (Table 4.1; Figure 4.8, step 1). It was therefore expected that both small and large fish remains would be found in Medemblik, but that in Enkhuizen only large fish remains would be recovered (Figure 4.8, step 2).

As predicted, the excavation at Medemblik yielded a variation in fish species size. However, no large eel remains were found, indicating the capture of juvenile fish only. These small eel could have been caught using baited fykes (passively) or with (eel) spears (actively).

In Enkhuizen, large fish were found, including pike and catfish, that were most likely caught actively during the spawning season. The perch from Enkhuizen also seems to have been relatively large, indicating that it was probably selectively caught using bait. The bulk of the eel remains found in Enkhuizen were also large and were therefore remains of adult fish. These would have been caught during migration (cf. section 4.3.2).

In summary, large and small fish species but no large eel were recovered from Medemblik. In contrast, primarily large fish species but no small eel were recovered in Enkhuizen (Figure 4.8, step 3). In Enkhuizen, small eel must have been caught as well however, evidenced by the ability to capture eel with the fyke trap uncovered at this site (Figure 4.6). The absence of smaller eel in Enkhuizen can therefore be explained by recent sieving practices, for which only a wide mesh size sieve was employed (Figure 4.8, step 4, right). In Medemblik, no large eel were found, although these were expected. This absence can be interpreted as a genuine difference as a result of past practices (Figure 4.8, step 4, left). It seems that people in Medemblik fished for eel in a different manner than in Enkhuizen and might, in general, have employed different and seemingly more passive fishing techniques. The average size of fish caught at both sites does not change from the Middle to the Late Bronze Age and neither does maximum size, indicating that the fishing practices differed locally and that this does not appear to change over time.

It is clear that pre- and post-depositional taphonomical processes can severely impact bone assemblages and their interpretation. Therefore, future research, both in the field and in the lab, should be adapted to equalize the data and facilitate interpretation as much as possible (see Chapter 11).

Processing for short- and long-term use

Fish processing activities and fish consumption could solely be discerned based on the different marks found on bone material. From the western sites, information on fish processing and consumption was present only from Hoogwoud. Here, two bones of plaice showed cut marks. One of the marks was on a bone that is situated behind the gills (*cleithrum*), the other on a vertebra near the tail. The mark near the gill was probably made when beheading or filleting a fish, whereas the mark on the vertebra was most likely the result of piercing the flatfish during capture, as was mentioned in the previous section. In addition, a limited number of fish bones from Hoogwoud, again mainly deriving from flatfish, was burned.

The sites in the west of West Frisia were located near saltwater. If Bronze Age West Frisians were able to extract salt, the entire array of preservation techniques would have been available to them. However, no salt-works from the Bronze Age are (yet) known. The only manner in which salt may have been obtained therefore, was through long-distance salt trade with for example the Hallstatt area in Switzerland (Kowarik & Reschreiter 2010), although no concrete evidence for this practice was observed. If salt was unavailable to West Frisian people in the Bronze Age, the drying of flatfish and the smoke-drying of fatty fish would still have been possible conservation methods.

In the eastern sites, most of the information on processing and consumption comes from Medemblik and Enkhuizen; no specific information on marks or burning of bones was available from Westwoud and Bovenkarspel. At Medemblik, two cut marks were found on the tail vertebrae of a cyprinid and a pike, which indicate the removal of tails. In addition to the cut mark, the vertebra of the cyprinid was burned, which indicates consumption. Medemblik also yielded the largest amount of burned bones (Beerenhout 2010, 111) from fish including eel, various cyprinids, pike, perch, and even a salmon/trout, which all indicate human use of fish near fire, and therefore consumption. The fish remains from Enkhuizen showed no cut marks, but low percentages of fish bones were burned.

The sites of eastern West Frisia did not have direct access to saltwater in the surroundings, nor were there indications for salt trade found. The most plausible preservation techniques therefore, if they were applied or required, would have been drying and smoke-drying.

From many sites in West Frisia there is evidence for fish processing and consumption, even though bones which could provide such indications are often lost to taphonomy due to their bad preservation characteristics. This means that the actual number of bones resulting from processing and consumption activities would have been higher originally, and that fishing as a practice should not be underestimated. However, based on the available evidence, it remains unclear whether the long-term preservation of fish played a significant role in West Frisian societies; when weather conditions were favourable enough for a longer period of time, drying could definitely have been a practiced preservation technique.

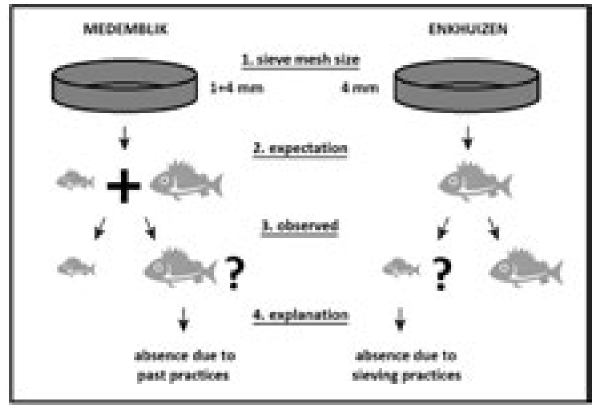


Figure 4.8. Overview of the expectations of fish size finds in Enkhuizen and Medemblik, based on sieving practices employed. Step 4 explains the specific type of absence of certain sized eel in both of the assemblages by linking this absence to either recent sieving or past human practices.

Storage and long-distance travel

Storage locations are unknown in West Frisia in general, so the storage of fish is no exception. However, based on the fact that storage locations need to be well-ventilated and elevated in order to preserve dried foods well, storage in the attic of buildings seems the most plausible location.

Based on the fish species found in West Frisia, there are no clear indications for long-distance travel of people. Rather, the ratios of (the preferences of) the different fish species found at each site seem to indicate very local fishing practices. This observations was further supported by the difference in fishing strategies applied at different sites in similar environments, such as for example between Enkhuizen and Medemblik.

Although evidence for long-distance travel, or trade of non-local species is not clear from the bone assemblage, the recent find of a paddle at Westwoud (Ons West-Friesland 2015; Figure 4.9) does indicate that West Frisian people would have had the ability to travel to other locations by boat for fishing. This paddle, which has a relatively long blade, is often used for travel at sea (pers. comm. R. van de Noort), since it can withstand high waves much more efficiently than a short blade. The additional presence of adult Atlantic cod at the Early Bronze Age site Schagen,

Figure 4.9. Wooden paddle uncovered at Westwoud (Ons West-Friesland 2015).

which can only be caught in the open sea with the use of a boat, underlines the potential importance of boats for sea fishing and sea travel in West Frisia.

4.4.2 Birds

Bird remains have been uncovered at five locations in West Frisia, including again the western sites Schagen and Hoogwoud, and the eastern sites Medemblik, Enkhuizen, and Bovenkarspel. Other reasons for the capture of birds are discussed in section 4.4.5.4.

Preparation: location, seasonality, and bait

Location

The habitat preferences of birds, as analysed in Chapter 2 (Figure 2.16) provided indications for the locations visited for fowling. The habitats included mostly wetlands, followed by grassland, shrub land, trees, and, in Schagen, also (sea) coastal and open water. Although at first glance it may seem that people practiced fowling at various locations, it must be kept in mind that birds can travel long distances through the air on a daily basis, visiting multiple habitats. Furthermore, the presence of only aquatic birds at Hoogwoud does not signify that just wetlands were present to be exploited around the settlement, but rather that specific human selection will have played a role (section 4.4.5). Therefore, the interpretation of fowling locations based on bird species is difficult. Local birds, such as for example woodcock, which do not travel long distances, can be indicators for local areas visited for fowling, in this case a forested area. Overall, based on a combination of the landscape reconstruction (Chapter 2) and the uncovered bird species (Table 4.5), it can be assumed that a variety of habitats was exploited for fowling, possibly with a tendency towards wetlands in the landscape.

Seasonality

Birds can be excellent seasonal indicators due to their long-distance migration behaviour. Similar to analysis of fish, the seasonal periods in which birds are assumed to have been most available or accessible to people were summarized in Table 4.5. The periods indicated in the table, include breeding and migration periods, and, for birds that undergo a flightless moult, the moulting period. Also shown in the table are species which breed and moult simultaneously. Some birds could only be identified to genus level, and in that case, the expected species within that genus (*i.e.* two in the cases discussed here) were included in Table 4.5, so that potential differences in catching methods for these species could be determined. Furthermore, groups were made based on the time of year a bird is available for capture, also based on migratory behaviour. Finally, birds of prey were highlighted in order to identify possible appropriate types of bait.

Table 4.5 shows that on all sites researched, about half the species found are migratory, indicating fowling during specific times of the year (*i.e.* spring and autumn). Other periods of capture most likely exploited were the breeding and moulting season, which can occur from February to November, depending on the species. So, including birds available for capture during winter, overall, birds could have been caught year-round (Table 4.5, category 1-3).

The western sites of West Frisia, especially Schagen, show a different picture from the eastern sites. Although many birds found in Schagen can be caught throughout the year, more than half of the

Table 4.5. Schematic representation of the seasonal behaviour of the birds found at each site.

