Chapter 15

The Exploitation of Fish at Çatalhöyük

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Fish remains have received little attention thus far in the faunal studies conducted at Çatalhöyük. Although fish has been mentioned sporadically as a likely food resource, possibly all year long except perhaps during the periods of maximum flood (Fairbairn *et al.* 2005a, 95), the general impression during the processing of the faunal material was that not many remains of larger individuals occur. Moreover, no fishing gear has been found, except perhaps for a few fishhooks, sometimes seen as being ornamental rather than utilitarian (Russell 2005). In any case, the hooks appeared too large for the fish found at the site. The majority of the fish bones are from small individuals, which led to the suggestion that the fish remains, to a large extent, may have entered the site unintentionally, embedded in the mud used for bricks. In order to obtain an initial idea of the possible role fish and fishing may have played at Çatalhöyük, a selection was made of sieved samples from about 120 units that were chosen in such a way as to cover the temporal span and the range of context types found at the site.

More than 8,000 units were excavated from the South, North, 4040, and KOPAL Areas at Çatalhöyük from 1995 to 2008, most of them probably containing at least some fish remains. Since separating and identifying the fish remains is labor-intensive, sub-sampling was necessary. For this study, we selected from among the 1,287 units for these areas from which the mammal remains and most other materials have been recorded. We aimed to cover the temporal sequence as fully as possible (mainly through the long sequence excavated in the South Area), and to sample a range of context types (discussed below) in order to address potential contextual variation. Additionally, we included all samples available from secure contexts in B.77, a burnt house in the 4040 Area, to examine spatial and contextual variation within a single house. This building was chosen because it has substantial deposits of many materials that may be associated with its use or its closing, including a fish bone concentration discussed below. The units selected for fish bone analysis are a subset of those chosen by project members for coordinated analysis across material categories, forming the basis of earlier publications (Hodder 2005c), as well as the studies in this volume.

For each unit, the fish remains analyzed were extracted from the 4, 2 and 1mm fractions of the heavy residue. In the case of the 4mm fractions, the entire heavy fraction was sorted by the heavy residue team, whereas this was less frequently done for the 2 and 1mm residues; large samples were subsampled for sorting (Cessford & Mitrović 2005). The proportion of sorted residue varied between 25 and 100 per cent for the 2mm fractions and between 12.5 and 100 per cent for the 1mm residues. As a result, the data are dealt with here in two ways. First, while describing the remains, the actual numbers (NISP – number of identified specimens) will be mentioned; but in a second step, it is necessary to carry out a correction for the proportion of sorted residue. Those 'virtual numbers' will be used while discussing the proportions among taxa and when considering the size distribution of the fish.

Description of the material

The fish remains were identified with the aid of the comparative skeletal collections housed at the Royal Belgian Institute of Natural Sciences (RBINS). These reference specimens consist of about 200 individuals of a total of 51 species collected during fieldwork in Anatolia by the first author (Van Neer *et al.* 2000; 2008). Additional modern skeletal material from the Habur River in northern Syria and from European freshwaters was used as well. Archaeological fish bones that were sufficiently preserved were used for the reconstruction of the corresponding fish length through direct comparison with modern specimens of known size. These body length reconstructions were done by 5cm size classes, except for the cyprinids larger than 30cm, in which case the class width was 10cm.

The represented taxa are exclusively cyprinids and loaches, two groups of fish with a large number of species that often show large morphological similarities. Another factor that hampers identifications is the fact that the freshwater fish fauna of Anatolia is not completely known at present. Despite earlier surveys and revisions (Bogutskaya 1992, 1997a; Erk'akan *et al.* 1999), new taxa are still described each year (Bogutskaya 1997b; Freyhof & Özuluğ 2006; Naseka *et al.* 2006; Bogutskaya *et al.* 2007; Erk'akan *et al.* 2007; Schöter

	original values		corrected values	
	NISP	%	NISP	%
Pseudophoxinus spp.	605	5.06	3496	5.62
Capoeta sp.	791	6.62	6808	10.94
Chondrostoma sp.	10	0.08	25	0.04
Gobio sp.	3	0.03	16	0.03
Leuciscus sp.	1	0.01	8	0.01
Leuciscinae indet.	101	0.84	1849	2.97
Cyprinidae indet.	9355	78.25	43261	69.53
Cobitis cf. *bilseli*	2	0.02	18	0.03
Cobitis cf. *fahirae*	1	0.01	8	0.01
Cobitis cf. *taenia*	4	0.03	17	0.03
Cobitis cf. *turcica*	1	0.01	8	0.01
Cobitis cf. *simplicispinna*	2	0.02	10	0.02
Cobitis cf. *vardarensis*	1	0.01	8	0.01
Cobitis sp.	24	0.20	177	0.28
Seminemacheilus cf. *lendlii*	26	0.22	207	0.33
Cobitoidea spp.	1028	8.60	6300	10.13
total identified fish	11955	100	62216	100
unidentified fish	6738			
grand total	18693			

Table 15.1. *Summary of the analyzed fish remains (NISP or number of identified specimens).*

et al. 2009; Küçük *et al.* 2009), or changes in the systematics are adopted (Özuluğ & Freyhof 2007). Moreover, the present-day distribution of fish is likely to have undergone changes in the recent past as a result of changes in the hydrology due to damming and irrigation projects. This is true in particular for the fish fauna in the Çatalhöyük region. An artificial outlet at the southeastern end of Lake Beyşehir connects to the Çarşamba River (Dursun 2010), and numerous canals have been constructed in the Konya plain that have altered the original hydrology. The vast marshlands that were still found in some places in the area in the 1970s have now disappeared because of drainage works (Rosen & Roberts 2005). These changes must have caused local extinctions as well as invasions, but other anthropogenic processes such as pollution, over-fishing and the introduction of new species have also taken place. The fact that the ichthyofauna found near the site today has probably undergone considerable changes, combined with the still incomplete knowledge about the taxonomic diversity of central Anatolian cyprinids and loaches, make it difficult to propose identifications beyond the level of genus. Only when very diagnostic bones are found will a cautious attribution to species be made (e.g. *Cobitis* cf. *bilseli*). It is unlikely, however, that this level of identification will hamper the archaeological interpretations, since apparently no great differences exist in the ecology and behavior of species within a genus (in terms of migrations and seasonal movements related to spawning).

