TROPHIC INTERACTIONS AMONG GROUPER (*EPINEPHELUS MARGINATUS*), OCTOPUS (*OCTOPUS VULGARIS*) AND RED LOBSTER (*PALINURUS ELEPHAS*) IN THE WESTERN MEDITERRANEAN

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Abstract

In the present paper a first evaluation of the trophic interactions between grouper, octopus and spiny red lobster in the western Mediterranean is presented. The efficiency of octopus preying on lobsters is also estimated from trap catches. Grouper and octopus base their diet on the same major taxonomic groups and this is reflected in the values of diet overlap. Trophic diversity of grouper and octopus is also very similar. The estimation of the octopus efficiency preying on lobsters shows that 23.5% of the attacks are successful.

Keywords : diet composition, trophic diversity, diet overlap, predation efficiency

Introduction

Long-line fishermen know that octopus makes a good bait for catching groupers, and the prevalence of this prey in the diet of groupers has been corroborated by scientific works. Fishermen also know that octopuses are active predators of lobsters because they produce damages in the fisheries for this crustacean. Thus, grouper (*Epinephelus marginatus*), octopus (*Octopus vulgaris*) and spiny red lobster (*Palinurus elephas*), all three species of high commercial interest, interact closely in the food webs of the continental shelf. The main objective of this work was to carry out a first assessment of the trophic interactions between the three species. To this end, diet composition, diet overlap, trophic diversity and predator-prey size relationships were analysed. The efficiency of a predator in catching its prey is an important input in the Lotka-Volterra predator-prey model but it is a difficult parameter to estimate in field studies. From a set of predator attacks to its prey, this parameter tells us the probability of capture. An additional objective of this work was to estimate the efficiency of octopus preying on lobsters from trap catches.

Materials and methods

Groupers were caught by commercial long-lines off the Balearic Islands, while octopuses and lobsters were collected in trap surveys conducted in the Columbretes Islands Marine Reserve, both in the north-western Mediterranean. All specimens were measured [grouper: total length (TL, cm); octopus : mantle length (ML, cm); lobster : carapace length (CL, cm)] and their stomach contents were analysed to the lowest possible taxonomic level.

To study diet composition and overlap, the following indices were used: A) Occurrence Index (OCI) : the ratio between the number of stomachs with one type of prey and the total number of stomachs with food, each stomach being counted as many times as the different type of prey it contained; B) Trophic diversity, using the Shannon-Weaver index (H´)[1]; C) Diet overlap, using Schoener's similarity index (C)[2], calculated by prey species and also by major taxonomic groups. Inputs to this analysis were preys that contributed 2% or more in terms of OCI. Following Langton [3]: C=0–0.29 (low overlap), C=0.3–0.59 (moderate overlap), and C>0.6 (high overlap).

The relationship between predator size and prey size was determined for grouper versus octopus and for octopus versus lobster. The size of octopuses preyed by groupers was calculated from the beaks present in the stomachs [4], while the size of the lobsters preyed by octopuses was obtained from dead individuals found in the traps.

The octopus predation efficiency on lobsters was calculated by the n° of dead lobsters/n° of interactions x 100. Interactions were defined as hauls where octopus and lobster (alive and/or dead) appeared plus hauls where dead-emptied lobster but not the octopus were found (the predator abandoned the trap after eating the prey).

Results and discussion

The diet composition by major taxonomic groups of the three species is in Fig. 1. Lobster diet consists mainly on molluscs (gastropods and bivalves) and sea urchins. Grouper and octopus share a preference for osteichthyes and brachiurids, although groupers also consume large quantities of cephalopods, mainly octopus (OCI=12%). Lobster OCI in grouper diet was low (1%).

Trophic diversity indices (H´) of grouper and octopus were very similar, 1.30 and 1.28 respectively, while that of lobster was slightly higher, 1.44. However, the diversity indices of grouper and octopus were underestimated because fishes are the most important prey in both predators and their determination at the species level in stomach samples is very difficult.

Similarity of grouper and octopus diets is reflected in the values of their diet overlap index. On the basis of the major taxonomic groups presented above, the degree of overlap appears to be high (0.79), but decreases to moderate (0.42) when overlap is examined at the species level. This is due to the fact that, although they prey on the same zoological groups, they do not consume the same species. Grouper-lobster and octopus-lobster diet overlap were low, both at the level of major groups (grouper-lobster : 0.29; octopus-lobster : 0.27) and at the species level (grouper-lobster : 0.14; octopus-lobster : 0.20).

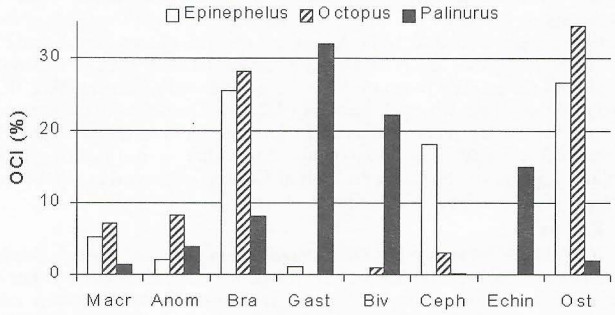

Figure 1. Diet composition of *E. marginatus*, *O. vulgaris* and *P.elephas* expressed in Occurrence Index (OCI) of major taxonomic groups. Major groups are Macrura, Anomura, Brachiura, Gastropoda, Bivalvia, Cephalopoda, Echinoidea and Osteichthya.

The estimated efficiency of octopus predation on lobster was 23.5%. This value probably overestimates predation efficiency in natural conditions, because a lobster's capacity to refuse the attack of an octopus is presumably higher in a natural cave than in a trap. This is presented as a first estimation as it provides an approximation to the efficiency that occurs in nature.

Predator-prey size relationships are in Fig. 2. In general, the larger the grouper the larger the octopus consumed although middle sized groupers may also eat large octopuses. The octopus-lobster size relationship shows the same tendency of increasing size of prey with size of predator. It also appears that while small octopuses do not prey on large lobsters, larger octopuses do not reject small lobsters.

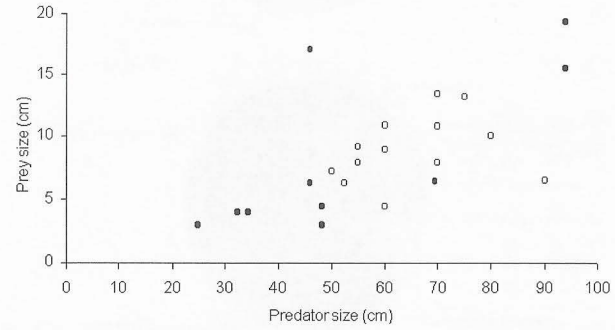

Figure 2. Relationships between predator size and prey size. Black circles are *E. marginatus versus O. vulgaris*. Open circles are *O. vulgaris versus P. elephas*; here *O.vulgaris* sizes were multiplied by 5.

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