Different groups are denoted by codes based on the availability of several bird species throughout the year. Data used derives from Europese Vogelgids Online 2012 and Nederlands Soortenregister 2015. Partial migrant denotes that birds do not migrate annually, but only when necessary due to very harsh weather conditions in winter.

species are migratory or partially migratory, which means they are present for a limited time only (*e.g.* only during summer or winter or resting periods during migration).

In eastern West Frisia, the sites yielded a variety of bird groups. Almost all birds could have been caught during summer. All sites seem to furthermore possess one or more species of bird which are only here during migration.
When the east and west are compared (Figure 4.10, Figure 4.11), it is clear that differences exist in the exploitation of birds. Overall, the periods in which birds can be caught at the western sites are more compressed into fewer months, whereas in the east, all three types of specific behaviour of the birds captured (*i.e.* breeding, migration, and moulting) seem to occur, and also during longer periods.

Still, both regions indicate that fowling could have been practiced at multiple times during the year. Migration seasons could be exploited in early spring and late autumn, whereas breeding and moulting seasons could be the focus for capturing birds in

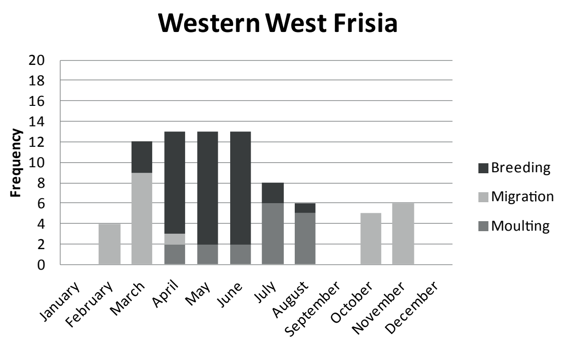


Figure 4.10. Seasonality summary of birds from western West Frisia.

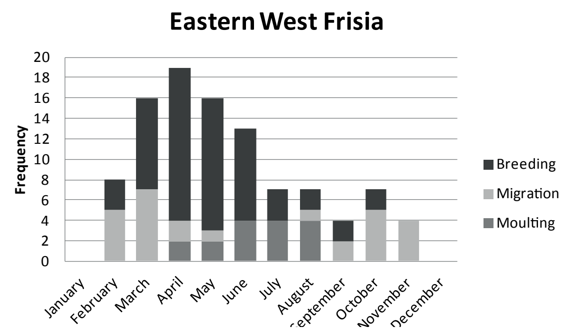


Figure 4.11. Seasonality summary of birds from eastern West Frisia.

between these periods. Winter fowling could have been an option as well, although no specific bird behaviour is linked to this period of the year. The absence of foliage during this time does however increases their visibility and could have facilitated capture.

Indirect indications for the seasonality of fowling, based on bird bones, were also present in West Frisia, although they are scarce. Egg-laying bones were absent from the assemblages, but in Medemblik, a bone of a young bird was found in a ditch, signifying capture in summer. Even though the young bird could not be identified to species level, it was observed that the bird possessed long legs. This could include birds such as cranes, storks, egrets, etc. (pers. comm. M. Groot), which are all possible targets for fowling in summer.

Bait

The two identified large birds of prey, Northern goshawk (*Accipiter gentilis*) and eagle owl (*Bubo bubo*), both hunt small mammals and birds on sight from their perches in trees, but goshawk can also fly along forest edges or waterways in the search of prey (Bijlsma 1993). This means that these birds may be captured with bait at these locations, although during a different times of the day (*i.e.* goshawk hunts during the day, eagle owl is active during dusk).

Fowling: tools, equipment, and strategy

Tools and equipment

Potential archaeological evidence for using a bow and arrow was uncovered in West Frisia in the form of flint arrow heads (Figure 4.12), which could have been used for fowling. Although fowling with bow and arrow will not have been the only form of hunting present in West Frisia, the absence of other hunting tools and equipment may very well be related to the transient nature of such fowling gear, which includes mostly nets, snares, and traps. Nonetheless, witness the fishing fyke present in Enkhuizen (section 4.4.1), people were familiar with the use of rope (also see Chapter 7, section 7.4.6.4), so the construction of nets and snares should have been no problem either. The most frequently found bird species at the sites of West Frisia are mallard (*Anas platyrhynchos*), common teal/garganey (), widgeon (*Anas penelope*), greylag goose (*Anser anser*), eagle owl (*Bubo bubo*), whooper swan (*Cygnus cygnus*), water rail (*Rallus aquaticus*), Eurasian woodcock (*Scolopax rusticola*), and thrushes (Table 4.5). Most of these species are anatids (*i.e.* ducks, geese), and these can be caught, as said before, during moulting season using the hands, nets, clubs, or dogs, possibly in combination with lures or decoys. Snares, and other traps are also a possibility, when passive fowling is practiced. Widgeon is an exception, since it only present during the winter period and cannot be caught during moulting season. Outside moulting season, anatids can be caught using snares and traps at fields, or by other methods of active fowling, such as nets, spears, arrows, etc.

Two birds which require some more attention include loon (*Gavia arctica/stellata*)(found at Schagen) and crane (*Grus grus*) (found at Bovenkarspel). The loon is a bird that hunts at the open sea and seeks the refuge of coastal waters or inland lakes in the breeding season. It is a difficult bird to catch but

Figure 4.12. West Frisian flint arrowheads.

possible techniques include using nets or practicing night fowling (Kenow 2009). Alternatively, it could be caught as a by-catch when using fish fykes (Studer 1992). Crane is a large bird that is only present in the Netherlands when it is resting during migration further north or south. It uses wetlands for shelter and feeding, and it forages on (agricultural) fields in the autumn. Apart from both the swan species, crane forms the largest bird found in West Frisia, reaching up to 120 cm in height. Catching one of these birds would not have been a simple task, although their size would allow for hunting with bow and arrow.

Another interesting aspect of the birds in West Frisia is that almost all sites in the east of West Frisia (Enkhuizen, Medemblik, Bovenkarspel), no matter how few the finds, have remains of birds of prey, both of which might have been caught by employing a lure in combination with a net. Eurasian woodcock, a resident local bird which inhabits the undergrowth of forests, is very hard to locate, so snares might have been used to catch such a bird, or perhaps it was hunted with the aid of dogs.

Three birds so far not mentioned are dunlin (*Calidris alpina*), and ruff (*Philomachus pugnax*). These birds all forage near water and could also be caught using nets or traps. Quail (*Coturnix coturnix*), rook (*Corvus frugilegus*) and carrion crow (*Corvus corone*) finally, might also have been caught using again nets or traps, but are located more in grassland and shrub land environments.

Strategy
A combination of active and passive hunting strategies will have existed in West Frisia. Although no clear indications for each hunting strategy could be obtained based on the birds themselves, the flint arrow heads uncovered at many sites in West Frisia at least provide indications for the occurrence of active hunting practices. Passive hunting strategies were not represented in the archaeological record in general, but are expected to have been practiced nonetheless, especially considering their combinability with farming practices. Passive hunting strategies usually employ nets, snares, and traps made from organic materials, so their absence is most likely due to taphonomical processes.

Processing

In the West Frisian bird assemblage, no apparent marks were found on bird bones. Although this may be interpreted as an absence of evidence for processing and consumption, the range of bird species present within each settlement makes it very implausible that birds became part of the archaeological assemblage of their own accord. An alternative explanation for the absence of marks on bird bones can be related to the hollow and fragile nature of these bones. These characteristics make them very susceptible to degradation via taphonomical processes. When these already fragile bones are additionally affected by cut or burn marks, their chance at preservation becomes even more reduced. Considering both these bird bone characteristics and the non-specific, wide-mesh sieving practices applied during many excavations, it is surprising that bird bones are uncovered at all.
Even though the bones themselves could not provide information on processing and consumption, potential processing practices performed in West Frisia could still be postulated. Since the Bronze Age climate was largely comparable to the present climate (Zagwijn 1991), low temperatures would have been unavailable in West Frisia during summer. When birds were indeed caught for consumption purposes, it is likely that in summer birds were processed and eaten within hours after capture (Maas-van Berkel *et al.* 2004, 22). In winter time however, temperatures might have constantly been sufficiently low to preserve the meat for longer periods of time. This means that during winter, an additional preservation method was available. Bird meat could also have been preserved using smoking and drying methods, but whether salt for salting procedures was available to the West Frisian farmers remains unknown.

Alternatively, birds could have been made flightless after capture and kept as a form of poultry within the settlement.

Storage and long-distance travel

Storage of processed bird meat could, comparable to processed fish, have been stored on attics within buildings. Due to the highly mobile nature of most birds, it is impossible to assess whether long-distance travel was performed by Bronze Age people; no outliers of bird habitats were uncovered to confirm or contradict this aspect of fowling.

4.4.3 Mammals

Mammal remains have been uncovered at nine locations in West Frisia. Small mammal remains were found at Schagen, Hoogwoud, Westwoud, Hoogkarspel, Enkhuizen, and Bovenkarspel. Large mammal remains were uncovered at Schagen, Hoogwoud, Medemblik, Zwaagdijk, Andijk, Hoogkarspel, Enkhuizen, and Bovenkarspel. Schagen and Hoogwoud are again considered to be the western West Frisian sites. Other reasons for the capture of small and large mammals is discussed in section 4.4.5.4.

