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Feeding habits of the bullet tuna *Auxis rochei* in the southern Tyrrhenian Sea

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A total of 235 bullet tunas (*Auxis rochei*) was caught off the north-eastern coast of Sicily between March 2003 and March 2004 for the purpose of studying their feeding habits. The fish were caught by means of an experimental surface gill-net during fishing surveys carried out on a monthly basis. The stomach contents were analysed and the prey identified, counted and weighed. The importance of the different prey types was assessed utilizing several feeding indices while possible size-related changes of the diet composition were highlighted by means of hierarchical cluster analysis, nMDS and SIMPER analysis. The results of this study showed that the bullet tuna is an epipelagic off-shore predator feeding on whatever abundant resource is available in the environment with a preference for planktonic crustaceans, small cephalopods and fish larvae. Among crustaceans, hyperiidean amphipods were the most important prey, with *Anchylomera blossevillei* as the dominant species, followed by the euphausiacean *Stylocheiron maximum*. Among cephalopods, *Heteroteuthis dispar* was recorded frequently while fish larvae showed high values of all indices. All prey were pelagic organisms. A size-related change in the diet composition was observed, even if it seemed related to the temporal fluctuations of the zooplanktonic assemblage in the environment. The average prey weight per stomach increased significantly in the larger predators which mostly fed on fish larvae belonging to several commercially important demersal and pelagic species.

INTRODUCTION

The bullet tuna, *Auxis rochei* Risso, 1810, is a medium epipelagic fish distributed worldwide in tropical and sub-tropical waters (Uchida, 1981). It appears along the continental shelf, forming large schools near the surface. The spawning season is reported to last from June to September (Uchida, 1981).

The worldwide distribution patterns and biological features of this species have been described by Uchida (1981) and Sabatés & Recasens (2001). However, the feeding habits of *A. rochei* have not been studied in detail and refer mainly to larval, juvenile and pre-adult individuals (Okada, 1955; Kumaran, 1964). Moreover, there is no published information regarding the feeding habits of *A. rochei* in the Mediterranean Sea.

Auxis rochei, along with *Sarda sarda* Bloch, 1793, is the most abundant small tuna species in the Mediterranean Sea, with average catches of approximately 5000 tn y^{-1} (ICCAT, 1996). In this area, *A. rochei* is exploited throughout the entire year by small-scale inshore fisheries (Mostarda et al., 2004). Thus, a knowledge of the feeding habits of this species is essential in determining its role in the pelagic food web and contributes to a better understanding of trophic dynamics, information which is needed as fisheries scientists apply ecosystem principles to fisheries management (Pauly et al., 2000). In fact, selective exploitation of predators can have profound effects on pelagic ecosystems because of the removal of predation pressure and because of top–down effects (Estes et al., 1998).

The goal of this work was to improve the knowledge on the feeding habits of the bullet tuna in the Mediterranean Sea, including the investigation of size-related variations in its diet, and at the same time to provide basic data for the development of multi-species assessment models. This study was carried out in the framework of an ecosystem-based management project regarding the analysis of the trophic relations within the pelagic fish community of the southern Tyrrhenian Sea.

MATERIALS AND METHODS

In order to study the feeding habits of the bullet tuna, a total of 235 individuals with a fork length (FL) between 194 mm and 465 mm were caught between March 2003 and March 2004 (Table 1) off the north-eastern coast of Sicily, between the towns of Milazzo and S. Agata di Militello in an area of approximately 4500 km^2 (Figure 1). No specimens were caught during January and February 2004 due to the inclement weather conditions.

The fish were caught by means of a surface gill-net specially built according to the so called 'ferrettara' model, measuring 2000 m in total length and 20 m in height. The net was subdivided into three portions with different mesh

Table 1. *Year, month, number and size range of specimens of the bullet tuna,* Auxis rochei *caught during experimental surveys in the Tyrrhenian Sea.*

Year	Month	Total no. of specimens caught	Size-range (mm FL)
2003	March	12	401–450
2003	April	17	345–457
2003	May	22	379–455
2003	June	39	365–443
2003	July	16	206–465
2003	August	17	216–415
2003	September	31	194–435
2003	October	16	261–339
2003	November	24	278–365
2003	December	21	345–383
2004	March	20	341–413

FL, fork length.

