

The Role of Fish in Ancient Time

Proceedings of the 13th Meeting
of the ICAZ Fish Remains Working Group
in October 4th – 9th, Basel/Augst 2005

Herausgegeben von
Heidemarie Hüster Plogmann



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Mesolithic wetland exploitation at Galgenbühel / Dos de la Forca Italy, Eastern Alps. The fish fauna

Marta Bazzanella, Lorenzo Betti and Ursula Wierer

Abstract / Zusammenfassung

Excavation of an Early Mesolithic rockshelter located at the bottom of the Adige Valley in South Tyrol (Italy) by the Archaeological Heritage Office of the Province of Bozen / Bolzano led to the discovery of an astonishing quantity of fish remains in addition to a variety of other wetland fauna. Taxonomic identification shows a predominance of Pike (*Esox lucius*) and of Cyprinids [mainly Rudd (*Scardinius erythrophthalmus*), Roach (*Rutilus erythrophthalmus*) and Tench (*Tinca tinca*)]. In the upper layers one can recognize a specialization in catching Pike only. No selection concerning fish size was made. Defining the fishing season preliminary data indicate that the site was frequented during the warmer seasons.

Bei der archäologischen Untersuchung der altmesolithischen Fundstelle Galgenbühel im Etschtal bei Salurn (Südtirol, Italien) durch das Amt für Bodendenkmäler, Abteilung Denkmalpflege, der Provinz Bozen wurde, neben verschiedenen am Wasser lebenden Faunen, eine große Menge an Fischresten geborgen. Aus der Artenbestimmung geht hervor, dass Hecht (*Esox lucius*) und Karpfische [hauptsächlich Rotfeder (*Scardinius erythrophthalmus*), Plötze (*Rutilus erythrophthalmus*) und Schleie (*Tinca tinca*)] überwiegen. Die jüngsten Schichten zeigen eine Spezialisierung im Fang von Hechten. Bezüglich der Fischgröße ist keine Selektion erkennbar. Die ersten Ergebnisse der Jahreszeitbestimmung weisen auf eine Nutzung des Felsdachs vom Frühjahr bis zum Spätsommer.

Keywords: Fish fauna, Pike, Cyprinids, Fish-size, Seasonality, Mesolithic, Sauveterrian, Alps, Italy.
Fischfauna, Hecht, Karpfische, Fischgröße, Jahreszeitbestimmung, Mesolithikum, Sauveterrien, Alpen, Italien.

Introduction

Occasion for the present paper arose from the study of finds recovered from the excavation of the Mesolithic site Galgenbühel/Dos de la Forca in Salurn, Province of Bolzano (Northern Italy). The rockshelter was investigated between 1999 and 2002 during four excavation seasons supervised by M. Bazzanella and U. Wierer under the direction of Bozen Archaeological Heritage Office (Bazzanella & Wierer 2001). Excavations produced a substantial quantity of ichthyofaunal remains the analysis of which was carried out by L. Betti. Preliminary results of this research as far as the upper stratigraphic levels are concerned were recently published (Bazzanella *et al* 2004).

The site is situated in the South-Eastern Alps at the bottom of the Adige Valley between Bozen and Trento (Figure 1). The rockshelter lies above a small detritic cone on the left-hand side of the valley at 225 m a.s.l. (Figure 2). Deposits preserved here have not been fully investigated. The area scrutinized in the course of the excavation ranges between 4 and 18 sqm. Several anthropic levels were identified forming a stratigraphic

series having an approximate depth of 2.5 m prior to reaching the sterile soil (Figure 3). Typo-technological aspects of the lithic assemblage along with ¹⁴C dates indicate a repeated use of the shelter by Sauveterrian groups during the Early Mesolithic between the mid of the 9th and the mid of the 8th millennium cal. BC.