An overview of the finds with the NISP given for the individual units is provided in Table 15.7 (on CD). The totals are given here in Table 15.1, with the first two columns corresponding to the totals of the different sieve fractions for each of the loci without any correction for the proportion of volumes sorted. Besides these actual find numbers, the 'true' proportions of the various fish taxa are given in the two columns at the right. These figures were obtained after corrections were made for the percentages of studied sieved residue.

It appears that 91 per cent of the 11,955 identified remains are from Cyprinidae and that the rest is from loaches (superfamily Cobitoidea, see below). Of the 10,866 cyprinids, about 14 per cent could be identified more precisely. The most common diagnostic elements were pharyngeal plates, basioccipitals, parts of the Weberian apparatus, first and second precaudal vertebrae, dentaries, maxillae and cleithra. The most frequent taxon is *Capoeta*, a genus of which presently 17 species are described from Anatolian freshwaters. An identification at species level was not attempted, although many of the species, several of which are endemic, can *a priori* be excluded as possible candidates for the Çatalhöyük fish. This is the case because their modern occurrences are much too distant from the study region (cf. distribution maps in Geldiay & Balık 1996, and information given in FishBase [Froese & Pauly 2010]). Although *Capoeta* can reach lengths of 40cm SL (standard length) and more, almost all 791 *Capoeta* remains from Çatalhöyük are from small individuals measuring 10cm SL or less. Exceptions are five bones corresponding to fish of 20–25cm that were found in an ash and charcoal dump (1066), and one bone of a *Capoeta* of between 10–15cm SL that was recovered from another dump (4844). When taking into account the corrections for the volumes sorted, it appears that 89.9 per cent of all *Capoeta* were less than 5cm SL and that 9.9 per cent measured between 5–10cm SL. In terms of NISP, the second most frequent fish taxon is *Pseudophoxinus*, a genus that, as mentioned above, is still poorly known taxonomically. The zooarchaeological material shows that several morphotypes occur in the pharyngeal plates (three morphotypes) and in the basioccipitals (minimum two morphotypes), indicating that at least three different species may have been present. In terms of reconstructed sizes, the *Pseudophoxinus* are larger on average than the *Capoeta* (Fig. 15.1) with many more individuals larger than 5cm SL. The three other genera that could be recognized in the Çatalhöyük material are represented by a few specimens only. Ten bones, belonging to the nases (genus *Chondrostoma*), are all from fish less than 5cm

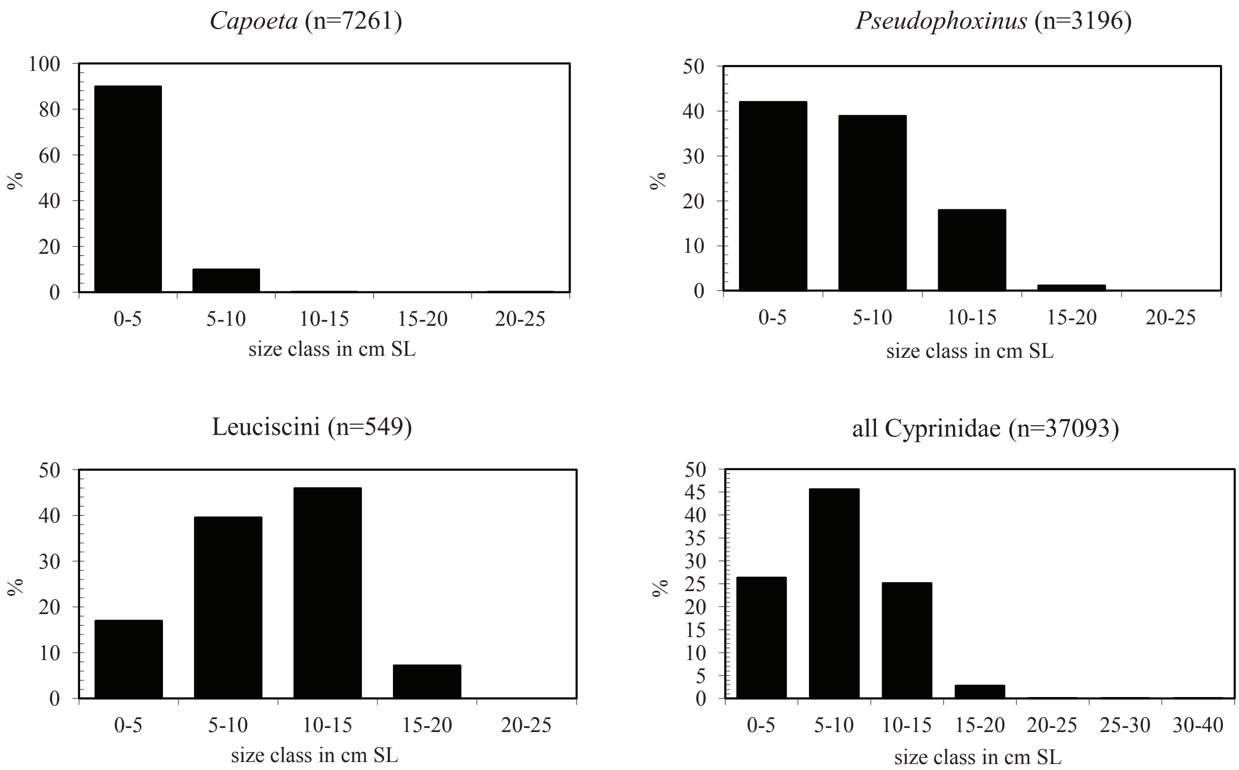

Figure 15.1. *Size distribution of the cyprinids of all studied contexts, except for those from a special deposit in building 77. The number of specimens (n) on which the proportions of the various size classes are based are 'virtual' figures that were obtained after corrections for the percentage studied of the various sieve fractions. For the Cyprinidae, the size distributions are indicated separately for* Capoeta *spp.,* ~~Pseudophxinus~~ *spp. and for the Leuciscini. The graph with all Cyprinidae includes the remains that were identifiable as well as those that could not be identified beyond the family level.*