Preparation: location, seasonality, and bait

Location
Locations for hunting mammals were reconstructed based on the habitat preferences of the animals (Chapter 2, Figure 2.17, 2.18, and 2.19). Habitat types, and therefore hunting locations for all sites include equal preferences for wetlands, grassland, shrub land, presence of trees, and, in the case of Schagen, the coast. Small mammals indicate mostly open areas, whereas large mammals prefer the cover of trees or shrubs; this difference in cover preference is related to the size of the animal. This variety in habitat types indicates that people fully exploited their surroundings, and targeted many different animal species.

Seasonality
The seasonality of game hunting was first analysed by attempting to identify certain periods of the year based on seasonal behaviour of large mammals (Table 4.6), since it is assumed they were the main targets for hunting; small mammals were not researched here. Two types of seasonal behaviour of mammals included in the table consist of mating and raising young. In both periods, animals are busy with procreation and feeding offspring, making them less focused on threats in the surroundings. Another seasonal aspect of mammal behaviour is migration. Migration for the species found in West Frisia is characterized mainly by short periods of relatively short movements (up to 50 km), mostly undertaken by young individuals that are banned from the population when they reach maturity (Twisk *et al.* 2010). The only exceptions to this are harbour seal (*Phoca vitulina*), wild cat (*Felis sylvestris*), and fox, species of which young individuals might travel up to 100 km in search of their own territory (Twisk *et al.* 2010: 291, 299, 315). However, it must be mentioned that for most animals, the distance of travel is related to the environment in which they reside. For example, the distances travelled in search of food in mountainous areas can differ considerably from distances in lowland areas, where there is more food available per square kilometre. It is therefore not assumed that large mammals migrated over large distances, and if migration did occur, the distance travelled would not take them out of West Frisia.

A final type of mammal behaviour is the formation of groups during winter by some species, which was also included in Table 4.6. In contrast with the seasonality tables related to fishing and fowling, no distinction was made between presence or absence of mammals, since all species could have been present in or near West Frisia throughout the year.

Interestingly, Table 4.6 has made clear that most of the seasonal behaviour of mammals is too general to identify specific periods of the year most suitable for hunting purposes, since each period can be favourable for hunting in one way or another. What is also apparent is that most of the mammals found in West Frisia do not exhibit specific seasonal behaviour during July and August; at two sites, Enkhuizen and Medemblik, none of the uncovered animals show specific behaviour during this time. Also interesting to note is that here, Hoogwoud reflects the eastern sites of West Frisia based on its mammal assemblage, whereas for fish and birds, it was more similar to the western site Schagen.

Some additional and more specific seasonal information for hunting was obtained from archaeological bone material. In Zwaagdijk, a bone of a young beaver was uncovered, which indicates capture in summer or autumn. At the same site, the skull of an elk with remains of antlers still attached was found, indicating that it was also caught between summer and autumn (Halici & Buitenhuis 2003, 166). Another skull of an elk was identified in Medemblik, with evidence of shed antlers (Groot 2010a, 94). Since antlers are shed between December and March, after which they regrow (Twisk *et al.* 2010), this indicates capture between winter and early spring. Based on these few examples, it seems that large mammals were at least caught from late summer to early spring, during various seasonal behavioural periods.

Bait

The predatory mammals indicated in Table 4.6 could have been lured with animal bait, such as fox, brown bear, weasel, wild cat, otter (*Lutra lutra*), polecat, and harbour seal. Other mammals could also have reacted to the use of bait, but this will have included the use of vegetative material. Bait in combination with traps or snares could have been effective for both type of mammal.

Game hunting

Tools and equipment

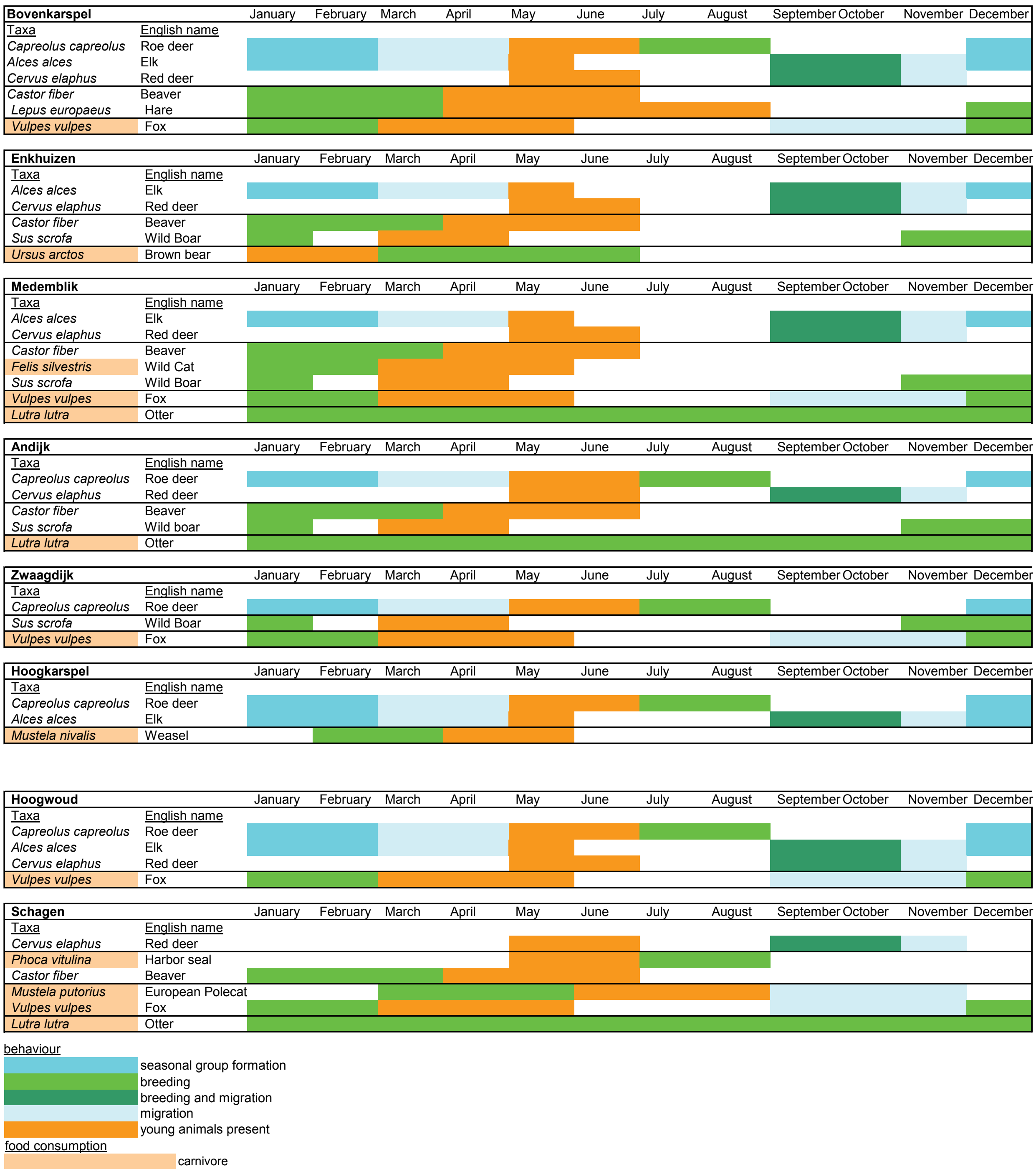
As stated previously (section 4.4.2), direct indications for hunting mammals were uncovered in the form of flint arrowheads at many locations in West Frisia (Figure 4.12). Other weapons besides bow and arrow were not identified, but the inherent characteristics of these types of hunting gear (section 4.3.2) can provide indications for possible causes of this absence.

The two main reasons for the absence of weapons in West Frisia can be related to both the shape and the material of the weapons. Rabbit sticks and spears, although very effective hunting weapons, are basically pointed sticks, which might not be recognised by excavators as weapons. Slings, clubs, and arrow shafts are equally hard to identify. Traps, nets and snares are often used off-site and are only found when excavations occur at those locations. All these types of hunting gear furthermore, are perishable, being constructed out of organic materials. Only under very specific circumstances are these materials preserved. The possible presence of flint arrowheads or sling stones, which are made from inorganic materials and are thus better preserved, may indicate the use of bow and arrow or sling, respectively. Still, the direct visibility of game hunting equipment remains very limited. However, the wide range of mammals species found in West Frisia, as well as the uncovered eel fyke from Enkhuizen (section 4.4.1), does provide indications that other types of gear, which may have been used for hunting mammals, must have originally been present here as well.

Indirect indications for hunting tools and equipment were found based on the uncovered mammal species. First of all, the wide range of mammal species found in West Frisia (Table 4.6; Chapter 2), indicates that people indeed had elaborate knowledge of the wild animals in their surroundings, because no “catchall” method exists to ensure the capture of all these species. This observation alone already indicates that multiple hunting techniques must have been known and applied.

From the large mammals species found, the most frequent are roe deer, beaver, red deer, fox, elk, and wild boar (Table 4.6). Roe deer could have been caught using snares or traps, or by using clubs, when young are encountered. Red deer and beaver can be hunted, apart from the use of bow and arrow, by being chased into traps by dogs or men. Fox might be snared, or captured by dogs. Wild boar respond very well to baiting, and can subsequently be hunted in several different ways, for example by trapping. Elk finally, were (pre)historically hunted in Sweden by using pitfalls (Ericsson 2011). People in West Frisia must have been using at least a combination of snaring and trapping, and either hunting with bow and arrow or using dogs and/or pitfalls to catch the range of species

Table 4.6. Schematic representation of the seasonal behaviour of the large mammals found at each site.