Human occupation is attested by abundant burning evidence. The interplay of anthropogenic levels and archaeologically sterile deposits seems to indicate various periods of occupation strewn inbetween episodes of site abandonment. Excavations produced abundant flint artefacts, a few bone tools and some perforated *Columbellae rusticae* (Bazzanella *et al* 2004; Wierer 2004). The variety of faunal remains highlights a rather differentiated economic system: besides the ichthyofauna, forest ungulates (in particular wild boar and red deer) are mostly represented; very common are wetland mammals such as beaver and otter (Wierer & Boscato, 2006). Exploitation of wetland areas in the valley bottom is further attested by marsh tortoise *Emys orbicularis* and fresh water molluscs of the *Unio* genus. In addition, bird and microfauna remains were recovered.

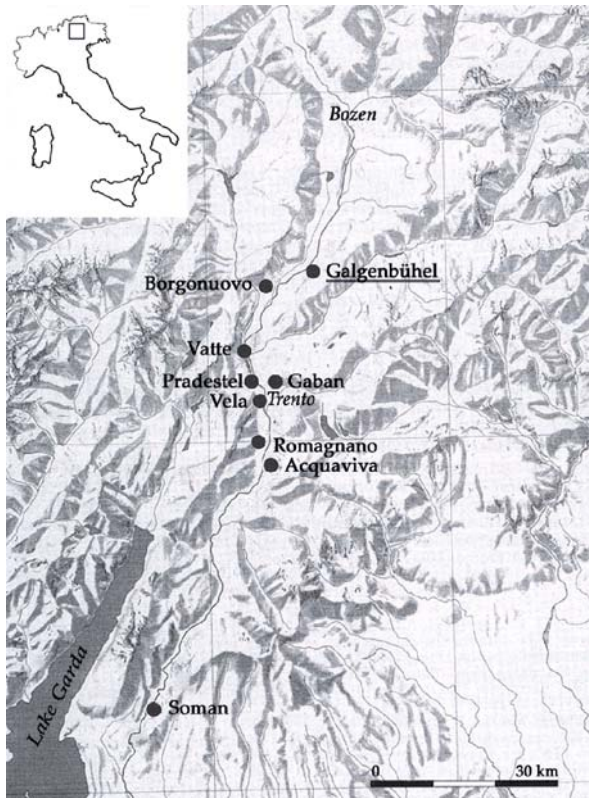


Fig. 1: Location of the Galgenbühel and the other sauveterian sites in the valley bottom of the Adige River.

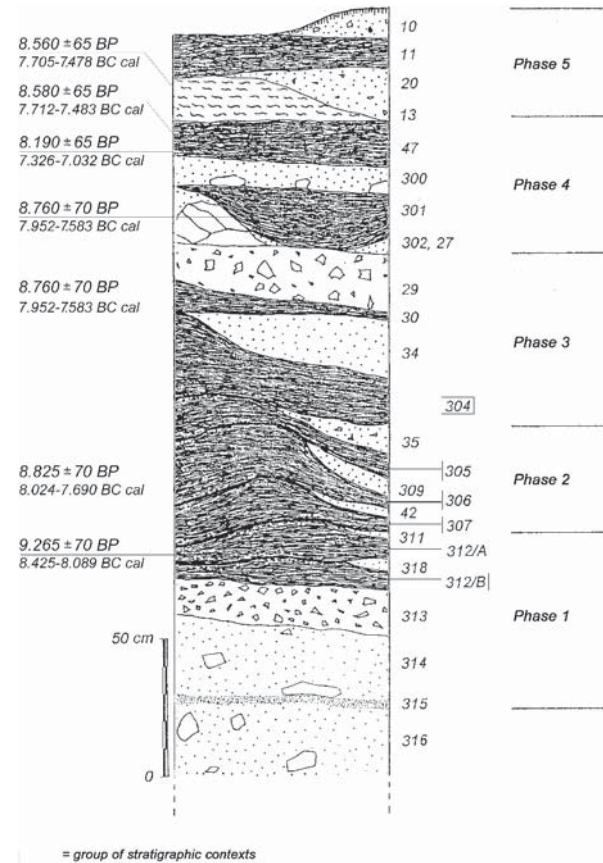


Fig. 3: Simplified stratigraphic sequence with datings (BP ¹⁴C; BC cal., ETH Zürich).