Figure 1. Study area in the southern Tyrrhenian Sea (central Mediterranean Sea).

sizes, respectively of 6, 7 and 8 knots in 25 cm, in order to facilitate the entangling of fish of different sizes. The fishing activities were carried out on a monthly basis between 1700 and 2000 h. Every specimen caught was classified and measured on board the vessel and, in order to interrupt the digestion process, the stomachs were removed as soon as possible and preserved in a 70% ethyl alcohol solution.

In the laboratory, the stomachs were dissected and the content observed under a stereoscopic microscope. The prey, identified to the lowest possible taxonomic level on the basis of their digestion state, were counted and weighed to the nearest 0.1 mg after removal of surface water by blotting paper. A fragmented prey count was based on the number of eyes, heads, mouth parts, tails or other anatomical parts traceable to a single specimen.

Data analyses

To assess the adequacy of the number of samples analysed, the cumulative number of new prey types against the cumulative number of non-empty stomachs were plotted (Ferry & Caillet, 1996). The PRIMER software was utilized to compute a prey species accumulation plot as an average of 999 curves based on different random orders of the stomachs. The standard deviation was calculated and represented on the graph for every tenth stomach. In order to assess whether the curve reached an asymptote, the logistic and linear regressions were calculated and their goodness of fit coefficient R^2 were compared: the sample size was considered sufficient if the R^2 for the logistic curve resulted higher than the R^2 for the linear relation.

The importance of the different prey types was evaluated calculating the frequency of occurrence (%F=number of stomachs containing prey *i*/total number of stomachs containing prey*100), percentage abundance (%N=number of prey *i*/total number of prey*100) and percentage weight (%W=weight of prey *i*/ total weight of all prey*100) (Hyslop, 1980). The percentage of empty stomachs was recorded (vacuity index: VI%).

Statistical analyses

Although size is a continuous variable and attributes based on size probably change continuously throughout ontogeny, size-related diet variations were investigated by dividing the collected sample into five 50 mm size-classes: Class I: 194–250 mm, N=23; Class II: 251–300 mm, N=32; Class III: 301–350 mm, N=37; Class IV: 351–400 mm, N=39; Class V: 401–465 mm, N=48.

Hierarchical cluster analysis and non-metric multidimensional scaling (nMDS), based on the Bray–Curtis similarity index and on the %W, were then used for classification and ordination of size-classes into groups (Clarke & Warwick, 1994). A multivariate multiple permutations test, SIMPER (Similarity Percentages, PRIMER) (Clarke, 1993) was used in order to determine which prey categories, within each group, were responsible for the clustering of individuals, in terms of Bray–Curtis similarities. All the analyses were performed pooling the prey into eight broad taxonomic categories: euphausiaceans, hyperiidean amphipods, cephalopods, urochordates, other invertebrates (which comprised rare categories such as copepods, mysidaceans, crustacean decapods, crustacean larvae, polychaetes, siphonophorans, chaetognats and gastropods), fish adults, fish juveniles and fish larvae.

One-way analysis of variance (ANOVA) and post-hoc multiple comparisons, following the Student–Newman–Keuls (SNK) procedure were used to detect differences in the average prey weight among size-groups (Sokal & Rohlf, 1981). Before running the ANOVA, the assumptions of normality of data and homogeneity of variance were tested using the Kolmogorov–Smirnov (Lilliefors probability) and Cochran's tests, respectively. When these assumptions were not met, data were log transformed, and the assumptions were tested again.

RESULTS

Of the total number of 235 stomachs of *Auxis rochei* analysed, 56 were empty (VI%=23.82), whereas 179 had at least one food item (76.18%).

