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# Size selectivity in the diet of the young cuttlefish *Sepia officinalis* (Mollusca: Sepiidae)

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The prey size of young cuttlefish was investigated by measuring the size of entire animals, carapace, periopods, and otoliths in the stomach contents of specimens from Morbihan Bay in 1994–1996. The young of the *Sepia* species consumed a wide range of prey sizes. The size of all isopods and amphipods was less than the 50% of those of the *Sepia*. The size ratio of brachyurans varied between 14 and 37% of the dorsal mantle length of the cuttlefish. The young could catch fish species which were three times larger than itself.

From June to November, in Morbihan Bay (south Brittany), young cuttlefish stay near the coast in the nursery ground before they move to the wintering area. During the first two months, they initially capture crustaceans and thereafter fish. The present paper examines samples used by Blanc et al. (1998) alongside new data and new information on prey size to investigate the relationship between prey size and predator size for the most important prey species in the diet of young *Sepia*. These results complete data on adults (Blanc et al., 1999).

The juvenile *Sepia* were sampled by a trawl (3.5×1.2×0.4 m with 5-mm mesh) from June to November (1994–1996) in Morbihan Bay. For each specimen, its ML (dorsal mantle length in millimetres) was measured. In the laboratory, each specimen was dissected and its whole stomach contents removed. These were stored in vials in 70% alcohol. The prey in the stomach contents were examined and identified using a binocular microscope (Hayward & Ryland, 1995), and measurements were taken by caliper to the nearest 0.1 mm. Some isopods and amphipods were identified directly using the entire specimen (total length) of individuals. Brachyuran species were identified by the shape of the carapace and the merus of periopod 2–5 (Blanc et al., 1998). Size references were: the cephalothorax length (CL), carapace width (CW) and total width of periopod merus (PMW) (Blanc et al., 1999). The merus size allowed the size of the crab eaten to be estimated and also to evaluate the surface area of the carapace (S, $mm^2$):

$$S = CL \times CW \quad (1)$$

Then, we could calculate the R index:

$$R = \frac{\text{weight of cuttlefish (g)}}{S} \quad (2)$$

When the R index >1 (i.e. the crab was 'small'), the capture of a crab was effected using tentacles (tentacle method). However, if R <1 (i.e. the crab was 'large'), then the arms were used (jump method) (Duval et al., 1984). Cephalopods found in stomach contents were identified by beaks and cuttlebone. Fish species were identified from otoliths, vertebrae and scales. Otolith pairs were combined when left and right otoliths were present and of similar length, they were then identified and measured to estimate fish length using a reference collection in Pinczon du Sel (1996). Their sizes were given by the relation between the otolith size (Lo) and total length (TL: from head to caudal fork) of the fish (Blanc et al., 1999). The following indice was used:

$$\text{Size ratio} = \frac{\text{Total Length (TL) of a prey}}{\text{ML of a predator}} \times 100 \quad (3)$$

Only 57.3% of young *Sepia* (N=902 animals) had full stomachs. Specimens of *S. officinalis* ranged from 7.61 to 88.56 mm ML. The species found in the diet of young *Sepia* were: isopods, *Cyathura carinata*; amphipods, *Ampelisca brevicornis*, *Marinogammarus marinus*, *Dexamine spinosa*, *Orchestia gammarellus*, *Phtisica marina*; caridea, not determined; brachyrans, *Liocarcinus arcuatus* and *Carcinus maenas*; cephalopods, *Sepia officinalis*; fish, Syngnathidae (*Syngnathus* sp., *Nerophis* sp.) and Gobiidae (*Gobius* sp.).

From June to September, *Sepia* juveniles eat isopods and amphipods. The most important prey was *P. marina* (Caprellidae) (35 ind per stomach). In July, brachyurans appeared in the stomach contents, represented by *L. arcuatus* and *C. maenas*. Fish appear in the diet from August (Figures 1 & 2). Two families of fish: Syngnathidae (identified by scales with right angle; Pinczon du Sel, 1996) and Gobiidae were recognized in the stomach contents of the juveniles of *Sepia officinalis*.

The size ratio of amphipods fluctuated between 15% (*A. brevicornis*) and 43.6% (*D. spinosa*). The size of the isopods and amphipods was smaller than 50% of predator ML. The size ratio of *P. marina* was large, 66–166% (Figure 1). The body size of *Phtisica* eaten fluctuated between 12.1 and 20.0 mm (Figure 2). Measurements gave the mean size of the stretched specimen of caprellids. From the estimation of the crab size eaten by the young cuttlefish, the surface area of a crab carapace and the R index were given. The size ratio fluctuated between 14 and 66% for *L. arcuatus* and 13.6–36.4% for *C. maenas*. All of these prey were caught by jump methods (R<1). *Syngnathus* sp. and *Nerophis* sp. were identified by scales, but total length could not be estimated. Size of gobies caught by juvenile cuttlefish was estimated by the following relationship: L=29.461Lo−9.238 ($r$=0.99, N=32; L and Lo in mm) (Pinczon du Sel, 1996). The size ratio of prey to predator fluctuated between 53 and 160% of the cuttlefish ML (Figure 1). The young fish were sometimes three times larger than the cuttlefish. From October, the size ratio varied between 53.4 and 57.2% (Figure 1). The size of cuttlefish was generally larger than 6 cm (Figure 2).