long. At least ten Anatolian species are listed in FishBase (Froese & Pauly 2010), but, using the distribution patterns mentioned there and in Bogutskaya (1997a), the most likely candidates for the Çatalhöyük nases seem to be *Chondrostoma regium* and *Chondrostoma beysehirense*. There are also three bones of gudgeon (*Gobio*), namely a hyomandibula of a fish measuring 5–10cm SL and two pharyngeal plates of individuals of 10–15cm SL. FishBase (Froese & Pauly 2010) lists six species for Turkey, of which three occur in Central Anatolia. The distribution of one of the species, *Gobio insuyanus*, is said to be limited to the Konya region. However, since not all the modern gudgeon species are available in the reference collection, it was not possible to attempt a specific identification. Moreover, genetic studies of modern gudgeons suggest that additional species may occur in Central Anatolia (Mendel *et al.* 2008). Finally, one pharyngeal plate of a cyprinid measuring less than 5cm SL was identified as *Leuciscus* because it was osteologically similar to *Leuciscus cephalus* (now synonymized with *Squalius cephalus*). Except for the latter species and for *Leuciscus anatolicus* – that occurs nowadays in Lake Beyşehir and probably also Lake Akşehir – there are no other *Leuciscus/Squalius* species in Central Anatolia. Besides the aforementioned genera, there are also a further 101 bones (mainly elements of the Weberian apparatus) that were classified as Leuciscinae. This is a subfamily of the cyprinids that includes, amongst others, the genera *Chondrostoma*, *Leuciscus* and *Pseudophoxinus* (see Bogutskaya 1997a). The term 'leuciscine' is used here to designate cyprinid remains that definitely do not belong to the genus *Capoeta*, which is the most common genus on the site. Given the proportions in which the other cyprinid taxa occur, it is likely that these leuciscine bones are mainly from *Pseudophoxinus*. The reconstructed sizes (Fig. 15.1) of this group show a preponderance of the size classes 5-10cm SL and 10–15cm SL, which is in agreement with the supposition that the remains are mainly from *Pseudophoxinus*.

The samples studied thus far yielded 1,089 remains of loaches. This is a very diverse group of fish with numerous taxa that, in Anatolia, belong to the families Cobitidae and Balitoridae. The systematics of these small fish that belong to the Cobitoidea

Location/Level	number of assemblages	all bone in grams	#fish bones	#fish per gram bone mass	min-max
midden South G	18	23819.2	86936	3.65	0.03–16.51
fill South G	2	265.6	208	0.78	0.47–0.93
penning layer South H-I	2	557.0	2010	3.61	0.42–8.51
construction material (floors) South K	3	315.6	723	2.29	1.75–7.69
midden South H-M	8	2434.7	4838	1.99	0.12–12.86
fill South H-M	4	258.6	294	1.14	0.02–11.29
ashy spreads South H-M	8	630.4	398	0.63	0.02–4.97
fill South P-S	11	386.0	80	0.21	0.0–0.62
midden South P-S	15	7852.9	735	0.09	0.0–0.69
construction material South P-S	2	568.8	44	0.08	0.0–0.08
ashy spreads P-S	4	37.4	0	0.00	0.0–0.0
fill 4040 ?G	15	934.7	201	0.22	0.00–8.19
stone cluster 4040 ?G	3	38.2	8	0.21	0.00–0.43
spread of burnt grain 4040 ?G	1	61.7	11	0.18	
construction material (mortar of wall) 4040 ?G	1	7.1	1	0.14	
ashy spreads 4040 G	3	17.2	0	0.00	0.0–0.0
construction material (floors) North ?G	3	154.7	530	3.43	2.01–5.40
fill North ?G-?H	7	245.0	495	2.02	0.04–13.94
construction material (support for wall) North ?G	1	60.1	68	1.13	
construction material (mortar) North ?G	1	54.2	10	0.18	
midden North ?G-?H	2	931.3	58	0.06	0.04–0.39

Table 15.2. *Summary of the fish bone densities by context type arranged chronologically.*

superfamily are not fully understood and it is likely that several Anatolian species still remain to be discovered. On the basis of the literature available, it appears that 12 species of Cobitidae and 32 species of Balitoridae have been described thus far from Anatolia. Again, taking into account the occurrence data given in Geldiay & Balık (1996) and in FishBase (Froese & Pauly 2010), combined with some observations mentioned in Van Neer *et al.* (2008), it seems that at least the following central Anatolian species need to be taken into account when considering the Çatalhöyük fauna: *Cobitis bilseli*, *Cobitis simplicispina*, *Cobitis taenia* and *Cobitis turcica* as far as the Cobitidae are concerned, and *Seminemacheilus lendlii*, *Seminemacheilus ispartensis*, *Nemacheilus angorae* and *Oxynoemacheilus eregliensis* for the Balitoridae. Both families seem to be present in the material from Çatalhöyük. Balitoridae were identified on the basis of the following elements: maxilla, dentary, quadrate, pharyngeal plate, subopercular, cleithrum, keratohyal, hyomandibular and urostyle. It appears that the 26 well-preserved specimens of these diagnostic elements match very closely the *Seminemacheilus lendlii*, but this attribution must be considered tentative because not all the other balitorids are available in the osteological reference collections. Thirty-five bones could be identified with certainty as *Cobitis*, and it is also clear that several species are present. The skeletal elements that allowed an identification as *Cobitis* are the suborbital spine, the maxilla, the keratohyal, the hyomandibular, the parasphenoid, the frontal, and Weberian apparatus. Nine of the suborbital spines and two of the maxillae suggested a specific identification. The two maxillae match perfectly with *Cobitis simplicispinna,* whereas five different morphotypes seem to occur among the suborbital spines. The latter, very diagnostic element whose morphology is always taken into account when dealing with *Cobitis* systematics (e.g. Erk'akan *et al.* 1999), indicates the presence of three of the four species that were supposed to occur in the area of Çatalhöyük according to modern distribution data, namely *Cobitis bilseli*, *Cobitis taenia* and *Cobitis turcica*. There are also, however, two suborbital spines that resemble the morphology of loaches not living in the area today, namely *Cobitis fahirae* and *Cobitis vardarensis*. These two species nowadays occur in more western parts of Anatolia, and it is not clear if the spines found at Çatalhöyük should be seen as an indication of a former wider distribution of those two species, or rather if two other taxa occurred with suborbital spines of a similar morphology. Summarizing, the group of the loaches comprise both Balitoridae and Cobitidae in almost equal proportions, but for the global quantification and the archaeological interpretation they will be simply grouped as 'loaches' or 'Cobitoidea superfamily'. The distribution of the reconstructed sizes (Fig. 15.2) shows that almost all the fish were less than 10cm long, with more than half of the animals below 5cm SL.

