

CM 1988/M:2 Theme Session (M) on Impact of Cephalopods in the Food Chain and their Interaction with the Environment

The role of young cephalopods in food webs and their environment: a major gap in our knowledge.

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ABSTRACT.—I review the lack of information on the role of early life history stages of cephalopods in ecosystems. The egg stages of pelagic spawning species are almost unknown, although spawning aggregations have been documented. Egg masses of some benthic spawners can be very abundant, covering the bottom in fairly large local areas, but few records indicate anything eating them. Paralarvae must be abundant to account for the numbers of adults caught by fishing and by other predators (with some left over to reproduce). However, numbers of paralarvae sampled by plankton nets are, with very few exceptions, very low. In spite of much speculation, we don't actually know what the paralarvae eat, much less their feeding rates. Thus, even if we knew their abundance, we couldn't calculate their impact as micropredators. We know even less about what is eating young cephalopods; few publications contribute any information about predation on paralarvae. Although most cephalopod mortality probably occurs during early stages, we can't confidently infer much about the major likely sources of mortality: starvation and predation.

keywords: Cephalopod early life history, eggs, paralarvae, feeding, predation.

Our knowledge of cephalopods and their ecological roles in general is very limited, compared with other nekton such as fishes and shrimps. Conventional methods used to study nekton seem to underrepresent the diversity and abundance of cephalopods, especially in pelagic and deep-sea ecosystems. These problems are even more troubling when considering the eggs, paralarvae, and early juveniles of most cephalopod species.

Whereas the eggs are known for many neritic species, which attach their eggs to benthic substrata, those of most pelagic spawners are unknown. The ommastrephid squids, which certainly are among the most important pelagic cephalopods, have been shown through laboratory studies of a few species to spawn large drifting gelatinous egg masses. In spite of ommastrephid abundance and importance and expeditions directed at studying their early life history, their eggs have yet to be located with certainty in their ecosystems. Eggs of enoploteuthids, another group of abundant and diverse squids, have been identified in only a few locations. Only very recently has it been found that gonatids, or at least some species of the family, carry their eggs while they develop. Although we assume that all pelagic octopods also carry their eggs, this has been shown conclusively for only a few species other than argonauts. Eggs of benthic spawning octopods, sepioids, sepiolids, and loliginids are easier to study, but important questions still remain. The benthic eggs of loliginids sometimes are very abundant, covering the sea floor, yet there are few reports of other animals or microbes using them in any way. Other eggs, such as those of sepiolids, are cryptic and seldom reported. The eggs of most deep-sea cirrate and incirrate octopods remain to be discovered.

We seem to be particularly inadequate in our ability to sample paralarval cephalopods quantitatively. The numbers of paralarvae collected in any standard plankton study are consistently low, much lower than those of larvae of ecologically similar fishes. For many species, the early juveniles, which are large enough to avoid plankton nets but too small to be retained by trawls, are even less well known than paralarvae. In general, paralarval abundance does not seem adequate to account for the overall cephalopod population numbers inferred from studies of ecology, fisheries, or predators. Isolated reports of very large numbers of paralarvae reinforce the impression that we are consistently underestimating paralarval abundance. If very high, and perhaps patchy, abundance is characteristic of some paralarvae, then their impact on food webs and ecosystem processes such as nutrient cycling may be very important at scales appropriate to planktonic organisms. Additionally, although it is possible to determine spawning habitat for cephalopods, little can be said about essential habitat and environmental vulnerability for paralarvae.

When paralarvae are collected, they often cannot be identified confidently. Paralarval taxonomy is generally adequate to the family level. However, distinguishing among closely related species, and sometimes even genera, often is not possible based on current knowledge. This, however, is a field in which knowledge is consistently progressing.

Some progress also has been made in recent years in studying what paralarvae eat. Methods are being developed to study the food and nutritional condition of paralarvae. However, there still are almost no direct observations of prey types and sizes for almost all species. Therefore, even if we did know how many paralarvae are in a particular area, we still could not predict what they are eating or how much. In spite of inferences from laboratory studies on a few neritic species, no direct evidence exists on the importance of paralarval starvation in the field on the overall mortality of any cephalopod species.

We also know almost nothing about predators of paralarvae. A few reports are scattered in the published literature. It is tempting to assume that anything that eats zooplankton in the 2-5 mm size range is a potential predator of cephalopod paralarvae. Without direct observations, though, questions about, for example, the relative importance of gelatinous megaplankton, predatory crustaceans, small fishes, filter feeders, and cannibalism in paralarval mortality simply cannot be answered. No information exists about selection either for or against cephalopod paralarvae by any potential predator. If we somehow knew where a cephalopod nursery area was, and knew that medusae were particularly abundant there one year, we would still be unable to predict how the medusae would affect recruitment of the cephalopod species.

All of this uncertainty affects our ability to understand and to predict the population dynamics of cephalopod species. Is there a "critical stage" in the early life history of cephalopods, similar to that proposed for fishes? Nothing can presently be concluded about the relative importance of starvation and predation in paralarval mortality. Complex calculations based on the distribution and abundance of late juveniles and adults currently must be based on assumptions about egg production and hatching as well as mortality in the early phases of the life cycle, assumptions that are either poorly supported or utterly untested.