Different groups are denoted by codes based on the availability of several mammal species throughout the year. Data used derives from Twisk, van Diepenbeek and Bekker 2010.

observed. Small mammals finally, when targeted for capture, might have been caught using traps or nets.

Strategy

Similar indications for (the absence of) hunting strategies which were discussed in section 4.4.2, were present for mammals. Based on the animal species uncovered, it can be assumed that both active and passive hunting techniques would have been part of the hunting repertoire of Bronze Age farmers, even though actual traps have not (yet) been found.

Processing

Marks on wild animal bones, indicative of processing and consumption, were found at several sites in West Frisia. In Medemblik for example, marks on the remains of a skull of fox, a scapula of wild boar, and a tibia of beaver were found which all indicate slaughter (Groot, unpubl. results). In Enkhuizen, only the femur of brown bear showed slaughter marks (Roessingh & Lohof 2011, 212). No charred or burnt bones of mammals were found.

Potential processing practices could further be explored based on the characteristics of mammal meat. When large game is killed, it is important to hang the meat at a temperature that does not reach above 7 °C, in order to tenderize the meat (cf. section 4.3.3). Inherently, this means that adequate immediate processing of meat from large mammals is only favourable during certain times of the year. Since it is assumed that the climate in the Bronze Age was largely the same as at present in the Netherlands, the months in which the temperature allowed for hanging of meat include October to April/ May (Klimaatatlas n.d.) or roughly from autumn to spring. This time period is largely concurrent with the observed seasonal indications for game capture based on bone material mentioned above, which occurred from late summer to early spring.

Processing with the aim of preserving the meat for a longer period of time may have included methods such as drying or smoke-drying, or refrigeration during winter months. It remains unknown whether salt for salting procedures was available to the West Frisian farmers, but these other preservation methods would have been adequate to ensure the availability of meat in winter.

Storage and long-distance travel

Possible storage locations for game meat are similar to those mentioned for fish and bird meat. The mammal species uncovered in West Frisia do not allow for a clear interpretation of long-distance travel for hunting. However, it is clear from the varying ratios of habitat preferences of the animals found at each site that people must have hunted relatively locally; each site shows a slight local variation in animal composition, and no clear preferences for the exploitation of a specific habitat type could be observed. The exact distance people travelled for hunting game is not known, but is assumed to lie between five and seven-and-a-half kilometres from the settlement (Chapter 3, section 3.3.5). The presence of large mammals such as brown bear and elk suggest that forest locations were present at relatively close proximity to the settlement. More detailed information on the potential location of these forest with respect to the settlements is further explored by an analysis of the home ranges (*i.e.* living areas) of large mammals found at each site in Chapter 8: Bronze Age farming in West Frisia (Cronau 2016).

4.4.4 Summary

The range of habitats, seasons, and animal species exploited in West Frisia indicates that knowledge and skill of (how to prepare for) hunting were still an integral part of Bronze Age society.

The employed hunting techniques could often not be confirmed directly by the presence of hunting gear, which is most likely due to the poor preservation characteristics of the organic materials of which they are often constructed. Some techniques however, could be indirectly reconstructed based on the uncovered animal species, as well as based on marks on bones. The resulting wide range of hunting techniques required to capture all the animals found in West Frisia also underlines the vast knowledge and skill which must have been present amongst Bronze Age people in order to create hunting tools and equipment. Hunting was mostly practiced locally, which was established for both western and eastern West Frisian sites, although boats may have been employed for particular hunting practices such as fishing. It has furthermore become clear that similar habitats were exploited differently at different sites, and that this remained a constant phenomenon throughout the Bronze Age. In addition, many sites in West Frisia also yielded evidence for wild animal processing and consumption indicating that wild animal meat may have aided Bronze Age subsistence during periods of the year when domestic resources were scarce.

Thus, for every main activity related to hunting, either direct or indirect indications were identified. Hunting therefore seems to have been an imbedded practice in West Frisian farming communities, and its role in subsistence should not be underestimated. Clearly, hunting wild animals was not an occasional occupation, but a careful consideration of environmental exploitation.

Instead of summarizing a list of bones and species present, the analysis of hunting in West Frisia performed here has shown that a detailed comparison between an expectation of practice and the observed data can provide clear evidence of hunting practices, even when the data available for such an analysis is of limited quantity and derives from excavations with differently applied methodologies.

4.4.5 Discussion

As shortly introduced at the beginning of section, several effects of (past and present) methodology and taphonomy can exist in the archaeozoological record. These factors are summarized and reflected upon here for every animal group. By becoming aware of potential influences of processes such as taphonomy (cf. Figure 4.8), and where possible, eliminating these effects, more insight can be gained into actual past human practice. For example, this awareness allows for a more accurate comparison of which species were and were not uncovered, showing possible selections for consumption of wild animals by past humans. Finally, other possible reasons for hunting are investigated in this section, exploring its importance to subsistence besides providing food.

4.4.5.1 Methodology

Sampling and sieving are the most important excavation methods which will have affected the archaeozoological record. Sampling often occurs in a random manner at excavations, and is usually performed when the chance of uncovering remains from a feature is already high. Often, samples for remains of fish, birds, or small mammals are only taken from contexts when they have already been observed with the naked eye. This means that other contexts, which may be equally or more informative, are not sampled, resulting in a possible loss of (additional) information. A more structured plan of sampling before excavation would greatly benefit the research on all the practices related to fishing and fowling, even if contexts do not seem promising at first glance.

Inadequate sieving practices also affect the composition of species uncovered from an excavated site to a large extent. When mesh sizes are too large, many fish, bird, and small mammal species are missed (Huisman 2009, 52), which may result in an interpretation based on biased data that may not reflect actual past practices. According to both Neer & Ervynck (1993) and Meadow (1988, 69), adequate sieving mesh sizes for the different animal groups are 1 mm-2 mm for fish remains, and 2 mm-4 mm for bird and small mammal remains (Chapter 2, section 2.4.5.1, Figure 2.20). Large mammal remains are best uncovered at sieving mesh sizes of 4 mm combined with hand collecting. Sieving for these animal groups at similar mesh sizes at every site can provide a firm platform for comparison of hunting practices between sites and even areas. Since in West Frisia, sieving was performed with different mesh sizes at every site, the detailed interpretation of practices was only limited to two sites with comparable practices. However, based on these two sites new insights into the local praxis of fishing were obtained, which underlines the importance of applying consistent and comparable excavation methodologies. For further elaboration on excavation methodology, see Chapter 11.

4.4.5.2 Taphonomy

Taphonomical processes can have a considerable impact on bone assemblages. Even though West Frisia has excellent preservation conditions with regard to bones due to its calcareous clayey soils, even here, taphonomy has had an effect. Working of the soil has resulted in high fragmentation of remains, resulting in an underrepresentation of certain find categories. Bones of small animals, including fish, birds, and small mammals, are prone to degradation in general due to their size and fragility. When these bones are further affected by processing such as by cut, chop, and burn marks, they are even more susceptible to degradation and subsequent loss via taphonomical processes. The chance of finding these bones, which are indicative of processing and consumption practices, is therefore small. When bones with marks are found however they provide rare insight into such hunting practices. The fact that these remains were present at all in West Frisia simultaneously means that the original number of bones indicating processing and consumption will have been even higher, and also that their presence is only possible under exceptional preservation conditions.

Similar considerations and reservations should be kept in mind when interpreting hunting methods based on the presence or absence of tools and equipment, since taphonomical processes will have also affected other organic materials. Hunting tools and equipment, often being made from exactly these (perishable) materials, are very prone to degradation, except under waterlogged conditions. The fish fyke found in Enkhuizen is a rare example of the preservation of hunting equipment under waterlogged conditions. Although it is only one example, it already signifies the skill and knowledge of constructing such hunting gear present in Bronze Age West Frisia. The presence of flint arrowheads furthermore, which are not very susceptible to degradation, provides another rare indication of hunting in this area at this time. All other types of weapons are most likely not preserved due to taphonomy, but this does not necessarily mean they were not originally present.

Thus, when interpreting fishing, fowling, and hunting in the past, the effects of methodology and taphonomy should be kept in mind before concluding on the importance of these practices for subsistence. The absence of wild animal remains or hunting equipment does not necessarily suggest the absence of such practices, but could purely be the result of both methodological and taphonomical processes affecting their visibility in the archaeological record. Comparison of expected practices with the (limited) evidence that is available at a site can (still) provide a clear idea of practices, even if not all remains directly indicative of hunting have stood the test of time.

4.4.5.3 Possible selection criteria for consumption

Since this thesis mainly focuses on food procurement, possible reasons for selecting wild animals for consumption are explored here. They include: edibility and flavour, addition to the diet, and availability and abundance.

Edibility and flavour

The flavour of a certain species of animal can be a reason for preferring that species over other species which might be more nutritious or more abundant. Whereas most animals are edible, some can be considered tastier than others, even if we do not perceive it as such nowadays. If (a combination of) certain animal species have a higher prevalence on a site than others, this could thus be a possible indication for a selection on flavour.