Fig. 2: Galgenbühel / Dos de la Forca at Salurn / Salorno (South Tyrol, Italy).

Materials and Methods

Archaeological excavations were carried out following stratigraphic layers according to the Cartesian recording method (minimum unit of 50x50 cm). The entire anthropic sediment was wet sieved with 1 mm meshes. Finds including all fish remains were hand-collected.

The limestone substratum contributed to good preservation of the fish remains although bone fragmentation ratio is rather high. A minor amount of the bones only was burnt. No material underwent chemical corrosion ascribable to mammal digestion processes.

Given the great quantity of recovered fish remains random samples have been selected from different human occupation levels. Finds underwent macro- and microscopic analysis in order to identify pertinent skeletal parts and taxon (family, genus and whenever possible species) by means of comparison with anatomical drawings and an ichthyofaunal reference collection.

Taxonomical basis taken as reference for both generic and specific identification are those set by Gandolfi and co-workers (Gandolfi *et al* 1991). For anatomical identification we in general adopted the definitions made by Tortonese (1970; 1975).

On the basis of 440 bone remains from strata 30 to 315 we, in addition, drew conclusions as to total body length. The methodology applied is based on the comparison with present-day ichthyofauna skeletons combined with “bone length vs. total body length” regression analysis. Data for such analysis were obtained from present-day biometric measures for some specific bone elements (e.g. on cleithrum and hyomandibular for the Pike).

In addition, 11 bones (mainly scales of *Cyprinidae*) were useful for the determination of the fishing season. The great majority of the remains turned out not to be suitable for seasonal dating because of their excessive fragmentation or consumption of their outer parts (Le Gall, 1981). The otolites recovered did not prove useful either due to external erosion caused by the presence of chemical agents in the deposit.

Microscopic analysis of the ichthyofauna was carried out with a 5-10 x magnifying glass as well as with a binocular dissection microscope at 10-40x magnification.

Results and Discussion

A total of 10,190 finds consisting of bone fragments and otolites were identified within the samples selected (Table 1).

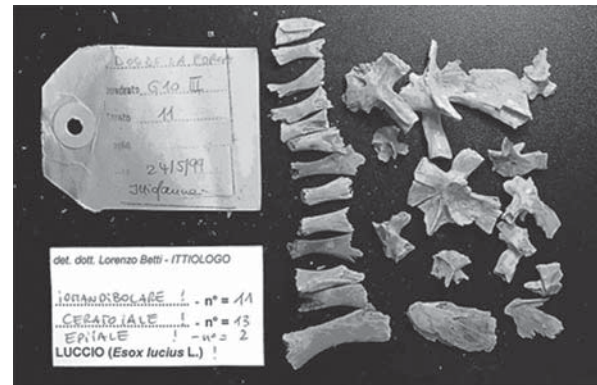


Fig. 4: Bones from the splanchnocranium of *Esox lucius* from strata 10-13.

Analysis of ichthyofaunal remains recovered from the most recent layers (10-13 and 47) revealed a predominance of Pike (*Esox lucius* Linnaeus): 99.7% of the total assemblage in layers 10-13, and 97.9% in layer 47 (Bazzanella *et al* 2004) (Figure 4). This species certainly was frequent in the Adige River already during the Pleistocene. Nowadays the presence of Pike in the valley bottom of the area has been reduced as a consequence of water management regulation policy's removing ponds and oxbow lakes along the river course. In the past such species was abundant in the slow moving reaches and slack water basins that characterized the Adige River's course on the valley bottom. However, according to simple ecologic principles, the total biomass of a strictly ichthyophagous fish as Pike happens to be one, must of necessity have been by far inferior to the biomass of the prey-fish total population. In fact, species naturally associated with Pike are very numerous in such environments. Nowadays, even though at different ratios, the following species populate the hydrographic network of the bottom of the Adige Valley (Betti 2002): cold and cool waters *Cyprinidae* (*Barbus meridionalis* Risso, *Barbus plebejus* Valenciennes, *Phoxinus phoxinus* Linnaeus, *Leuciscus cephalus* Linnaeus, *Leuciscus souffia* Risso etc.) along with *Salmonidae* such as *Salmo (trutta)* (Linnaeus) and *Thymallus thymallus* (Linnaeus) as well as *Cottus gobio* (Linnaeus), *Anguilla anguilla* (Linnaeus) and temperate and warm waters *Cyprinidae* (such as *Tinca tinca* Linnaeus, *Scardinius erythrophthalmus* Linnaeus and *Rutilus erythrophthalmus* Zernian).