The cumulative prey types curve (Figure 2) resulted as fitting better with a logistic curve (R^2=0.948, $F_{(1,177)}$=3257.74, P<0.001) than with a linear relation (R^2=0.896, $F_{(1,177)}$=1525.23, P<0.001) when 100% of the stomachs examined were considered; then sample size was considered sufficient to describe the diet of the bullet tuna.

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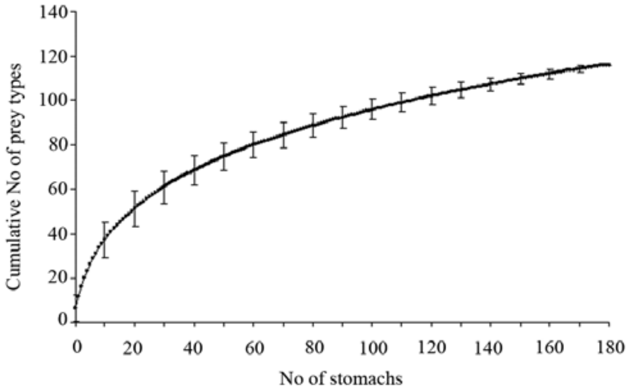

Figure 2. Prey species accumulation plot as an average of 999 curves based on different random orders of the stomachs extracted (no. of stomachs=179). Vertical bars represent standard deviation.

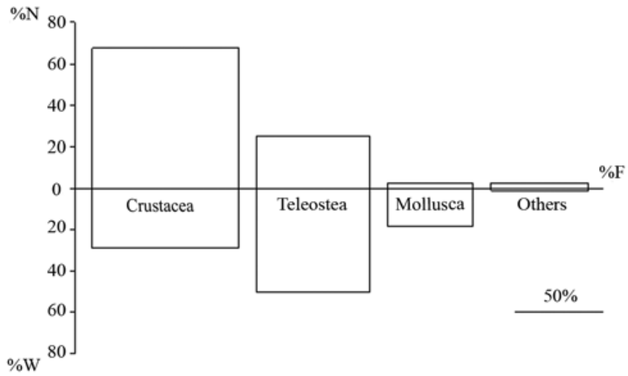

Figure 3. Frequency of occurrence (%F), percentage by number (%N) and percentage by weight (%W) for the main prey categories found in the stomachs of *Auxis rochei* in the southern Tyrrhenian Sea. The 50% scale bar refers to frequency of occurrence.