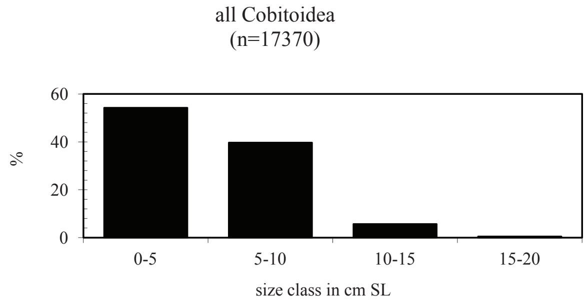

Figure 15.2. *Size distribution of the loaches of all studied contexts. The number of specimens (n) on which the proportions of the various size classes are based are 'virtual' figures that were obtained after corrections for the percentage studied of the various sieve fractions.*

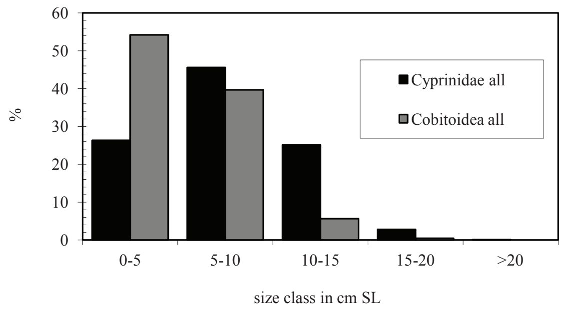

Figure 15.3. *Size distributions of all cyprinids and loaches, based on figures that were corrected for the proportions of the various sieve residues analyzed.*

The exploited habitats and the fishing season

Geomorphological work shows that Çatalhöyük was situated on an alluvial floodplain close to the main channel of the Çarşamba River (Rosen & Roberts 2005). Because of increased winter flow, nowadays between October and May, and the snow-melt from the Taurus Mountains to the south of Çatalhöyük, much of the Çarşamba alluvial fan must have been marshland in winter and spring. During the wettest time periods, Çatalhöyük may have been an island within this marsh and it was therefore suggested that the inhabitants of the site had reed- or log-boats at their disposal (Rosen & Roberts 2005, 48). It will be shown that such boats were in any case not needed for the capture of the type of fish found thus far in the excavations. An alternate view sees the seasonal flooding as far less severe, and the river channel as a series of connected pools, becoming less connected during the dry season. The substrates were sufficiently permeable to permit drainage, so that the site was located on dry land (Volume 9, Chapter 3).

It is obvious that the observed species spectrum and the size distributions of the encountered taxa are a reflection of where and when fishing was carried out, and that these characteristics of the ichthyofauna are also related to the type of fishing gear that was used.

Despite the limited ecological information that is available on the Anatolian freshwater fish taxa, it is possible to reconstruct in general terms the type of environment that was exploited. The information below has been compiled from FishBase (Froese & Pauly 2010) and Coad (2010) and also includes personal observations, made by the first author during the fieldwork mentioned above.

Loaches are benthic fish that generally live in still waters of rivers, lakes, oxbows and backwaters, where they occur over sandy or muddy substrates. They can bury themselves in this sediment but also hide under rocks or in dense plant growth. Although some species can live in waters with a stronger flow, they usually occur in lakes, lowland rivers and marshlands with little current. They are also found in springs and associated wetlands. Some loaches can easily survive in oxygen-poor waters. Spawning takes place in late spring-early summer. The size distribution of the loaches from Çatalhöyük (Fig. 15.2) shows that both young (less than 5cm SL) and adult fish have been captured.

The cyprinids are the most commonly encountered family at the site, with the most abundant genera being *Capoeta* and *Pseudophoxinus*. Almost no ecological information is found in the literature on these fish but, during surveys carried out in Anatolia, *Pseudophoxinus* species could be captured in late spring-early summer with hand nets and electric fishing gear in shallow parts of small rivers or inshore areas of lakes. Some species also occur in marshes (Özuluğ & Öztürk 2008). Maximum reported lengths are 22cm TL (total length) for *Pseudophoxinus anatolicus*, but not many other species attain lengths above 10cm (see Bogutskaya 1992). The size distribution of the *Pseudophoxinus* from Çatalhöyük (Fig. 15.1) suggests that both juvenile (less than 5cm SL) and adult fish may have been captured.

The preferred habitat of the various *Capoeta* and *Chondrostoma* species are poorly documented and it is unclear to what extent the information compiled below can be applied to the species from Çatalhöyük. The two *Capoeta* species for which we found ecological data (*C. damascina* and *C. capoeta*) inhabit lakes and streams with both slow- and fast-moving waters that can be muddy or clear. Both species spawn mostly on stony or gravelly substrates; *C. damascina* reproduces between January and March in small streams. Some ecological information was found for *Chondrostoma nasus*, *C. holmwoodii* and *C. vardarense*, indicating that the adults of these fish can live in lowland waters with little current, but that they are also found in rather shallow water with a fast current. They can be found in the upper reaches of rivers, and at least two of the aforementioned species migrate upstream and ascend small tributaries to spawn on gravel. The *Chon-*

	number of assemblages	all bone in gram	#fish bones	#fish per gram bone mass	min-max
mortar	2	61.3	11	0.18	0.14-0.18
floors	6	470.2	1253	2.66	2.29-3.43
stone cluster	3	38.2	8	0.21	0.00-0.43
penning layer	2	557.0	2010	3.6	0.42-8.51
ashy spreads	15	685.0	398	0.58	0.00-0.63
fill	39	2090.0	1278	0.61	0.22-2.02
midden	43	35038.1	92567	2.64	0.06-3.65