A prevalence of Pike in levels 10-13 and 47 coupled with the scarcity of *Cyprinidae* suggests that fishing was highly selective. The rare remains belonging to the Carp family in these strata (Table 2) could even come from the gastric content of Pike themselves.

Other species typical of Alpine waters which have a similar or at times higher nutritional value (as in the case of *Salmonidae*) are absent. Such absence could re-

late to fishing having taken place exclusively from lakes and slow moving waters.

In the most ancient levels, i.e. from 30 to 315, ichthyofaunal composition differs significantly. *Cyprinidae* clearly prevail accounting for between 75.3% and 98.0% (Table 1 and 2). These percentages relate mainly to temperate and warm water species such as Rudd *Scardinius erythrophthalmus*, Roach *Rutilus erythrophthalmus* and Tench *Tinca tinca* which nowadays are widespread in piedmont waters of southern Alpine and Padana plain areas where they are dominant both in terms of numbers (mostly Rudd and Roach) and of weight (especially Tench).

The first two are particularly abundant with Rudd prevailing in all stratigraphic contexts. They are medium-to-small size species with Rudd measuring on average 13 cm in length (for approximately 20g of weight) and Roach measuring 8.2 cm on average (for approximately 10g of weight) and may consequently not be considered to represent the majority of the ichthyo-biomass. Tench is always represented by a lower percentage than 7%. However, being a larger fish with an average length of 26.4 cm and a weight of approximately 300g, Tench forms a rather remarkable component of the total assemblage of fish caught in some of the layers (in particular 312/B).

In the lower strata, from 30 to 315 Pike is also present even though it is less abundant. However, when considering that this fish is 64.1 cm long and weighs 2.2 kg on average Pike once again is probably the dominant species within the ichthyobiomass. Within the fish assemblage there are other, less important, taxa (*Anguilla anguilla* L., *Salmonidae*, *Lota lota* L. and *Perca fluviatilis* L.). Particularly significant is the nearly total absence of *Salmonidae* which were probably dominant in rivers and streams on valley bottoms and piedmont areas as it is the case today. This aspect too points to the community living at Galgenbühel having been selective. The total absence of river species already noticed in the more recent levels is probably due to the preference of marshland as fishing grounds.

No selection seems to occur with regard to variation of fish size and weight: in levels 10-13 and 47 Pike shows a size variation of between 0.2 kg and 10.0 kg (which corresponds to 20-110 cm in length), the majority of this species weighing between 0.2 and 0.7 kg (total body length being 20-50 cm) with single individuals weighing between 2.5 and 4 kg (total body length: 70-80 cm) not infrequently occurring either.

In the lower levels (30-315) Pike average size is clearly larger: individuals between 60 and 80 cm (weighing be-

Esox lucius - context 304 (35 elements)

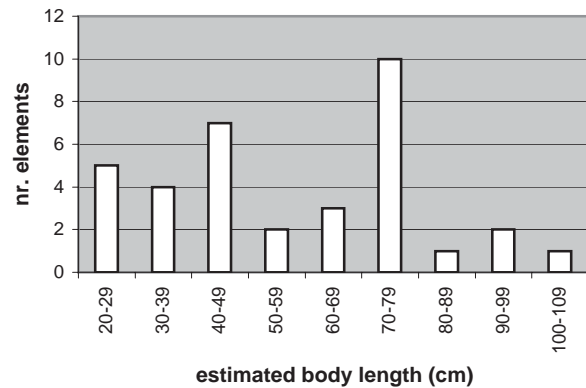


Fig. 5: Pike size distribution (total estimated length in cm) from context 304.

tween 2 and 4 kg) are more frequently occurring whereas small size individuals are fewer when compared with the most recent strata 10-13 and 47 (see for example context 304: Figure 5).