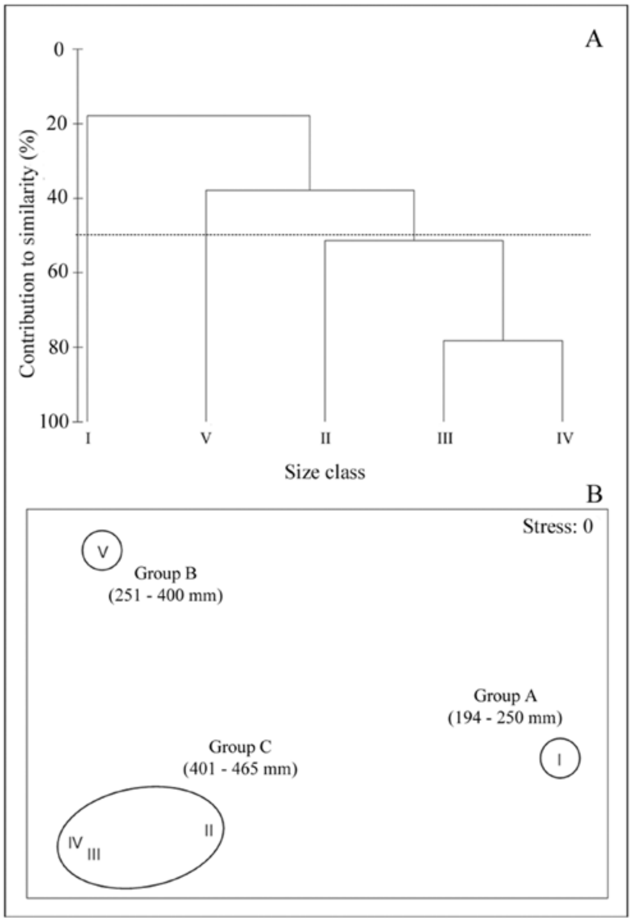

Figure 4. Hierarchical cluster analysis and nMDS based on percentage by weight values (%W) of the five 50 mm size-classes. (A) The three groups defined at arbitrary similarity level of 50% are indicated (dotted line); (B) nMDS showing the ordination of the size-classes into three size-groups with similar diets.

The analysis of stomach contents led to the identification of 18,364 prey for a total prey weight of 988.10 g belonging to 115 taxa mainly of crustaceans, fish (mostly larvae and juveniles) and molluscs. Polychaetes, siphonophorans, chaetognats and urochordates were also present.

Figure 3 summarizes %F, %N and %W for the principal taxonomic categories. Crustaceans showed the highest values of abundance (%N=68.02) while fish were the best represented taxon in terms of percentage in weight (%W=50.23), followed by crustaceans (%W=29.01) and molluscs (%W=18.65). In terms of frequency of occurrence, crustaceans displayed the highest value (%F=83.24), even if fish (%F=64.25) and molluscs (%F=48.60) were also recorded frequently. Appendix 1 shows the prey taxa and their respective %F, %N, %W values.

Among crustaceans, hyperiidean amphipods were the most frequent prey item (%F=77.09), with *Anchylomera blossevillei* showing high values of frequency of occurrence (%F=59.78), abundance (%N=19.35) and percentage weight (%W=6.81). Other hyperiideans such as *Brachyscelus crusculum* and *Phronima sedentaria* were found frequently in the stomachs of the bullet tuna. Euphausiaceans, mainly represented by *Stylocheiron maximum*, showed relatively high values of frequency of occurrence, abundance and percentage by weight (%F=39.22; %N=32.93; %W=13.14). Finally, crustacean larvae were also a common element in the diet of *A. rochei* (%F=54.19).

Among teleosts, the most significant component was represented by larval stages. These exhibited the highest values of frequency of occurrence (%F=53.07), abundance (%N=24.10) and weight percentage (%W=25.15). With the exception of *Engraulis encrasicolus*, which showed moderately high values of all the indices, the other identified species within this category were found infrequently.

Ultimately, molluscs were represented, above all, by cephalopods (%F=39.66; %N=1.94; %W=18.53), with *Heteroteuthis dispar* being the most frequent and important species in weight (%F=8.94; %W=5.48).

Less abundant crustaceans (copepods, mysids, isopods), polychaetes, siphonophorans and chaetognats were recorded occasionally.

Variations in stomach contents relative to fish length

The cluster analysis and nMDS (Figure 4) (Stress=0) allowed for the identification of three size-groups, below 50% of similarity, that were separated along a size gradient. The smallest (Group A) and largest (Group C) specimens' groups showed a limited size-range (194–250 mm and 401–

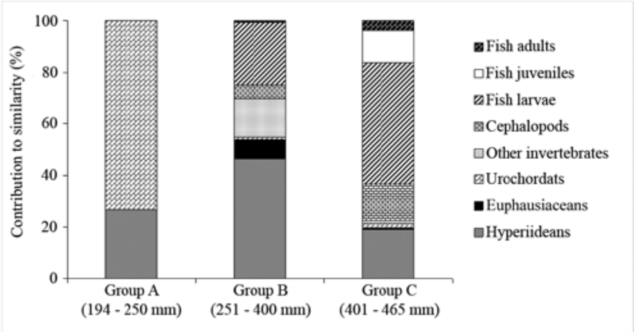

Figure 5. Similarity percentage contribution given by the main prey types for each size group. Group A, 194–250 mm fork length (FL); Group B, 251–400 mm FL; Group C, 401–465 mm FL. Other invertebrates comprehend copepods, mysidaceans, crustacean decapods, crustacean larvae, polychaetes, siphonophorans, chaetognats and gastropods.