Fish

Fish have been uncovered at many sites, but the species most often present both in terms of bone remains and frequency include eel, pike, bream, perch, and cyprinids in the eastern sites (Table 4.7), and mostly flatfish species in the western sites (Table 4.8). The higher presence of these fish could be related to edibility and flavour, since most of them are still being consumed at present. However, flavour is very subjective, so caution must be exercised before drawing definitive conclusions. Still, three of the fish which were expected based on the available habitats present in West Frisia, including sunbleak (*Leucaspius delineatus*), spined loach (*Cobitis taenia*), and bitterling (*Rhodeus amarus*) (Appendix A1.3) were not found, and are also generally considered to taste bad (Vissengids 2016).

Birds

West Frisian birds may also have been selected based on their edibility and flavour. Furthermore, rather than the birds themselves, the eggs of birds

Table 4.7. Frequency and number of fish remains from the eastern West Frisian sites.

Taxa	English name	Boven-karspel	Westwoud	Medemblik	Enkhuizen	No.	Freq.
Cyprinidae indet.	Carp-family	4863	36	82	1075	6056	4
Anguilla anguilla	Eel	1037	88	82	843	2050	4
Perca fluviatilis	Mullet-family	100	3	71	427	601	4
Esox lucius	Pike	149	13	147	223	532	4
Abramis brama	Bream	85	1	44	107	237	4
Rutilus rutilus	Roach	67	0	5	40	112	3
Blicca bjoerkna	Silver bream	31	0	3	3	37	3
Gasterosteus aculeatus/	3-Spined stickleback	606	21	0	0	627	2
Alburnus alburnus	Bleak	54	0	0	1	55	2
Siluris glanis	Catfish	14	0	0	10	24	2
Scardinius erythropthalmus	Common rudd	0	0	2	3	5	2
Mugilidae	Pike	0	0	2	2	4	2
Abramis brama/ Blicca bjoerkna	Bream/ Silver bream	0	0	0	35	35	1
Leuciscus idus	Ide	8	0	0	0	8	1
Tinca tinca	Tench	6	0	0	0	6	1
Pleuronectidae	Fatfish-family	0	0	3	0	3	1
Gymnocephalus cernuus	Ruffe	2	0	0	0	2	1
Eutrigla gurnardus	Grey gurnard	0	0	0	1	1	1
Salmonidae indet.	Salmon-family	0	0	1	0	1	1
Pungitius pungitius	10-Spined stickleback	0	0	0	0	0	0
TOTAL		7022	162	442	2770	10396	

Table 4.8. Frequency and number of fish remains from the western West Frisian sites.

Taxa	English name	Hoogwoud	Schagen	No.	Freq.
Pleuronectidae	Flatfish-family	97	1147	1244	2
Platichthys flesus	Flounder	3	34	37	2
Anguilla anguilla	Eel	2	24	26	2
Liza ramada	Thin lipped grey mullet	9	10	19	2
Dicentrarchus labrax	Sea bass	1	8	9	2
Raja clavata	Thornback ray	1	6	7	2
Gasterosteus aculeatus	3-Spined stickleback	0	34	34	1
Alosa fallax / alosa	Shad	0	23	23	1
Clupea harengus/Sprattus sprattus	Atlantic herring/sprat	0	17	17	1
Cyprinidae indet.	Carp-family	0	11	11	1
Solea solea	Sole	0	11	11	1
Acipenser sturio	Sturgeon	0	9	9	1
Gadus morhua/Merlangius merlangus	Cod/Whiting	0	9	9	1
Osmerus eperlanus	Smelt	0	7	7	1
Alosa alosa	Allis shad	0	6	6	1
Coregonus spec.	Whitefishes	0	6	6	1
Perca fluviatilis	Perch	0	6	6	1
Esox lucius	Pike	0	5	5	1
Abramis brama	Bream	4	0	4	1
Liza ramada / aurata	Thin lipped-/Golden grey mullet	0	4	4	1
Pleuronectus platessa	Plaice	4	0	4	1
Dasyatis pastinaca	Stingray	0	3	3	1
Mugilidae indet.	Mullet-family	3	0	3	1
Alosa fallax	Twaite shad	0	2	2	1
Chondrichthyes	Rays/Sharks	0	2	2	1
Gadus morhua	Atlantic cod	2	0	2	1
Rajidae	Skates and Rays	0	2	2	1
Salmo salar / trutta	Atlantic salmon/trout	0	2	2	1
Clupea harengus	Atlantic herring	0	1	1	1
TOTAL		126	1389	1515	

may have been collected as an additional food source in the Bronze Age which was not available at the settlement.

The edibility and flavour of the bird species found in West Frisia, as well their eggs, was evaluated in order to identify possible selection of birds on edibility and flavour. As stated previously, flavour is very subjective, but global trends in the edibility and taste of different birds and eggs has been researched in the past (Cott 1947; Cott 1954). Cott performed taste experiments with wild birds and eggs right after World War II in order to avoid possible food shortages in such situations in the future. He tested the taste, texture and edibility of wild birds and eggs on people from all over the world. Since most birds were tasted by people from different countries, it is assumed that a potential bias due to cultural preference is less probable. Therefore, the information provided by Cott is applied to the West Frisian data. The edibility aspects of the birds and their eggs found in West Frisia are summarized in Table 4.9. Only where it is specifically stated that the bird flesh or egg is inedible, a '-' mark is given.

What Table 4.9 clarifies is that almost all birds found as well as their eggs are considered to be edible to a certain extent. Thus it seems that based on the uncovered bird species, edibility may have been a reason for catching these birds (and eggs) by West Frisian people, except for swallows and loons.

Besides edibility, flavour might also have been an important consideration for selecting certain birds. Interestingly, bird meat absorbs the flavour from the feed a bird consumes (Cott 1947, 484). So, generally speaking, birds feeding on fish are (at present) considered (in the western hemisphere) as less palatable than birds feeding on fruit or nuts. This is a very variable factor, which can differ between species, within species depending on foraging location, and even per time of day or season. Certain species might therefore only be preferred during a certain time of the year, independent of the ease with which they can be caught. Crane for example, is only considered to be palatable when it has consumed crops, and thrushes only in autumn, after having consumed berries.

An example of a possible preference for flavour might be observed in Schagen. Schagen was located relatively close to the sea and several saltwater fish were found there, yet only one seabird was found (loon), compared to multiple species of freshwater aquatic bird. Loon hunts on fish, which makes their flesh taste rank and this is not considered to be edible by most (Cott 1947, 478). Other birds expected near saltwater-influenced sites such as Schagen or Hoogwoud would include several species of gull and tern (Birdlife International n.d.). These birds also feed on fish and were therefore perhaps not held in high esteem with regard to their taste. Birds found which are considered to be edible and also appear near the coast are dunlin, brent goose (*Branta bernicla*), and barnacle goose (*Branta leucopsis*). The absence of (other) inedible bird species at Schagen, and the presence of these edible birds from the same habitat type may be the result of human selection on flavour.

Another indication for the possible selection based on flavour in West Frisia is more indirect and is related to the edibility and taste of birds based on plumage colour. Cott examined the relationship between the visibility of birds in the wild (bright plumage vs. cryptic colouration) and their taste (Cott 1947, 436-447). A general trend that is observed is that birds of which both male and female are well camouflaged (and are normally more vulnerable to attack) are usually considered to taste better than their brightly coloured counterparts. Ironically, this also means that the best catches with respect to taste are the hardest to see/find and perhaps catch. Many of the birds found in West Frisia however, are of exactly this camouflaged type. Their presence shows that flavour might indeed have been one of the major considerations when catching a bird.

Eggs

In order to assess the edibility of wild bird eggs, Cott consulted an actual Egg Tasting Panel (Cott 1954). Eggs were rated in a single-blind research fashion based on their colour, texture, flavour, and overall edibility. Of course, a bias exists since the Egg Tasting Panel was already operational for testing "normal" eggs on their quality in Great Britain. Therefore, the range of opinions of people from the article on edibility of wild birds (Cott, 1947) was not

Table 4.9. Overview of the edibility characteristics of birds found in West Frisia as well as their eggs.

Taxa	English name	Bird edibility	Page	Egg edibility	Page
Accipiter gentilis	Northern Goshawk	+	475	?	n/a
Alauda arvensis	Skylark	+	473	+/-	439-440
Anas crecca/querquedula	Common teal	+	n/a	+	370
Anas querquedula	Common teal/ Garganey	+	n/a	+	370
Anas penelope	Widgeon	+	n/a	no eggs	n/a
Anas platyrhynchos	Mallard	+	469	+	368/369
Anser anser	Greylag goose	+	n/a	+	365/366
Branta bernicla	Brent goose	+	475	no eggs	366
Branta leucopsis	Barnacle goose	+	475	no eggs	366
Bubo bubo	Eagle owl	+	461/462	-	425
Calidris alpina	Dunlin	+	471	?	n/a
Corvus corone	Carrion crow	+	n/a	+	430
Corvus frugilegus	Carrion crow/Rook	+	476	+/-	430
Coturnix coturnix	Quail	+	470	+	384
Cygnus cygnus	Whooper swan	+	-	no eggs	364
Cygnus olor	Mute swan	+ (young)	475	+	365
Gavia stellata	Red-throated loon	-	478	no eggs	348
Gavia arctica	Black-throated loon	+/-	478	no eggs	n/a
Grus grus	Crane	+/-	475	no eggs	n/a
Hirundinidae	Swallows	-	463	+/-	451
Philomachus pugnax	Ruff	+	471	+	399
Rallus aquaticus	Water rail	+	n/a	+	389
Scolopax rusticola	Eurasian woodcock	+	471	+	397/398
Sylvia spec.	Warbler spec.	+	462	-	455
Turdus spec.	Thrush spec.	+ (autumn)	485	+/-	454

Page numbers beside the edibility of birds refer to the article by Cott from 1947, the page numbers beside the edibility of eggs refer to the article by Cott from 1954. Symbols related to bird edibility: +=edible, +/-=edibility rating differs between tasters, -=inedible, ?=unknown. Symbols related to egg edibility: +=edible, rating higher than 6.5, +/-=edibility rating between 5.0 and 6.5, -=inedible, rating lower than 5.0, ?=unknown, no eggs=bird is not present in West Frisia during egg laying season, so eggs could not have been collected.

available for the edibility of wild bird eggs. However, it is the only elaborate article on the consumption characteristics of wild bird eggs made before the collection of such eggs was prohibited, and is therefore considered to be a general guideline to flavour.