As regards the Carp family some results are presented here with reference to group of contexts 307. Distribution in size of *Rutilus erythrophthalmus* (Figure 6) roughly corresponds to the normal structure of a wild population with the quantity of younger categories being the only exception: in their natural habitat individuals with a body length between 1 and 4 cm corresponding to the yearling category are most numerous. Poor representation of this category in the archaeological sample is ascribable to the fish being more difficult to catch as well as their being in lesser demand. Similar conclusions can also be drawn for *Scardinius erythrophthalmus* (Figure 6).

On the basis of the limited amount of data available from a preliminary study on the seasons of fishing statistically significant conclusions may not be drawn (Table 3). It is worth mentioning that out of 11 'readable' bone elements 7 are associated with spring and 4 with summer. At the time of this writing there is no evidence of winter fishing. As regards Rudd and Roach in particular it seems likely that they were fished mainly during the warmer seasons when fishermen could take full advantage of the species' gregarious behaviour which becomes evident during the reproductive period (late spring-early summer) with large groups moving to shallow waters closer by the river banks thus becoming an easier catch.

Conclusions

The large quantitative prevalence of the ichthyofauna among the animal bones recovered from all layers allows to define Galgenbühel/Dos de la Forca as a spe-

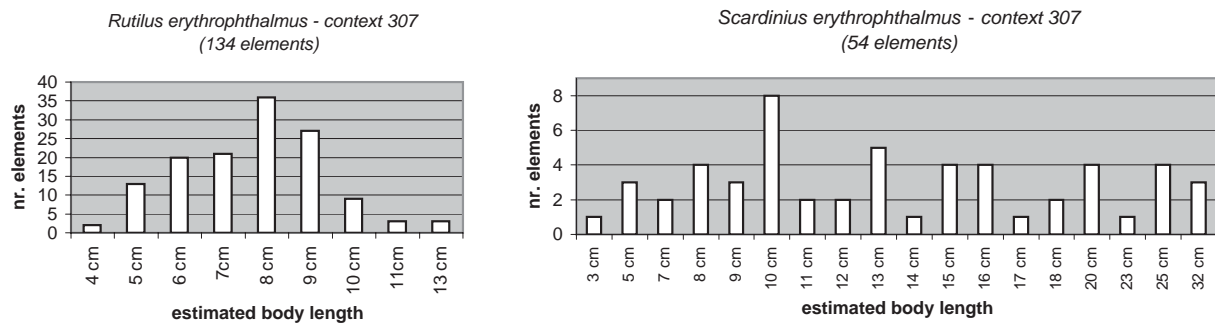


Fig. 6: Rudd and Roach size distribution (estimated total length in cm) from context 307.

cialised fishing site which was repeatedly visited for nearly a millennium by Sauveterrian hunter-gatherers (-fishermen). Within the wider frame of Mesolithic occupation of the Adige River catchment area the site under discussion represents the so far only example of an economic system strongly based on wetland resource exploitation. Other Sauveterrian valley bottom sites (Fig. 1) on the basis of the faunal analysis show a diversified economy which even though it includes fishing has its balance strongly shifted towards hunting of mammals (ichthyofauna was recovered at the sites of Romagnano and Pradestel - Boscato & Sala 1980, Acquaviva - Riedel 1982 and Soman - Tagliacozzo & Casoli 1992).

The location of Galgenbühel with respect to the wetland area in the Early Holocene is not entirely clear because of the lack of exhaustive geomorphological studies. The Mesolithic camp was undoubtedly situated above the water level, a characteristic shared also by contemporaneous valley-bottom sites: these are all located on detritic or alluvial cones. Various studies outline that the valley at that time was characterised by a landscape within which the Adige River's snakelike course formed swamps and natural ponds in proximity of alluvial cones (Coltorti 1994; Bassetti 2004). The habitat of aquatic and semiaquatic fauna recovered from Galgenbühel conforms to such a palaeoenvironmental reconstruction. In addition to the ichthyofauna, recovered fresh water molluscs, reptiles and mammals remains also belong to species living in slack or slow-flowing waters.