Table 15.3. *Averages of fish bone densities in the various context types.*

drostoma remains do not include a single bone from adult, sexually mature fish, and they all pertain to small fish of less than 5cm long. The same pattern is observed in *Capoeta*, the most frequently represented taxon at the site. Despite the fact that *Capoeta* species can attain sizes of 40 to 70cm SL, there are only five bones from fish of 20–25cm that could be from a sexually mature individual. All the rest are definitely from juvenile specimens, to be considered as being in their first growth year (the so-called 0^+ age group). Roughly ninety per cent of the remains are from fish smaller than 5cm SL, the other ten per cent measured between 5 and 10cm SL (Fig. 15.1). The size of these cyprinids indicates they were only a few months old. The size distributions show that the inhabitants of Çatalhöyük did not harvest reproducing *Capoeta* or *Chondrostoma* on their spawning grounds. It is conceivable that the *Capoeta* and *Chondrostoma* adults seasonally migrated from the Çarşamba towards smaller tributaries near the tell for spawning, and that the young fry would afterwards migrate laterally into adjacent, flooded areas where more vegetation and nutrients were available than in the channels.

The fishing activities thus consisted mainly of the harvest of small-sized fish, both adults of smaller species like the loaches, the *Pseudophoxinus* and the *Gobio*, and – on the other hand – the young of the larger species of *Capoeta* and *Chondrostoma*. Juveniles of *Pseudophoxinus* and loaches are numerous as well. All these small fish may have occurred in the immediate vicinity of the site if it is accepted that this was – at least seasonally – a mosaic of shallow, marshy waters. The aquatic mollusks found at Çatalhöyük also suggest abundant shallow water habitats (Gümüş 2009). The intensive exploitation of these waters may have started in late spring-early summer when the waters on the floodplain started dropping, resulting in the formation of smaller water bodies that were easily accessible for the inhabitants of Çatalhöyük. Although spawning *Chondrostoma* or *Capoeta* have not been captured, it is likely that the recovered *Pseudophoxinus* remains are, at least partially, from fish that occurred inshore for reproduction. During the modern fish surveys carried out by the first author (Van Neer *et al.* 2008), several species of this genus were found in large numbers in the month of May with their gonads well developed, but in August, almost no *Pseudophoxinus* could be captured because they were no longer occurring in inshore habitats. The presence of the young *Capoeta* and *Chondrostoma* confirms that the fishing season lasted a few months after the start of the spawning season (which, in Western and Central Anatolia, is generally late April-May for cyprinids).

Although it is likely that fluctuations in the hydrological regime resulted in inter-annual variation, fishing activities at Çatalhöyük seem to have lasted a few months, after which exploitation became less profitable because the local fish stocks started to be exhausted. It cannot be excluded either that much of the shallow water habitats dried up during the summer.

Fishing methods

Successful exploitation of the small-sized fish requires that they are easily accessible. The small species (mainly *Pseudophoxinus* and the loaches) reproduced in the shallow waters, at which time they must have occurred in inshore areas, making them vulnerable to humans and other predators. Later on, juveniles of the larger fish (mainly *Capoeta* and some *Chondrostoma*), but also juvenile loaches and *Pseudophoxinus*, may have concentrated gradually as the flood waters continued to drop and small water bodies were formed. Such waters of more limited extent and shallow depth must have been easily wadable, thus facilitating the capture of the fish. In such environments, various fishing methods may have been used.

As mentioned in the introduction, objects resembling large fishhooks occur, but they are rare and clearly too large for the fish that we find at the site. Even if some of them are actual fishhooks that were used as such, the fish that might have been caught with them are not present in the assemblages studied to date. No other artifacts, such as net weights, have been found that can be seen as evidence for fishing tools, but it is possible that gear made of perishable plant material was used.

Judging from the basketry and matting found in the houses of Çatalhöyük (Wendrich 2005), the inhabitants must have been capable of manufacturing scoop baskets as well. These baskets are very efficient and still used today in shallow water habitats to filter fish from water (von Brandt 1984, 212–214). These baskets can be plaited plates or shovel-shaped implements made from wickerwork that are rather small and easy to handle. This gear is typically used today in Asia and Africa by children and women wading in the water, sometimes working collectively in a line. At Çatalhöyük, scoop baskets would have been very efficient gear in marginal areas, including those with abundant vegetation in a marshier environment. Such habitats may have been used by the small spawning fish, and they are also preferably occupied by loaches. As water levels of the flood plain gradually dropped during the summer, isolated water bodies may have formed, and people may also have dammed parts of the alluvial plain to create smaller pools or ponds that could be intensively exploited. Scoop baskets would have been very efficient in such an environment; small water bodies may even have been scooped out completely. Fine-meshed nets would of course also be efficient, but it is unclear if these were manufactured at Çatalhöyük, although the textile finds from the site show that the inhabitants worked with small fibers and could therefore have made nets; indeed, Helbaek tentatively refers to one specimen as resembling an unknotted fishnet (Burnham 1965; Helbaek 1963; Ryder 1965; Vogelsang-Eastwood 1988). An alternative, passive, use of baskets and traps would be to place them on the outlet of small water bodies. The water current in such temporary channels permits fish to easily leave the alluvial plain as floodwaters recede; constructing barriers in the right places would allow the harvesting of fish with very little effort expended.