Even though there is no evidence for the consumption of eggs in West Frisia (*e.g.* in the form of eggshells), the presence of the birds that lay them means they would have been available to people. Table 4.9 shows that the edibility of the eggs might reveal indications for why certain bird species were found and others were not. First of all, eggs of birds of prey are either inedible (*i.e.* eagle owl), or of unknown taste (*i.e.* Northern goshawk). Both birds build nests high up in trees and are very protective, so perhaps it would not have been easy to collect these eggs, even if the taste was good. Secondly, there is a group of birds of which the eggs are of average taste, including skylark (*Alauda arvensis*), rook, and swallows. Thirdly, there is a large group of birds of which both the meat and the eggs are considered to be tasty. These are teal, garganey, mallard, goose, crow, quail, mute swan (Cygnus olor), ruff, water rail, and woodcock. Apart from crow, all these birds build nests on the ground, so eggs could have been collected relatively easily when the nesting location was known.

The last group of birds seen in Table 4.9 is the group of migratory birds. Regardless of the taste of their eggs, which is excellent in the case of brent goose, barnacle goose, and whooper swan (data not shown), these birds are not present in West Frisia in egg-laying season. Therefore, their eggs would have been unavailable to the West Frisians and are therefore not discussed any further.

Eggs can only be gathered during a limited time. After the eggs are lain, the chick will start to develop inside the egg, provided the parent is brooding. Depending on the species, incubation time from egg-laying to hatching will on average take about 20-30 days (Broedseizoen 2016), depending on the size of the bird. Within this short period, eggs need to be gathered; the longer one waits with collecting, the further the chick will have developed. However, when a bird has not completed laying the full clutch of eggs, and eggs are carefully removed from the nest during this time, the bird will continue to lay fresh eggs to try and complete the clutch. This results in a larger time frame for humans in which to collect eggs (United States 2009, 78). Alternatively, a preference could have existed for consuming the underdeveloped chick. Underdeveloped or hatched chicks could potentially also have been collected, which is possible for a longer period of time. Juvenile birds are often easier to collect than adults since they cannot yet fly. In the West Frisian bird bone assemblage, one example of a juvenile bird was found in Medemblik, indicating that this practice probably did occur.

In summary, at the eastern sites of West Frisia, almost all species found either have tasteful meat, or eggs, or both. As mentioned above, in Schagen, several species of gull were expected but missing from the bird assemblage. The eggs of some of the possibly present gulls in western West Frisia, *e.g.* lesser black-backed gull (*Larus fiscus*), kittiwake (*Rissa* spec.), and common tern (*Sterna hirundo*) are all very tasty. The eggs of the lesser black-backed gull even had one of the highest scores of the 212 species of bird eggs tested (Cott 1954, 452-3). This example indicates that the presence or absence of bird species at a settlement does not (necessarily) reflect the total range of bird species exploited (for their eggs); the number of species of which only the eggs were collected will not have entered the archaeological record of settlement sites. Regardless of whether all species which have been exploited were also found however, this study has made clear that most ground-nesting birds have both tasteful meat and/or eggs, and could have been targeted for that reason.

Mammals

All mammals are edible, and every mammal has its own specific flavour. Bronze Age people may have had a preference for a different flavour meat than the meat of their own livestock. Such a selection might have been based specifically on the flavour of the animal regardless of size. Alternatively, elk, wild boar, roe deer, red deer, beaver, and hare could have been selected based on a combination of flavour and amount of meat.

Addition to the diet

Animals may also have been specifically selected for their nutritive properties. One large specimen of fish, bird, or mammal, or many smaller specimens could have provided people directly with a considerable amount of meat or fat. Furthermore, it would be possible to preserve meat for periods of the year when food was scarce.

Where a selection based on nutritive properties would indeed have been important to Bronze Age people, it would certainly have meant that certain periods of the year were more favourable for capturing animals than other.

Fish

Fish grow throughout their lives, but some species in particular grow larger than others. Eel, pike, catfish, and sturgeon are able to grow to a substantial size and would have been available to people during spawning and migratory seasons. Other species might instead have had a more favourable meat yield than others. Bykowski & Dutkiewicz (1996) propose that cyprinids only have a meat yield of around 50% because they possess relatively many small bones in comparison to meat, but most other fish have a yield percentage of 50-60%. Salmonids can even reach a meat yield percentage of 75%, which can create a possible target for nutritive properties in its own right. Moreover, in general, saltwater and migratory fish are usually more nutritious than freshwater fish, which may have been another possible selection criterium.

In western West Frisia, mostly saltwater and anadromous fish were found. Most species belonged to the flatfish family (Table 4.7), which could be preserved for longer periods of time, providing nutrients for periods in which food is scarce. At the eastern sites, members of the cyprinid family were most abundant (Table 4.8), differing in size from very large to average. Both single large individuals and/or many small individuals together could thus have provided high amounts of nutrients to people throughout West Frisia.

Birds

The selection of birds based on nutritive properties may have been focused on large birds, such as swans. However, many smaller birds have been uncovered in West Frisia as well, which together may also have provided a potentially high meat yield. Furthermore, the nutritive properties of a bird depend on the time of year in which a bird is caught. Obviously, when a bird has used a lot of energy, it will have suffered weight loss, which mainly occurs during moulting and during/after migration. Birds are expected to be most nutritious just before migration, or at the start of breeding and moulting seasons. These periods are therefore interesting to hunt for birds to enrich the diet. In addition, when bird meat was required to sustain people during times of scarcity, the nutritive properties may not have needed to be optimal for a bird to be hunted for consumption. Indeed, birds found in West Frisia, including whooper swan, widgeon, brent goose, and barnacle goose (Table 4.5), are only present from late autumn to early spring, which may indicate the selection of birds to complement the winter diet.

Mammals

Meat of wild mammals generally possesses a lower nutritive content in comparison to domesticated animals (Mann 2000, 74). Hunting mammals will therefore not necessarily have increased the nutrients in the diet of people in comparison with domestic meat. Smaller mammals such as mice or voles could not have added much to the diet on their own, but could have been caught in larger numbers to aid subsistence. Large wild animals, such as elk and especially brown bear, may have possessed more meat than for example domestic Bronze Age cattle, which in this manner may have compensated for the lower nutritive content of their meat.

Similar to birds, mammals differ in their meat yield throughout the year; during winter, their fat reserves become depleted, decreasing their nutritive value even further. Still, the availability of wild animal meat during winter, no matter the nutritive levels, may have aided the winter diet of people during the unavailability of domestic meat (Chapter 8, section 8.3.1). The indication for *e.g.* winter hunting of elk found in Medemblik (section 4.4.3) could be evidence for such a selection.

Availability and abundance

Selection based on taste and nutritional value of animals were not the only possible considerations of people for hunting. Certain species are not (always) present in the surroundings of the settlement, so availability is an important factor related to the selection of animals. Furthermore, periods of abundance of certain species may have formed specific targets for hunting: when certain species are abundant, this fact may outweigh or even nullify the selection on individual flavour and nutrient properties of a species.

Fish
Possible selections based on both availability and abundance of fish species in West Frisia were observed. Shads, herring/sprat, mullet, and eel all live in schools, which means that they are naturally in abundance. Migratory fish, such as salmon, eel, whitefishes, and mullets might have been caught because of both their seasonal availability and abundance. Other fish, which are not migratory but are abundant, are flatfish, which may also have been selected for this reason.

Birds
Bird species could also have been selected by West Frisian people based on their abundance and availability. Many of the bird species found in West Frisia are available all year, but many migratory birds are only available in spring and autumn. Furthermore, migratory periods also host many bird species which are highly abundant at the same time. This period of the year is therefore a potential target for hunting selections based on both availability and abundance. During moulting season, aquatic birds also become more widely available; due to the decreased mobility of these birds when moulting, the accessibility to these birds increases for a hunter.

Mammals
Mammals are available throughout the year, since migration distance is restricted. Their relative abundance however, can differ depending on the season. During winter, roe deer and elk form groups, which results in a condensed availability of these species. The resulting relatively higher abundance of mammal species in certain areas may therefore have been a specific reason for selection.

4.4.5.4 Other reasons for hunting

Reasons for hunting can also be different than for human consumption purposes. Although it is assumed that animals were consumed after being hunted, their meat may not have been the initial reason for hunting: wild animals have more possible uses.