From taxonomic identification it has been possible to observe sensitive changes in the composition of fish species throughout time which are not due to climatic or environmental changes. A change of trend is, however, clearly detectable: from indiscriminate or moderately selective fishing practices recognised in the earliest phases (dominated by *Cyprinidae*) to extremely selective fishing (almost exclusively concentrated on Pike) in later periods. It is difficult to say whether such shift might have been culturally prompted, i.e. different eating habits exhibited by people of different extraction,

or whether it had been conditioned by economic choices. With the latter point of view in mind the hypothesis was put forward (Bazzanella *et al* 2004) that a relationship might have existed between the huge amount of fish remains and more generally evidence of burning. This is particularly noticeable in contexts 304, 305, 306 and 307 excavated to a sufficient spatial extent and consisting of layers rich in charcoal, negative features filled with carbonaceous soil, accumulations of ash and traces of heated reddish soil. It is likely that such traces are the remains of fires lit to dry and smoke fish in order to preserve it. Such interpretation is not a novelty for Paleolithic and Mesolithic sites (Desse & Granier 1976; Duche 1986-87). Pike is particularly suited for this treatment due to its size and compact meat: maybe these aspects led fishermen to select this species only from a certain point in time onwards?

Considering the variety of species caught the question quite naturally arises as to the type of fishing techniques employed. Excavations did not bring to light artefacts which could be identified as fishing tools in an unambiguous way. In general and on the basis of the faunal remains present in the lower levels (315-30), the catching of fish might have been achieved in part at least using techniques which allow for the catch of a great many fish at one time (nets, creels, or by drying up stretches of the river course) and even of small size specimen Rudd and Roach. For the upper layers, contexts 47 and 10-13 dominated by Pike which species was most probably caught with a range of tools designed to catch single individuals (lace with a slip-knot, bow and arrow, harpoon etc.). These techniques can be applied due to Pike's behaviour to move to shallow waters in summer time, remaining motionless among the vegetation waiting for their prey or at the beginning of spring during spawning time. In particular the lace with a slip-knot fishing practice was widely used in Europe until 20-30 years ago: maybe Mesolithic fishermen knew it as well. A lace with a slip-knot was put around the head of the fish with the help of a wooden stick. Subsequently the lace was tightened around the branchia by pulling it with a jerk. This method would explain the general wide size range of individuals caught.

Preliminary results obtained from the seasonal dating on the remains from contexts 30, 304, 306 and 307 are particularly interesting since they complement other data which would suggest site occupation during the spring and summer months: exposure to the North of the rockshelter, increased ease in catching fish and marsh tortoise during warmer seasons and identification of remains belonging to some 0-4 week-old wild boar killed at the end of spring (Wierer & Boscato 2006).

The data collected so far throw new light on settlement system theory put forward for these areas during the Early Mesolithic (Broglia & Lanzinger 1990; Lanzinger 1996). As opposed to that theory our findings suggest a more complex use of the territory and its resources and therefore a more sophisticated type of peoples' mobility: during the summer season human communities made use of both Alpine grasslands and valley bottoms. The present state of research therefore suggests that as opposed to other valley-bottom sites Galgenbühel cannot be considered a wintering camp only. Occupation of the site should be considered as part of making use of the economic opportunities offered by the area's natural riches during the warmer seasons.