Another efficient technique in these isolated, shallow waters may have been the stupefaction of fish, although this practice is difficult to confirm archaeologically. Stunning of fish is possible through stirring of the mud, which results in a drop in the oxygen content. Large, communal fish drives are known from tropical countries, but also from temperate ones such as Hungary, where people tramp around in shallow waters to stir up the mud. Another way of paralyzing fish is to poison them with ichthyotoxic plants (von Brandt 1984, 34–40), which are cut to pieces or crushed and then added to the water. Although this method is most frequently practiced in tropical countries, several ichthyotoxic plants are also used in temperate regions (Álvarez 2000). Some of the taxa listed by von Brandt (1984, 38) and Álvarez (2000) have been found during the macrobotanical and anthracological analyses at Çatalhöyük (Fairbairn *et al.* 2002; Chapter 7), namely *Hyoscyamus, Verbascum* and Thymelaeaceae. A few additional taxa have been identified at Çatalhöyük that were not listed in the aforementioned publications on traditional fishing, but that could be suitable for fish poisoning as well. These are plants containing water-soluble chemicals that can stun or kill fish, such as cyanides (*Amygdalus*), poisonous etheric oils (*Artemisia*, *Juniperus*), saponines (e.g. several species of *Rumex*), alkaloids (*Adonis*, *Clematis*, *Heliotropium*) and tannins (Marinova pers. comm.). These plants may have been thrown in the water in crushed form. It is not excluded that alternative methods were known, such as the one observed by Ertuğ-Yaraş (1997), consisting of hitting the water with bundles of twigs to scare the fish. A similar technique is applied in the shallow rivers of southwest Bulgaria, with the use of whole plants of *Verbascum* or branches of *Juglans* or *Juniperus oxycedrus*, which are considered by the local population to have ichthyotoxic effects (Marinova pers. comm.).

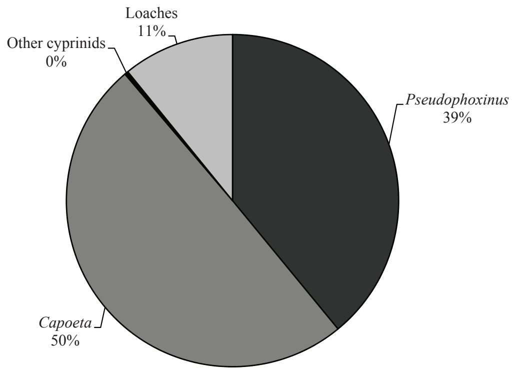

Figure 15.4. *Percentage contribution of the major fish taxa, based on corrected NISP values (n=62,216).*

Fish in the diet

Starting from the corrected NISP values (Table 15.1), the proportions of the various taxa have been recalculated assuming that, within the 'Cyprinidae indet.', the proportions of the genera are the same as in the well-identified part of the finds collection. Moreover, to simplify this exercise it is accepted that the 'Leuciscini indet.' are all *Pseudophoxinus*, and all loaches are considered as one group. The loaches represent about 10 per cent of the consumed fish, whereas the remainder is mainly the cyprinids *Capoeta* and *Pseudophoxinus* with about 50 and 40 per cent of the finds, respectively (Fig. 15.4). The contribution of the other cyprinids is negligible.

The proportion of fish remains versus those of consumed mammals and birds can be a good measure for documenting diachronic changes in the relative contribution of fish to the diet (see below), but expressing their contribution in meat weight is not feasible due to problems related to differential preservation. It is likely, however, that in terms of meat yield fish was a minor food resource. Carbon and nitrogen isotopic analyses carried out thus far on human bone from Çatalhöyük (Richards *et al.* 2003a; 2005; Chapter 13) do not provide evi-

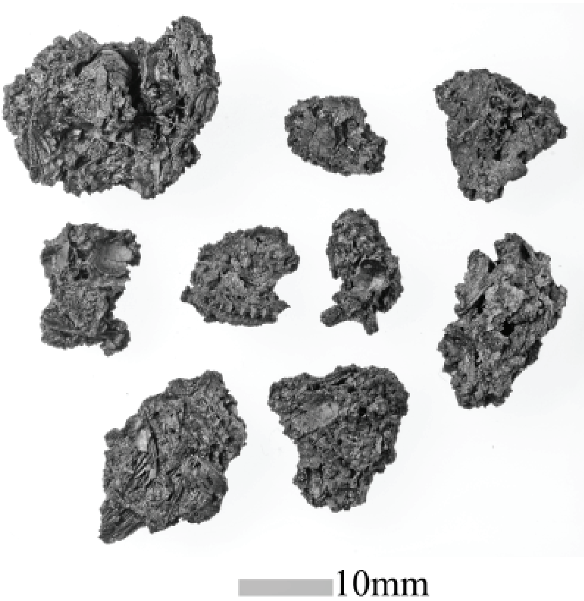

Figure 15.5. *Pieces of burnt material from Building 77 containing peas and fish remains (Photograph by Ian Cartwright, School of Archaeology, University of Oxford).*

dence for fish consumption. It remains to be seen whether the additional use of stable sulfur isotopes (Richards *et al.* 2001; 2003b) will enable better documentation of the contribution of fish to the diet.

Although fish was probably not a major supplier of nutrients, it may have been a rather regular food ingredient. A special find ((16498), (17513) and (17519)) from burnt B.77 suggests that small fish may have been used in a dish, not yet retained in previous interpretations (Atalay & Hastorf 2005), that consisted also of peas and some naked barley grain (Chapter 7). This particular deposit contained no bones of loaches, although there were numerous remains of small cyprinids – both *Capoeta* and *Pseudophoxinus* mainly between 5 and 10cm SL – sometimes still in articulation (Fig. 15.5). Besides an albeit limited source of animal protein and fat, the fish may have added flavor to the dish, particularly if they were used in dry form as is still done today in many tropical and subtropical regions. When fish are small, as is the case here, they can be dried in the sun on rocks, matting or screens without any preliminary preparation (Maar *et al.* 1966). During summer, the roofs of the houses at Çatalhöyük may have been suitable for sun-drying of fish, as with some of the plant foods (Atalay & Hastorf 2005). The quality of the product, and the time it could be stored for future consumption, will have depended on the amount of time and effort that was spent. The fish should ideally be turned periodically to ensure even drying, and attention should be paid to insect infestation (Maar *et al.* 1966). When weather conditions are dry and hot, small fish can be dried within a few days (Essuman 1992).

Intra-site variation in fish abundance

In order to verify if, and to what extent, the amount of fish remains varies through time or according to context type, a measure has been established that expresses the amount of fish bone within the faunal assemblages of the various units. For each unit, the total number of fish remains (identified and unidentified) was calculated by correcting for the proportion of studied sieved residue. This virtual number was then divided by the mass of the total faunal bone from the heavy residue, a figure that was available for all units. Using the number of fish bones per gram of heavy residue bone (also called 'fish bone density' below), several meaningful trends seem to appear (Tables 15.2–4).