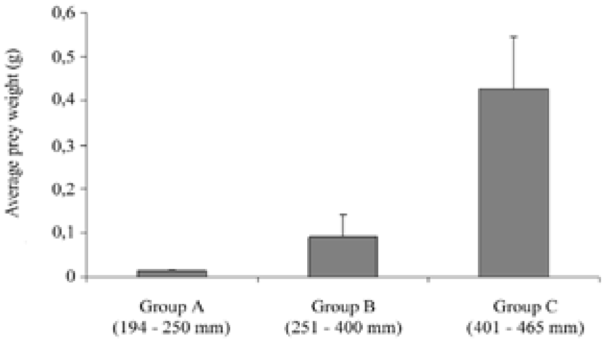

Figure 6. Average prey weight among size-groups of *Auxis rochei*. Vertical bars represent standard error.

465 mm, respectively) in comparison with the intermediate size-group (Group B) which included individuals belonging to a broader size spectrum (251–400 mm).

According to SIMPER analysis (Figure 5), the prey that contributed the most to the similarity of Group A were urochordats (73.05%) and hyperiidean amphipods (26.90%). The intermediate size-group showed a more heterogeneous diet based on macro-zooplanktonic prey such as hyperiids (46.29%), fish larvae (24.49%) and other invertebrates (14.87%). Among nektonic prey, cephalopods (5.24%), fish juveniles and fish adults (0.4% and 0.3%, respectively) appeared. The largest specimens fed primarily on fish larvae (47.11%) and hyperiids (19.07%) even if an increase of cephalopods (14.17%) and other nektonic prey, such as fish juveniles (12.53%) and fish adults (3.82%), was observed.

The ANOVA showed significant differences between the average prey weight per stomach of the three size-groups ($F_{2,176}$=7.08 ; P<0.01) (Figure 6). However, the SNK *post-hoc* test revealed no significant differences between the average prey weight of the first and the second size-classes (P>0.05) so that: Class I =Class II <Class III.

DISCUSSION

This research represents the first study of the feeding habits of the bullet tuna in the Mediterranean Sea. Moreover, even if a limited number of studies were carried out in other areas, these never focused on size-related diet shifts. The results of this study showed that *Auxis rochei* of fork length between 194 and 465 mm (FL) is an epipelagic carnivorous predator feeding on a variety of planktonic invertebrates, small sized cephalopods and fish larvae.

This supports the findings of Grudtsev (1992) who observed that *A. rochei* of fork length between 27 and 39 cm in the eastern Atlantic, fed on euphausiaceans, small squid and teleosts of the family Myctophidae. Moreover, Yang & Sun (1977) studied the feeding habits of smaller specimens (24 to 35 cm) in Taiwan waters and described a diet dominated by euphausiaceans, followed by mollusc pteropods and unidentified fish larvae. Kumaran (1964), in Indian waters, observed that among 31 pre-adult *A. rochei* (17–25.2 cm), fish (mostly clupeids) constituted 42% by volume followed by crustaceans (24%; larvae and amphipods) and molluscs (22%; *Sepioteuthis* sp.). Finally, Okada (1955) and Whitley (1964) observed that *A. rochei* fed on small sized fish (juveniles and larvae of anchovies, mullets, silversides and other small fish).

Despite the fact that crustaceans were, overall, the most abundant prey, while teleost larvae were the most important prey in terms of weight, differences in the retention time in the stomach and susceptibility to digestive erosion of these prey could have biased these results (Hyslop, 1980).