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References

- Bassetti, Michele. 2004:
Approccio geoarcheologico al territorio della Valle dell'Adige: Appunti sui dati paleoambientali. In: M. de Vos (ed.), *Archeologia del territorio. Proceedings of the congress at Trento, 23th-25th of November 2000*: 263-301. Trento.
- Bazzanella, Marta; Betti, Lorenzo; Wierer, Ursula. 2004:
Galgenbühel/Dos de la Forca. Un nouveau site sauveterrien dans la Vallée de l'Adige (Bozen/Bolzano, Italie). In: *The Mesolithic - Section 7, Proceedings of the XIV UISPP Congress at Liège-Belgium, 2nd-8th of September 2001*. BAR International Series 1302: 215-225. Oxford.
- Bazzanella, Marta; Wierer, Ursula. 2001:
Die mesolithische Fundstelle am Galgenbühel in Salurn, Südtirol. Eine Sauveterrienstation im Etschtal. In: *Der Schlern* 75/2: 116-128.
- Betti, Lorenzo. 2002:
Carta ittica del Trentino. Provincia Autonoma di Trento, Servizio Faunistico. Trento.
- Boscato, Paolo; Sala, Benedetto. 1980:
Dati paleontologici e cronologici di tre depositi epipaleolitici in Valle dell'Adige (TN). In: *Preistoria Alpina* 16: 45-61.
- Broglia, Alberto; Lanzinger, Michele. 1990:
Considerazioni sulla distribuzione dei siti tra la fine del Paleolitico superiore e l'inizio del Neolitico nell'Italia Nord-orientale. In: P. Biagi (ed.), *The Neolithisation of the Alpine Region*. Monografie di "Natura Bresciana" 13: 53-69.
- Coltorti, Mauro. 1994:
L'evoluzione geomorfologia del paesaggio. In: E. Cavada (ed.), *Archeologia a Mezzacorona*: 23-36. Centro di Studi Rotaliani Mezzacorona. Trento.
- Desse, G.; Granier, J. 1976:
Les poissons. In: *La Préhistoire Française* vol. I: 437-443. Ed. CNRS Paris. Paris.
- Duche, Gérard. 1986-87:
Première approche de la faune ichtyologique du niveau 2B du Bois des Brousses. In: Aniane, Hérault. *Etudes Quaternaires Languedociennes* 5 - 1986-87: 13-20.
- Gandolfi, Gilberto; Zerunian, Sergio; Torricelli, Patrizia; Marconato, Andrea. 1991:
I pesci delle acque interne italiane. Ministero dell'Ambiente, Unione Zoologica Italiana. Roma.
- Lanzinger, Michele. 1996:
Sistemi di insediamento mesolitico come adattamento agli ambienti montani alpini. In: Kozłowski S. K.; Tozzi, C. *The Mesolithic. Colloquia of the XIII UISPP Congress at Forlì-Italy, 8th-14th September 1996, vol. 7*: 125-140. Forlì.
- Le Gall, Olivier. 1981:
L'ichtyofaune dulcicole dans les gisements préhistoriques. In: *Quaternaria* XXIII-1981: 219-232.
- Riedel, Alfredo. 1982:
Die Fauna der vorgeschichtlichen Siedlung von Aquaviva di Besenello. In: *Preistoria Alpina* 18 - 1982: 205-207.
- Tagliacozzo, Antonio; Cassoli, Pier Francesco. 1992:
La macrofauna de l'Abri Soman (Val d'Adige - Italie). In: *Preistoria Alpina* 28 - 1992: 181-192.
- Tortonese, Enrico. 1970:
Osteichthyes. Fauna d'Italia X. Calderini Ed., Bologna.
- Tortonese, Enrico. 1975:
Osteichthyes. Fauna d'Italia XI. Calderini Ed., Bologna.
- Wierer, Ursula. 2004:
Il sito di Galgenbühel/Dos de la Forca a Salurn/Salorno (BZ). Aspetti culturali e ambientali del Mesolitico antico nell'area alpina". PhD thesis, Dipartimento di Scienze Ambientali, Sezione Ecologia Preistorica, Università degli Studi di Siena.
- Wierer, Ursula; Boscato, Paolo. 2006:
Lo sfruttamento delle risorse animali nel sito mesolitico di Galgenbühel/Dos de al Forca: la macrofauna. In: Tecchiati, U.; Sala, B. (ed.), *Archaeozoological studies in honour of Alfredo Riedel*: 85-98. Bolzano.