Fish
Fish may have been caught as food for the consumption by domestic animals or as bait for the capture of other wild animals. Another use may have been for the creation of fish bone tools or ornaments. Tougher elements of the fish skeleton, such as the spikes of a perch, could potentially have been used as needles, or punching tools. The possession of special skeletal elements, such as the dorsal fin of the grey gurnard found in Enkhuizen, may have for example functioned as a form of skill portrayal, since this fish is so hard to catch (section 4.4.1).

Birds
Bird bones and feathers can have multiple uses. Bird bones can be used to make awls or needles (Gál 2005, 56). Furthermore they can be made into flutes or whistles, which, perhaps ironically, can be used to attract other birds when fowling (Mannermaa 2003, 21). The possession of a specific bird bone might also have had ornamental reasons, or even a religious or ritual meaning if certain birds were considered to have a special status.

In West Frisia, certain pottery decorations were created by pressing hollow bird bones into the clay (Bakker & Brandt 1966: Fig. 17; Figure 4.13).

Feathers could be also have been an important reason for hunting birds. The preference for a specific colour of feathers for use as decoration or as ornaments can furthermore be one of the reasons to capture birds in a certain season, for example when males display their bright breeding plumage during courtship (section 4.3.1), such as ruff (found in Enkhuizen). Bird species such as cranes and swans have conspicuous feathers all year-round.
Another, perhaps more practical reason to collect feathers from a bird, would be for insulation. Down can be used for bedding, lining of (winter) clothes, shoes, etc. Especially aquatic birds and birds living in cold environments produce more down in autumn to prevent heat loss in winter (Ginn and Melville 1983; Bird body temperatures 2016). The capture of

Figure 4.13. West Frisian pottery with decoration made with bird bones (from: Bakker & Brandt 1966: Fig. 17).

barnacle goose and brent goose in Schagen, which are only present from late autumn to early spring, may indeed have been carried out to obtain their thick layer of down.

Ritual, religious, or symbolic uses for bird bones and feathers might also have existed, although clear evidence for this is rare and hard to interpret. However, in some prehistoric burial rituals, bird bones or bird bone artefacts have been found. At the Neolithic site Vaateranta in Finland for example, wild bird remains are only found in graves (Mannermaa 2003, 20-1). Symbolic properties of bird wings have also been assigned to a Late Neolithic burial site in Tamula, Estonia, where parts of crane wings have been found in the hands of a deceased child (Mannermaa 2003, 23). Although the region and time period are different from West Frisia, these examples show the potential importance of birds in the lives of people.

A final other reason for hunting which does not include a use of the animal, is killing birds because they are considered pests. Examples of pests are carrion crow and rook, which are both species that are known to eat meat from dead animals. When hunted fish or meat is hanging in a settlement, for example when drying, it may form a source of food for these birds as well. Other birds may have been killed for feeding on grain and seed(ling) s, potentially endangering the harvest yields, or preying on young domestic animals (*e.g.* eagle owl). Killing these birds will mainly have occurred to protect food sources at and around the settlement rather than that they themselves were a source of food themselves.

Mammals

Wild mammals could have been hunted for several reasons, but the main reasons discussed here are for obtaining wild animal parts and exercising pest control. Hunting for portrayal of skill or status are also possible reasons for hunting mammals, but these are not further elaborated upon here.

Wild animals can have certain physical attributes that domesticated animals do not, or no longer possess, such as large(r) long bones, antlers, and hides/pelts. People may have hunted these wild animals because they could not produce these sources of raw material themselves. Depending on the desired animal part, hunters will have needed to employ different hunting techniques. Antlers and bone can be made into tools, and these raw materials can be obtained by capturing the animal regardless of technique. Hides and pelts however, are presumably used for clothing and should not be damaged by for example being pierced by hunting gear. Therefore, if wild animals were caught for their pelt or hide, they are most likely to have been caught using traps or snares, which do not damage the skin (section 4.3.2).

In fact, all the large mammals found in West Frisia, besides being ultimately used for consumption, may have initially been caught for their fur. Species such as beaver, otter, hare, polecat, fox, and wild cat possess well-insulating fur coats. Indications for skinning of fur animals can include specific markings on skulls and pelvic bones of mammals (Trolle-Lassen 1986;

Trolle-Lassen 1987). In the Medemblik assemblage, cut marks on the skull and mandible of a fox indeed indicate skinning and use of the entire pelt (Groot 2010a, 86), and in the assemblage of Schagen, fine cutmarks on the phalanges of otter also indicate skinning of the animal (Zeiler *et al.* 2007, 9). Schagen and Medemblik are situated approximately 20 km apart, and range in habitation time from the Early to Late Bronze Age. Therefore, these examples provide few but clear indications that wild animals were exploited for their pelts throughout the Bronze Age, and throughout West Frisia. It follows then that if people were specifically hunting animals for their fur, they may also have selected a particular type of fur. In winter, most mammals possess a winter coat which consists of thicker fur, which might be preferred by people for winter clothing.

Other wild mammals, such as roe deer, red deer, and elk possess a hide that can also function as a source of clothing material. Indeed, a Bronze Age bog body from the province of Drenthe, the Netherlands was wearing deerskin shoes, indicating the persistent use of wild animal skins during this time (Sanden 1990). Deer can also provide antlers, which have specific properties for the creation of tools, which are not present in other types of raw material. Antlers may be collected after being shed, therefore finding them does not necessarily indicate hunting. However, the presence of a skull of elk with attached antlers, which were removed after death (Groot 2010a, 94) indicates that hunting for this source of raw material may still have played a role in subsistence for creating specific tools. Indeed, several tools made from wild animal bone and antler have been identified in West Frisia. These include a possible hammer made from red deer antler (found in Enkhuizen: Roessingh & Lohof 2011, 214), a possible hoe tool and an axe socket also made from red deer antler (found in Bovenkarspel: IJzereef 1981, 141), and an awl made from elk bone (found in Medemblik: Schurmans 2010, 96-7).

Another reason why wild animals might have been hunted by the people of West Frisia might be because they were posing a threat to the safety or well-being of the farming community. Animals can be dangerous when people or livestock are attacked, or be a nuisance or pest when they are consuming food stores in houses or crops and domestic animals in fields. Many of the animals found in West Frisia can be considered pests in one way or another. Small mammals which could have been pests include wood mouse (*Apodemus sylvaticus*), harvest mouse (*Micromys minutus*), common vole (*Microtus arvalis*), and house mouse (*Mus musculus*), since they may have eaten seeds and grains from storage locations. Therefore, these animals might have been selectively killed by humans for this reason. Roe deer, red deer, wild boar, elk, and hare form a threat to modern-day harvests by feeding on cultivated crops (Twisk *et al.* 2010, 336-7), and could have done so in the past as well. Brown bear, wild cat, polecat, fox, otter, and weasel, being carnivores, might have been attracted to (smoke-)drying fish or meat, if indeed this preservation method was practised in West Frisia. Brown bear and wild boar might in addition have posed a threat to humans if threatened when with young (Twisk *et al.* 2010, 337). Livestock and their young finally, may also have been threatened by brown bear, fox, and wild cat (Twisk *et al.* 2010, 279). So, pest control could also have been an important (additional) reason to kill wild animals.

Overall, there are clear indications from all over West Frisia, throughout the Bronze Age, that hunting for raw material or pest control may have formed a very important additional part of subsistence. In concurrence with Kent (1989, 45), hunting formed a complementary subsistence strategy to animal husbandry, providing people with meat and raw materials not (always) available from domestic animals. Killing wild animals could provide people with tools, clothing, and safety, besides having a final use as a source of food. The reflection of such practices will have resulted in a lower visibility in the archaeozoological record than when wild animals still formed the main food resource: hunting for raw material is necessary on a much less regular basis than for daily year-round consumption purposes. Within a Bronze Age farming community, where domestic animals will have formed the major source of consumable animal products, the presence of such regular consumption waste (*i.e.* domestic animal bones) will have greatly overshadowed the presence of waste from, raw material processing, pest control, or seasonal consumption (*i.e.* wild animal bones). Furthermore, the selection of only a few individuals from a wild animal population, versus the presence of every domestic animal present within a breeding herd population increasingly exacerbates the ratios between wild and domestic animal bone reflections at a settlement.

The above examples are the results of the new manner in which data is approached in this chapter. They have clearly indicated that the presence of low numbers of remains of certain wild animal groups within a settlement should not be directly interpreted as being of minor importance to subsistence without first considering the methodological, taphonomical, and selection processes which may have resulted in the final observed wild animal bone assemblage.

4.5 RECONSTRUCTION OF HUNTING

The current view on hunting, with its inherent main components, was challenged in this chapter by applying several disciplines to the analysis of the subject. The summary provided below (4.5.1) shows the contribution of each of these proxies as well as the applied approach in this chapter. Results obtained from this new manner of analysis are compared to the main components of the current model as well as the new main component presented in section 4.3.5. It is subsequently evaluated whether these current components remain valid (section 4.5.2), and the new main components are combined to form a new model for hunting in Bronze Age West Frisia (section 4.5.3).

4.5.1 Contributions of proxies and approach to the reconstruction of hunting

The use of ethnographical studies for the creation of an expectation of hunting has provided a means to identify its general and persisting importance within modern-day small-scale mixed subsistence farming communities. Furthermore it provided examples of specific methods related to hunting.