The presence of the mesopelagic teleosts *Maurolicus muelleri* and *Paralepis speciosa* in the stomachs of *A. rochei* provided some indications of its feeding activity. These species undertake vertical migrations moving towards the epipelagic layer from dusk to dawn (Tortonese, 1975). Considering the fact that the reported depth range of *A. rochei* is within the epipelagic zone (0–200 m; Uchida, 1981), it could be hypothesized that the bullet tuna predates them at least close to sunset or at dusk, as many other tuna species do (Magnuson, 1969). This consideration agrees with the findings of Bard et al. (1998) which showed, by means of sonic tracking experiments, that some tunas also feed at dusk, when mesopelagic micro-nekton migrates towards the surface. This behaviour is probably a response to the endogenous rhythms that tend to 'anticipate' the start of the daylight or night period (Woodhead, 1966).

It was interesting to notice that the bullet tuna ate larvae of pelagic (*Sardina pilchardus*, *Engraulis encrasicolus*) as well as demersal species (Scorpaenidae, Serranidae, Sparidae, Gadidae, Bothidae) of commercial interest. Fish predation upon fish larvae has recently been implicated as potentially the greatest source of mortality in marine fish larvae (Bailey & Houde, 1989). Considering that *A. rochei* is known to be one of the most abundant small tuna in the Mediterranean, (ICCAT, 1996) as well as in the area of study (Mostarda et al., 2004), it seems necessary to carry out more detailed studies on its consumption rates and abundance in order to determine the predation impact on prey species.

Feeding habits in relation to size

A size-related change in the diet composition of the bullet tuna was observed. Within the sampled size-range, three groups were identified. A more detailed assessment of the diet composition of the different size-groups, showed that macro-zooplanktonic prey were always the predominant

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food item. The diet of the smallest specimens was dominated by urochordats and hyperiidean amphipods. This result was not in accordance with the study of Kumaran (1964), in which *A. rochei* of similar size-range (17–25.2 cm) fed upon fish, crustaceans and molluscs. This could possibly be explained by differences between the planktonic and nektonic prey communities and their distribution in the two areas. From the medium sized fish to the largest ones, an increase in the importance of fish larvae as well as nektonic prey was observed. This shift was also highlighted by the variation of the average prey weight which increased significantly in the largest specimens. Assuming wet weight as a good approximation of prey size (Hernroth, 1985), our findings indicated that *A. rochei* improves with growth its ability to catch larger prey such as juveniles and adults of fish. These results are consistent with the observation that predators become more successful as they grow, due to a variety of factors including increased sustained and burst swimming speeds, and better visual acuity (Beamish, 1978). Further, size-related morphological characters of predators, including the mouth gape, determine the selection of larger prey (Lukoschek & McCormick, 2001).

However, it has to be underlined that the observed size-related diet shift could have been biased by the potential temporal changes in the abundances and relative size distribution of prey in the environment, which were not recorded.

Finally, even if some of the largest individuals resulted to be capable of predating fast-swimming prey, our findings did not provide evidence of a significant change, during growth, in the foraging behaviour. In fact, the predominance of macro-zooplanktonic prey suggests the adoption of a ram feeding strategy (swimming through prey schools with mouth open) (Gerking, 1994) by all size-groups.

This quantitative study of the feeding ecology of *A. rochei* represents a valid contribution for the management of the pelagic ecosystems of the southern Tyrrhenian Sea in which this very abundant species is implicated. These data, considering that no previous studies were conducted in the Mediterranean Sea, will be useful in ecological modelling for the better representation of the trophic flows associated with large, medium and small pelagics.