Table 15.8 (on CD) gives for each unit detailed information about provenience, dating, type of deposit, total mass of heavy residue bone, number of fish bones (sum of identified and unidentified), and number of fish bones per gram of total bone. One particular deposit from burnt B.77 ((16498), (17513) and (17519)) – consisting only of macrobotanical material and fish bone – is not presented in this table and has been dealt with separately in a previous paragraph.

The results are presented as follows: first, variation in fish densities by context type is verified, and second, possible temporal changes are examined. Table 15.2 summarizes the data from Table 15.8 (on CD) and shows, in chronological order, the fish bone densities in the various context types. For each context type, the number of assemblages of that type is indicated together with the total mass of the heavy residue bone, the total number of fish bones and the average number of fish bones per gram total bone mass. The minimum and maximum values of the latter proportion are also given and illustrate the large variation in fish bone density that can occur within a specific context type in a particular period.

Data are summarized in Table 15.3 to illustrate the averages and variation in fish bone densities by context type. As mentioned in the introduction, mud used for building construction has been proposed as a possible source of intrusive fish remains. The absolute number of fish bones in the two mortar contexts is very low (1 and 10 remains), and compared with the overall vertebrate bone mass (which is also minimal), the fish bone densities are also low. Mud used for floor construction was also analyzed, with the expectation that they would contain equally low numbers of fish bone. This was not the case, however, and it remains to be seen if this can be explained by trampling effects that resulted in the inclusion in floors of small fish remains that were initially lying on the floors' surface, or whether it was due to the addition of midden-derived deposits used in floor construction.

Level South G	3.65
Level South H-M	1.99
Level South P-S	0.09
Level North ?G-?H	0.06

Table 15.4. *Average fish bone densities of middens and fills according to large temporal units.*

Level	% cyprinids	% loaches	corrected NISP
South G	89.9	10.1	56744
South H-M	77.7	22.3	4039
South P-S	96.2	3.8	763
North ?G-?H & 4040 ?G	99.3	0.7	9871

Table 15.5. *Proportion of cyprinids and loaches through the large temporal units.*

The faunal remains from three ground stone clusters, all from the floor of B.77 in Level 4040 ?G, yielded very little bone in general, and fish bone densities were low. This is in distinct contrast to the remarkable concentration of fish bones in association with peas and barley in the southeast corner of this building ((16498), (17513) and (17519)).

Two penning layers, one from Level South H and another from Level South I, were relatively rich in fish bone. In the layer from Level South H, the fish bone density is comparable to what is seen in richer midden deposits, which are the context types with the highest abundance of fish remains. Several explanations for this are possible. Caprines may have been fed leftovers of fish or even whole, dried fish as is still done today throughout southeastern Arabia to feed camels and goats (Cordes & Scholz 1980). Alternatively, the layers may correspond to midden deposits that were formed after the area was no longer used to keep animals, or in other seasons. The density of general faunal bone, comparable to the lower end of the range for middens, shows that these deposits include dumped garbage as well as trampled dung.

Fifteen assemblages representing ashy deposits have been analyzed. These show a lot of variation in the amount and density of fish bone. About half of the retained ashy spreads contained no fish bone at all. Highest densities were observed in oven rake-outs (of Levels South J-L), but in one such instance (in Level South S) no fish bone occurred at all. Perhaps the variation reflects the extent to which rake-outs and other ashy deposits include general floor sweepings, or possibly this is seasonal variation.

In general the midden deposits have a higher fish bone density compared to the fills. This is the case for the average values, but also remains valid when each period is considered separately (the only exception being Levels South P-S). Middens are formed by dumping rubbish, while the fills are generally a mixture of redeposited sediments of various types and pulverized building material. Animal bone is generally sparse in the fills, and often similar in nature to the faunal assemblages from construction material. The low levels of fish bone in fill even in comparison to overall animal bone perhaps reflects the generally low fish densities in construction material noted above. There may also be a taphonomic effect, with delicate fish bones lost as material was churned up for redeposition as fill.

When looking for temporal trends in the relative importance of fish to the diet, it is advisable to compare assemblages from a single, particular context type. Midden and fills are the context types of which most assemblages have been studied (43 and 39 respectively) and therefore enable the best temporal coverage. In terms of absolute number of fish bones, the middens are the richest. For this reason, and also because fills are mainly redeposited material of which the temporal association may be less clear, the values obtained for the middens are the most relevant ones. In the South Area, there is a clear decreasing trend in fish bone densities, becoming very low in Levels South P-S (Table 15.4). These low levels are matched in the North Area middens, which probably belong to roughly the same period.

Another way of approaching the diachronic changes in fish bone densities is to keep each smaller chronological unit separate and to consider all context types (Figure 15.6). This gives more temporal resolution, but is strictly speaking less precise because different types of deposits are lumped and because for certain time periods, the number of assemblages is small. It appears that after Level South G, an even higher contribution of fish is seen in Level South H, although this observation is only based on two assemblages (a burning layer and a penning layer). Afterwards, in Level South I, there is a sudden drop in the fish bone density of the single assemblage (another penning layer) that belongs to this period. Figures remain at a comparable level from Level South J through Level South ?M, after which they drop considerably again. These low figures, certainly those from Level South R and Level South S, must be relevant since they are based on a large number of assemblages, including numerous middens. The assemblages from Level 4040 ?G yield a low fish bone density, comparable to what is seen in the more or less contemporaneous contexts from Levels South P-S. Much higher average values are seen in the roughly equivalent Level North ?G and Level North ?H, however. This is due to the relatively high densities in the floors and fills (see Table 15.2). When only the middens from Level North ?G and Level North ?H are considered, a low fish bone density (0.06) is seen comparable to what occurs in Levels South P-S.