This study of the diet of young cuttlefish showed that these cephalopods actively feed from July to November (Blanc et al., 1998). In June (period of the first hatching), many cuttlefish lived on the inner yolk reserve. The ingestion of food by the young is correlated with the development and increasing activity

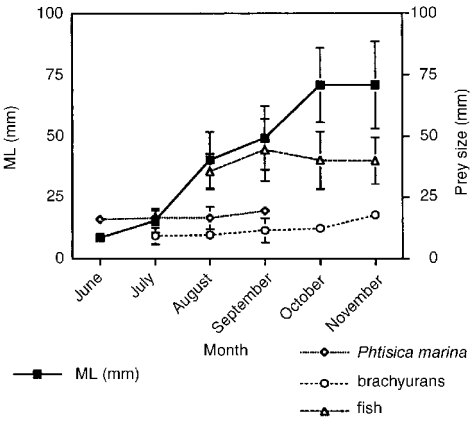


**Figure 1.** Growth curve in the early stages (June–November) of *Sepia* and size ratio of prey to predator.

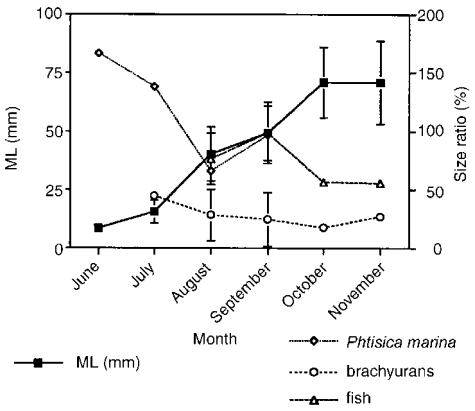


**Figure 2.** Growth curve of young of *Sepia* and size of their prey from June to November.

of the digestive gland (Boucau-Camou et al., 1985). The diet of young cuttlefish is essentially based on crustaceans, which represent 89% of the nutrition for animals less than 85 mm ML (Blanc et al., 1998). From June to September, their diet was based mainly on caprellids *P. marina*. The young cuttlefish capture these prey on the algae *Cystoseira* sp. (Blanc, 1998), they are principally pelagic at night (Hayward & Ryland, 1995), which corresponds to feeding activity of young (Castro & Guerra, 1990). The size ratio prey to predator was greater than 66%. Other amphipods *A. brevicornis*, *M. marinus*, *D. spinosa* and *O. gammarellus* and the only isopod *Cyathura carinata* eaten were found in low quantity in their stomachs. The size ratio was less than 50%. It seems that there was no selection of size for these prey. In the laboratory, Blanc (1998) demonstrated that there was no selection in size for the amphipod *O. gammarellus* whatever the size. *Palaemon adspersus* (Crangonidae) was found in the stomach of cuttlefish but it was not possible to estimate their size. The head of the prey was rarely eaten, we only found pieces of rostra of shrimps. As *Sepia* matures, its food begins to include *L. arcuatus* and *Carcinus maenas*, from July to November for the former species and from August to November for the latter. Adults, principally eat the green crab *C. maenas*, the most important Brachyura in the Bay of Biscay (Pinczon du Sel, 1996). The size ratio varied from 14 to 37% of the dorsal mantle length of the young for the two crabs. The capture of these preys was made with the arms ($R < 1$). The selection of capturing methods depended on the size of crabs but also on the age of the young cuttlefish. Between 3 and 10 d, the jump method appeared but the tentacular method was dominant (Boulet, 1964). The jump method required a more precise handling and motor assessment of arms and suckers (Chichery & Chichery, 1988). *Sepia officinalis* can also seize its prey with its arm by jumping on it (Wilson, 1946). Fish species were identified in the diet of young cuttlefish from August to November. Two families of teleosts were found in food of young Syngnathidae and Gobiidae. The size of the goby species varied between 53 and 106% of the ML of the young. No Labridae species were recognized in the stomach contents. The adults of *S. officinalis* seem to be more selective in prey size, the size of the fish eaten fluctuated between 25 and 85% of the predator's ML and between 20 and 40% for crabs (Blanc et al., 1998). The young of *Loligo opalescens* showed no selectivity with regards to prey length (Hurley, 1976). The relationship between fish prey length and mantle length of *L. forbesii* showed an increase in the prey size up to a mantle length of 200 mm. The changes in prey size were related to the consumed prey species (Collins & Pierce, 1996). The results of this study suggest that young cuttlefish are less selective in prey size than adults (Blanc et al., 1999). Cephalopods are opportunistic in the choice of their diet but more selective in prey size. This opportunist behaviour seems to be the origin of the difference in the diet of young and adult cuttlefish. The variation in behaviour depends on the age, experience and motivation of the predator.

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