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Appendix 1. *Summary of* Auxis rochei *stomach content analysis: prey list, frequency of occurrence (%F), abundance (%N) and percentage by weight (%W). Total values are given in bold font*

	%F	%N	%W
CRUSTACEA			
Copepoda	**11.73**	**0.50**	**0.04**
Calanoida unidentified	11.73	0.50	0.04
Euphausiacea	**39.11**	**32.93**	**13.14**
Meganyctiphanes norvegica	1.12	0.02	0.01
Nematoscelis megalops	1.12	0.12	0.02
Stylocheiron maximum	20.11	18.63	7.66
Euphausiacea unidentified	22.91	14.16	5.45
Mysidacea	**3.91**	**0.20**	**0.02**
Siriella sp.	2.79	0.17	0.01
Mysidacea unidentified	1.12	0.03	0.01
Amphipoda hyperiidea	**77.09**	**25.60**	**10.59**
Anchylomera blossevillei	59.78	19.35	6.81
Brachyscelus crusculum	36.31	1.71	1.30
Euprimno macropus	16.76	0.63	0.10
Hyperia sp.	1.12	0.01	<0.01
Hyperidea unidentified	19.55	1.27	0.57
Lycea sp.	1.12	0.05	<0.01
Phronima atlantica	1.68	0.02	<0.01
Phronima sedentaria	25.70	1.46	1.13
Phrosina semilunata	17.88	0.34	0.40
Platiscelus ovoides	1.12	0.02	<0.01
Platiscelus serratulus	3.91	0.06	0.01
Platiscelus sp.	8.94	0.15	0.04
Pronoidae unidentified	1.12	0.04	<0.01
Scina crassicornis	0.56	<0.01	<0.01
Streetsia sp.	19.55	0.39	0.18
Vibilia armata	3.35	0.05	0.01
Vibilia gibbosa	1.12	0.02	<0.01
Vibilia jeangerardi	1.12	0.01	<0.01
Vibilia sp.	0.56	<0.01	<0.01
Isopoda	**2.23**	**0.03**	**<0.01**
Isopoda unidentified	2.23	0.03	<0.01
Crustacean larvae	**54.19**	**6.34**	**3.00**
Alpheus sp.	0.56	<0.01	<0.01
Brachiura unidentified	6.70	0.32	0.10
Brachycarpus biunguiculatus	6.15	0.10	0.09
Callianassa truncata	0.56	<0.01	<0.01
Callianassa tyrrena	0.56	<0.01	<0.01
Crangonidae unidentified	0.56	<0.01	<0.01
Decapoda unidentified	29.05	4.14	1.53
Euphausiacea unidentified	3.91	0.80	0.60
Paenaeidae unidentified	0.56	<0.01	<0.01
Palaemonidae unidentified	7.82	0.14	0.11
Palinuridea unidentified	10.06	0.25	0.30
Pandalidae unidentified	0.56	0.02	<0.01
Pinnotheres pisum	0.56	<0.01	<0.01
Portunus hastatus	0.56	<0.01	<0.01
Sergestes corniculum	0.56	0.03	0.02
Sinalpheus sp.	0.56	<0.01	<0.01
Stomatopoda unidentified	13.41	0.51	0.24
Crustacea unidentified	**18.99**	**2.43**	**2.21**
CRUSTACEA total	**83.24**	**68.02**	**29.01**
CNIDARIA			
Siphonophora	**2.79**	**0.04**	**0.02**
Diphyidae unidentified	2.79	0.04	0.02
CNIDARIA total	**2.79**	**0.03**	**0.01**
ANELLIDA			
Polychaeta	**25.70**	**1.04**	**0.79**
Alciopidae unidentified	25.14	1.03	0.79
Vanadis cristallina	0.56	<0.01	<0.01
Nereididae unidentified	0.56	<0.01	<0.01
ANELLIDA total	**25.70**	**1.04**	**0.79**
MOLLUSCA			
Gasteropoda	**22.91**	**0.53**	**0.12**
Atlanta sp.	6.70	0.13	0.02
Cavolinia sp.	2.23	0.02	<0.01
Creseis acicula	1.12	0.01	<0.01