It is not entirely clear if, or to what extent, this decrease

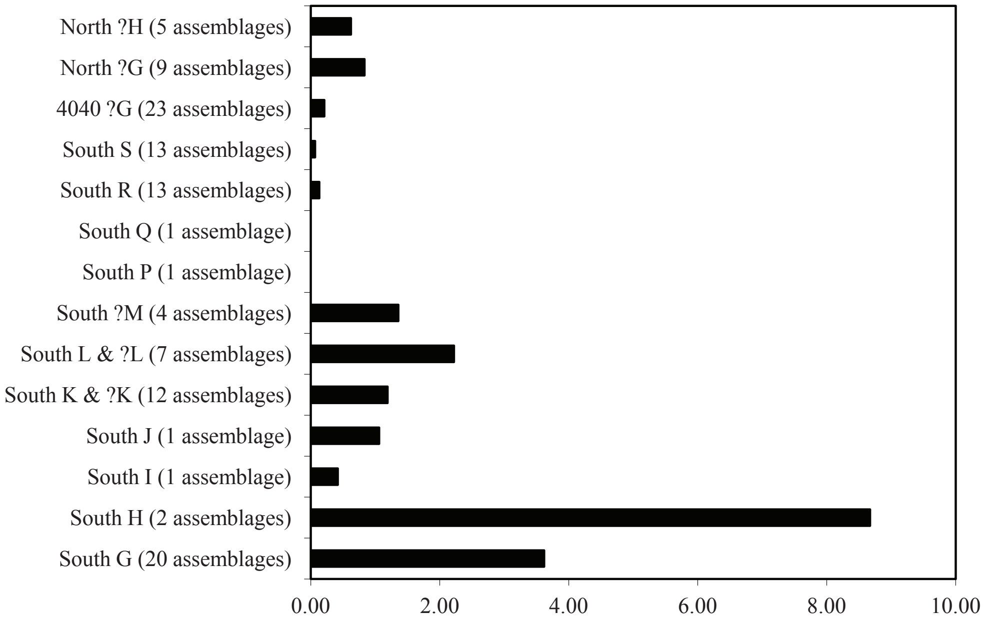

Figure 15.6. *Average fish bone densities of all studied material according to smaller temporal units.*

in fish bone densities could be related to environmental or climatic change. Increasing aridification in later occupation levels has been suggested previously (Asouti 2005; Jenkins 2005), although it is likely to have started somewhat earlier in the sequence than the shift noted here. It has recently been suggested (Volume 9, Chapter 3) that intensive clay digging around the site may have had local environmental consequences, degrading wetland resources and causing drainage, with no climatic change during the time span covered here (Chapter 8). The species composition is rather constant through time, with cyprinids being the most exploited fish (Table 15.5). Loaches appear to become rarer in the later levels, however. The size distributions of the fish taxa show some temporal variation (Table 15.6). In the cyprinids, it is seen that the smaller size class (less than 5cm SL), which represents about a quarter of this fish family in Level South G and Levels South H-M, is totally absent in Levels South P-S. The same is true for the 4040 Area, and in the North Area the smallest size class is also poorly represented. The loaches show a similar trend, with a marked decrease through time in the proportion of the fish smaller than 5cm SL. It seems that less small fry were captured during these later periods. Since all size classes are still exploited, albeit in different proportions, the fishing gear may have remained the same. The observed size changes are possibly related to the disappearance of suitable spawning grounds with abundant vegetation required for egg-laying, and where larvae undergo their first growth stage. The lower proportion of loaches in later levels might also be explained by a loss of densely vegetated aquatic habitats.

Discussion

In sum, the fish bones at Çatalhöyük are primarily cyprinids and loaches, and overwhelmingly from fish less than 10cm long. This includes both adults of small species and immature individuals of larger species. This pattern suggests that fishing was seasonal, occurring in late spring through mid-summer, and targeted small fish in pools on the floodplain. The fish were probably harvested with baskets or perhaps nets; they were not caught with the fishhooks found at the site, as these are meant to target larger fish.

The small size of the fish remains recovered at Çatalhöyük had previously raised the possibility that the fish bones are intrusive, coming in with the alluvium used as building material. Closer study negates this idea, however. Bone from natural deaths should not be so restricted by size and season. Moreover, fish bones are scarce in construction material, and most abundant in the middens, even in comparison to general animal bone quantities. The middens contain massive amounts of rubbish, including the majority of the remains of meals. As such, the fish appear to have been deliberately caught and consumed. We suggest that the inhabitants of Çatalhöyük may have targeted small fish because they were easily caught and easily dried, with no need for processing such as scaling

Level	0–5 cm SL	5–10 cm SL	10–15 cm SL	15–20 cm SL	>20 cm SL	corrected NISP
	Cyprinidae					
South G	26.6	45.7	25.0	2.6	0.1	35205
South H-M	22.0	43.1	26.9	6.7	1.2	1646
South P-S	0.0	64.3	33.1	2.6	0.0	701
4040 ?G	0.0	54.9	43.9	1.2	0.0	164
North ?G-?H	6.8	48.4	43.2	1.0	0.5	192
	Cobitidae					
South G	56.9	37.4	5.4	0.3	0.0	15932
South H-M	25.2	69.3	4.9	0.6	0.0	1250
South P-S	0.0	100.0	0.0	0.0	0.0	32
4040 ?G	-	-	-	-	-	0
North ?G-?H	15.5	64.3	20.2	0.0	0.0	84

Table 15.6. *Reconstructed sizes of the cyprinids and loaches through the large temporal units***.**

and gutting. Thus it is likely that many of the fish were stored, and this may account for the occasional finds on floors, most dramatically in the deposit in B.77. Here, a large number of fish bones, some partially articulated, were mixed with and, in the burning that ended the life of the house, fused to a large number of peas, along with barley. This was a dense concentration and, as no evidence of a container survived, it is unclear whether it represents the remains of a prepared dish or simply that these items were stored together.

The amount of fish remains present on site declines over time throughout the occupation at Çatalhöyük. If we examine only the midden deposits – as they are likely the most accurate reflection of fish exploitation – consumption is highest during the earliest levels at the site (Levels South G-H) and drops sharply in later levels (Levels South P-T). Clay-digging activities may have altered the hydrology in the vicinity of the site so that the floodplain pools no longer existed, or became less suitable, as a spawning and nursing area for fish (Volume 9, Chapter 3). In later periods, when many changes are evident at the site, there may also have been scheduling conflicts as a result of alterations in food-production/procurement regimes, such as an apparent increase in sheep herding. In any case, fish would never have comprised a large part of the diet, although dried fish may have provided welcome protein and fat, and perhaps even a bit of flavor, in the lean months of the year.

Acknowledgments

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