FAMILY:	Strat. contexts/Group of contexts: TAXON:	10-13*		47		30		304	
		NISP	%	NISP	%	NISP	%	NISP	%
ANGUILLIDAE	<i>Anguilla anguilla L.</i>	-	-	-	-	-	-	-	-
SALMONIDAE	SALMONIDAE unid.	-	-	-	-	-	-	2	0,1
ESOCIDAE	<i>Esox lucius L.</i>	3395	99,7	1037	97,9	106	7,3	337	24,5
CYPRINIDAE	CYPRINIDAE unid.	8	0,2	17	1,6	298	20,6	566	41,2
CYPRINIDAE	<i>Rutilus erythrophthalmus Z.</i>	-	-	4	0,4	1	0,1	15	1,1
CYPRINIDAE	<i>Leuciscus cephalus L.</i>	-	-	-	-	-	-	1	0,1
CYPRINIDAE	<i>Scardinius erythrophthalmus L.</i>	1	0,05	1	0,1	1044	72,0	452	32,9
CYPRINIDAE	<i>Tinca tinca L.</i>	-	-	-	-	-	-	-	-
PERCIDAE	<i>Perca fluviatilis L.</i>	-	-	-	-	-	-	-	-
GADIDAE	<i>Lota lota L.</i>	1	0,05	-	-	-	-	1	0,1
	Total NISP	3405		1059		1449		1374	

Table 1a: Bones identified according to taxon and stratigraphic context/group of contexts (* for further details on 10-13, please see Bazzanella *et al.* 2004).

Strat. contexts/Group of contexts: TAXON:	306		307		312/B		313-315		Total
	NISP	%	NISP	%	NISP	%	NISP	%	NISP
<i>Anguilla anguilla L.</i>	-	-	2	0,3	-	-	-	-	2
SALMONIDAE unid.	-	-	-	-	-	-	-	-	2
<i>Esox lucius L.</i>	27	2,5	34	4,5	19	2,0	12	10,6	4967
CYPRINIDAE unid.	37	3,4	326	42,7	679	72,0	95	84,1	2026
<i>Rutilus erythrophthalmus Z.</i>	39	3,6	141	18,5	9	1,0	2	1,8	211
<i>Leuciscus cephalus L.</i>	-	-	-	-	-	-	-	-	1
<i>Scardinius erythrophthalmus L.</i>	979	90,4	238	31,2	172	18,2	4	3,5	2891
<i>Tinca tinca L.</i>	1	0,1	21	2,7	64	6,8	-	-	86
<i>Perca fluviatilis L.</i>	-	-	2	0,3	-	-	-	-	2
<i>Lota lota L.</i>	-	-	-	-	-	-	-	-	2
Total NISP	1083		764		943		113		10190

Table 1b: Bones identified according to taxon and stratigraphic context/group of contexts (* for further details on 10-13, please see Bazzanella *et al.* 2004).

Stratigraphic context/ group of contexts:	10-13		47		30		304		306		307		312/B		313-315		Total
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP
Total CYPRINIDAE	9	0,2	22	2,1	1343	92,7	1034	75,3	1056	97,5	726	95,1	924	98,0	101	89,4	5215

Table 2: Total identified elements belonging to the *Cyprinidae* family (percentages calculated on total NISP of all taxons).

Stratigraphic context/group of contexts	Family/Taxon	Skeletal element	Integrity	Seasonal dating
30	fam. CYPRINIDAE	Scale		late summer
304	<i>Scardinius erythrophthalmus</i> L.	Scale		spring
304	fam. CYPRINIDAE	Scale		spring
304	fam. CYPRINIDAE	Scale		late spring
304	fam. CYPRINIDAE	Scale		late spring
304	<i>Esox lucius</i> L.	Supracleithrum	fragm.	summer
304	fam. CYPRINIDAE	Scale		summer
306	<i>Scardinius erythrophthalmus</i> L.	Scale	fragm.	spring
306	<i>Scardinius erythrophthalmus</i> L.	Scale	fragm.	spring
306	<i>Scardinius erythrophthalmus</i> L.	Scale	fragm.	spring
307	<i>Scardinius erythrophthalmus</i> L.	Scale		summer

Table 3: Bones selected for determination of season of death.