Gasteropoda unidentified	2.23	0.03	<0.01
Hyalocylis striata	1.12	0.04	<0.01
Oxygirus keraudrenii	13.97	0.26	0.10
Pteropoda unidentified	2.23	0.04	<0.01
Cephalopoda	**39.66**	**1.94**	**18.53**
Cephalopoda unidentified	25.14	0.80	3.95
Heteroteutys dispar	8.94	0.44	5.48
Loliginidae unidentified	0.56	0.02	0.08
Octopodidae unidentified	2.79	0.03	0.23
Octopus defilippi	0.56	<0.01	0.04
Ommastrephidae unidentified	3.35	0.05	4.34
Onycoteutidae unidentified	7.26	0.13	1.03
Onycotheutis baxii	0.56	<0.01	0.03
Sepiolidae unidentified	10.61	0.39	1.98
Theuthoidea unidentified	3.35	0.08	1.39
MOLLUSCA total	**48.60**	**2.48**	**18.65**
Chaetognatha	**2.79**	**2.48**	**0.14**
Chaetognatha unidentified	2.79	2.48	0.14
UROCHORDATA			
Appendicularia unidentified	0.56	<0.01	<0.01
Salpidae unidentified	21.23	0.74	1.06
Thaliacea unidentified	8.94	0.31	0.19
UROCHORDATA total	**30.73**	**1.05**	**1.25**
VERTEBRATA Teleostea			
Adults	**10.06**	**0.54**	**10.73**
Engraulis encrasicolus	0.56	0.01	2.99
Gymnammodytes cicerellus	1.12	0.03	0.02
Maurolicus muelleri	8.38	0.50	5.89
Sardina pilchardus	0.56	<0.01	1.83
Juveniles	**8.94**	**0.25**	**14.35**
Clupeidae unidentified	0.56	<0.01	0.18
Paralepididae unidentified	5.03	0.16	5.49
Paralepis sp.	1.68	0.03	2.06
Paralepis speciosa	1.68	0.05	6.62
Larvae	**53.07**	**24.10**	**25.15**
Anguilliformes unidentified	1.12	0.01	0.10
Anthias anthias	5.03	0.20	0.11
Aphia minuta	0.56	0.38	0.18
Boops boops	1.12	0.07	0.22
Bothidae unidentified	7.26	0.25	0.16
Callionimus sp.	0.56	<0.01	<0.01
Cepola rubescens	0.56	<0.01	<0.01
Clorophtalmus agassizi	0.56	<0.01	0.01
Clupeidae unidentified	3.35	4.00	1.64
Coris julis	3.35	0.27	0.14
Dicentrarchus labrax	0.56	0.01	<0.01
Engraulis encrasicolus	3.91	5.44	7.50
Gadidae unidentified	2.23	0.04	0.07
Gnatoplys mystax	0.56	0.01	<0.01
Gobidae unidentified	0.56	<0.01	<0.01
Gymnammodytes cicerellus	2.23	1.55	3.45
Helicolenus dactylopterus	2.23	0.07	0.05
Hoplostaetus mediterraneus	1.12	0.01	<0.01
Lepidopus caudatus	3.35	0.11	0.78
Macrorhamphosus scolopax	0.56	<0.01	<0.01
Notolepis rissoi	1.68	0.02	0.02
Ophiidiidae unidentified	0.56	<0.01	<0.01
Pagrus pagrus	0.56	<0.01	<0.01
Paralepididae unidentified	5.59	0.24	0.38
Parophidion vassalli	2.23	0.08	0.09
Pleuronettiformes unidentified	0.56	<0.01	<0.01
Sardinella aurita	0.56	<0.01	<0.01
Scorpaena scrofa	3.35	0.05	0.07
Scorpaena sp.	1.12	0.02	0.02
Scorpaenidae unidentified	3.91	0.07	0.15
Serranidae unidentified	1.68	0.02	0.02
Sinodus saurus	0.56	<0.01	<0.01
Sparidae unidentified	1.12	0.08	0.02
Sphyraenidae unidentified	0.56	<0.01	0.11
Stomiformes unidentified	0.56	<0.01	<0.01
Teleostean larvae unidentified	45.81	11.05	9.79
VERTEBRATA Teleostea total	**64.25**	**24.89**	**50.23**