Ecological information of animal species has allowed for an analysis of the ratios of possible hunting locations based on animal habitat preferences (cf. Chapter 2), as well as the seasonality of hunting based on animal migration studies. By applying ecology to the West Frisian data, more information on location and locality of practice related to hunting was obtained, also in relation to the settlement (cf. Chapter 3).

Biology has mainly provided information on the behaviour of animals. This behavioural information, including food preference, reproduction, and migration, has enabled the reconstruction of human practice including the use of possible appropriate types of bait, seasonality, availability, and abundance. Furthermore it gave indirect indications for the use of different hunting strategies and equipment. Biological and ecological information combined are both vital to understanding the complexity of skill and knowledge required to capture animals.

Archaeology finally, has provided direct and indirect indications for hunting as a practice in the Bronze Age. Direct indications for capture include the actual finds of hunting gear, whereas indirect indications for capture and seasonality could be obtained from the specific presence and marks on bone material.

The approach in this chapter was to view hunting from different perspectives by using multiple proxies. Combining and integrating these sources of information has enabled the analysis of West Frisian data to produce more detailed results as well as create an understanding of why certain activities or tools may rarely become visible in the archaeological record. Through this approach it has become clear that the absence of evidence for tools and activity should not directly be linked to their relative importance to subsistence. Rather, through the evaluation of other processes affecting the assemblage, the importance of hunting in a farming community could be postulated as an additional but integral part of life in the Bronze Age.

4.5.2 Assessing previous main components

From the previous section, it is clear that the approach of this chapter has yielded new results with regard to the role and praxis of hunting in Bronze Age West Frisia. In this section the validity of the main components of the current model are evaluated by comparing them to the new results.

Main component 1 was formulated as follows:

(1) Bronze Age people are self-sufficient full-time farmers with no apparent need for wild resource exploitation.

Based on all available proxies, the presence of wild animal resource exploitation in the Bronze Age in West Frisia was established. Clearly, people continued to hunt wild animals to aid them in their subsistence, either for obtaining an additional source of food, raw material or protection of the settlement. Since the new results do not match main component 1, a new main component 1 is formulated:

(N1) Bronze Age people were farmers producing crops and livestock, but continued to exploit the surroundings of the settlement for wild animals to aid them in their subsistence.

Main component 2 was formulated as follows:

(2) Frequency of wild animal remains can be linked directly to relative (economic) importance of hunting in aiding subsistence in Bronze Age farming communities.

A careful analysis of the potential effects of excavation methodology, pre- and post-depositional taphonomical processes, and past human selections, has revealed that the frequency of wild animal bones should not be directly linked to relative (economic) importance of hunting for subsistence, since a shift in use of wild animals may have occurred during the Bronze Age. It is postulated in this chapter that animals may no longer have been hunted for daily consumption purposes, since livestock is available for this purpose. Reasons for hunting in this period may include procuring raw material not available from own production, obtaining additional food sources, or eliminating pests that threaten people, crops, and livestock. A subsequent reflection of wild animals in the archaeozoological record will thus have also been different. Again, the current main component and the new results are not compatible and main component 2 is therefore newly formulated:

(N2) Frequency of wild animal remains cannot be linked directly to relative (economic) importance in aiding subsistence in Bronze Age farming communities without careful consideration of the effects of methodology, taphonomy and past selection processes on the final bone assemblage.

Main component 3 was formulated as follows:

(3) Hunting of mammals and birds was not practised in the Middle and Late Bronze Age, but fishing remained of some importance.

Based on all available proxies combined with the analysis of the potential effects of methodology, taphonomy, and past human selections, it is clear that hunting of all animal groups (including fish, birds and mammals) was still occurring in the Bronze Age. Their relative importance to subsistence should not be identified purely based on numbers of remains (see new main component N2), but rather on the potential individual contribution of each animal group, also for reasons other than for consumption. The results suggest that also main component 3 should be reformulated:

(N3) Hunting of fish, birds, and mammals was practiced in both the Middle and Late Bronze Age in West Frisia; their individual importance should not be measured by amounts of remains but by their potential individual contribution to subsistence, encompassing only consumption purposes.

Main component 4 was formulated as follows:

(4) Large game was only hunted on a very opportunistic basis, without specialisation or concentration on a particular species or the surrounding available richness in the area.

Based on analyses with the aid of ecology, biology, and ethnography, it has become clear that West Frisian people were able to acquire a wide range of animal species of each animal group. Each animal group in turn contains species from varying habitats, which all display varying behaviour. Extensive knowledge about these different types of animals and their behaviour, as well as the skill involved in order to catch them in different habitats must have been present amongst Bronze Age people, signifying a strong connection with the available richness in the surroundings of the settlement. At first glance hunting may appear opportunistic, because no single species was preferred, but when the other uses of animals are analysed, a single use may tie different species together. Hunting to acquire antlers may include targeting several species of deer, whereas the procurement of skins, pelts or hides may include many different targeted mammal species as well. Furthermore, hunting animals for food during times of scarcity (*e.g.* winter) may also be based on a single goal (meat) without a clear preference for the obtained animals species. The above results show that main component 4 should also be reformulated:

(N4) Large game was hunted for specific uses such as raw material or meat during periods of the year when domestic meat was scarce; specialisation occurred not based on a species, but rather on a use, and the surrounding available richness in the area was exploited accordingly.

Main component 5 was formulated as follows:

(5) Hunting did not aid Bronze Age subsistence in terms of consumption, but may have been practiced for other reasons which were equally important.

Based on the comparison of the West Frisian data and subsistence situation to the ethnographical examples, it was concluded that hunting in the Bronze Age could have aided subsistence both for reasons of consumption as well as other reasons. Hunting animals during times of scarcity or preserving animal meat for such times may have been important additions to the Bronze Age diet during the winter, when available food sources were scarcer. Furthermore, additional uses of animals such as for raw material for the construction of tools and clothing may have aided subsistence in a comparably important manner. In fact, since in the Bronze Age, tools and clothing could only be constructed from limited types of material, the need for hunting for these types of raw materials may have been more pronounced in Bronze Age subsistence in comparison to modern-day parallels where presumably only hunting for food is considered. Therefore, main component number 5 should therefore be reformulated as follows:

(N5) Hunting aided Bronze Age subsistence both in terms of consumption and as a source of raw material, increasing its relatively importance to subsistence in comparison to when only dietary contribution is considered.

Since none of the main components of the current model were able to describe the role and praxis of hunting in West Frisia in concurrence with the new results, the new main components are combined and integrated to form a new model.

4.5.3 New model for hunting

The role of hunting in the Bronze Age in West Frisia is postulated to have been different from preceding periods. Where wild animals previously would have formed a large part of the daily diet, farming communities would have produced their own meat by practicing animal husbandry. In order to aid Bronze Age subsistence, hunting must have added something to subsistence which farming life alone could not provide. Additions to subsistence in the Bronze Age made by hunting may have included different types of food that were unavailable at the settlement, such as fish and eggs, or ensuring the availability of consumable animal products in general during times of food scarcity. The latter example could be achieved by hunting animals during these times of scarcity, or by hunting during preceding periods of wild animal abundance with the aim of preserving fish and meat for the long term. Periods of availability and abundance included (depending on the animal group) reproduction, moulting, and migration periods. Other reasons for hunting animals during the Bronze Age may have included acquiring raw material not available at the settlement, such as feathers, antlers, or furs. A final reason for hunting postulated in this research is that some animals may have been hunted because they posed a threat to the people, crops, and livestock on the settlement.

Although the zoological remains from West Frisia contained relatively few bones of wild animals, the broad range of wild animal species found reflects the intricate knowledge of a wide variety of animals that still existed throughout the Bronze Age.

The organisation of hunting would have required careful preparation and planning, especially because it was practiced next to farming with its inherent multitude of related activities. First of all, since hunting mostly requires more than one person, it would have needed a combined effort from several inhabitants of a settlement. Hunting needed to be combined with farming, meaning that only certain times of the day or year would have allowed enough people to hunt. Hunting would therefore have included both active and passive hunting strategies. Since during active hunting the presence of the hunter is required throughout the entire hunting process, active hunting would have mainly occurred during quiet times within the farming calendar. Passive hunting techniques however, could have been practiced throughout the year, during both quiet, and busy periods, when it could have been practiced during quiet times of the day (*i.e.* dawn and dusk). This means that passive hunting is overall most easily combined with farming life. The required combination with farming practices would furthermore have resulted in a relatively local nature of hunting in general. Visited locations for hunting would have been varied and available in the settlement surroundings, and these habitat types would have differed between the western and eastern part of West Frisia. In the west of West Frisia, the intertidal habitat was exploited with a focus on migratory fish and birds. Other habitats, including grassland, shrub land, forests, and wetlands were also exploited, resulting in a variety of mammals being caught as well. Eastern West Frisian sites divided their attention between hunting in wetlands, grassland, shrub land, and forests to obtain a range of fish, birds, and mammals. Here, mainly the breeding and moulting seasons were exploited, with an additional focus on migration periods.

Processing of hunted animals depended on the species and its final use, but may have included skinning for obtaining fur, processing for immediate consumption, and preservation techniques for long-term storage of fish and meat.

Thus, considering both the wide range of uncovered animal species with their different behaviour and habitat preferences, and the inherent skill and knowledge required for the preparation of hunting and processing these animals, hunting as a practice must still have formed an integral part of the lives of Bronze Age people.