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Coral reef fish larvae and temperate fish larvae – not to be compared

Coral reef fish larvae & Blooper Science

Marathon Fish larvae

Coral reef fish ecology is a new research area, probably just about 40 years old, compared, for example, to research in temperate fish ecology, which has been studied extensively for more than 100 years. Therefore, coral reef fish ecologists often have to "borrow" knowledge from what we know about temperate fishes, simply in order to establish the first research in coral reef fish ecology.

However, this sometimes causes some big "bloopers". Such a blooper is the case regarding the swimming abilities of coral reef fish larvae.

The life cycle of most coral reef fishes includes a larval planktonic stage, lasting from a few days up to several weeks, before settling to a benthic habitat. This phase has been considered the 'black box' by coral reef ecologist, because the coral reef fish larvae field is very difficult to examine. For example, they are quite difficult to sample in large numbers, because of the many more species in much lower numbers on a coral reef than in a temperate ecosystem, where there are a few species in very high numbers. Therefore, to establish important coral reef fish dispersal models for predicting the size of reef fish populations, ecologists assumed that coral reef fish larvae behave exactly as temperate fish larvae out there in the blue water. However, when finally the first swimming results with reef fish larvae turned up it caused a shock among coral reef fish ecologists. They swim fast and very long distances.

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Surprising results

The results of swimming tests with coral reef fish larvae showed that larvae of coral reef fishes are strong, effective swimmers, capable of sustained speeds higher than ambient ocean currents, and of swimming non-stop for tens of kilometers over tens of hours. Further, they are much faster than larvae of temperate species of similar size, particularly the well-studied herrings and cods. This surprising information on settlement-stage larvae is the result of laboratory swimming-chamber (or flume) measurements of swimming endurance in 51 species of 9 families, and speed measurements on the coral reef of free-swimming larvae for over 50 species of 15 families. Both sets of research were conducted by Australian researchers. Temperate fish larvae of 1–2 cm apparently swim at 1–5 body lengths per second, whereas similarly sized larvae of coral reef fishes swim at a mean speed of 13.7 body lengths per second, with some as fast as 34 body lengths per second. Put into perspective, a freestyle human swimmer capable of 13.7 body lengths per second would swim the 100-m race in 3.6 seconds; the Olympic record for 100-m freestyle is 48 seconds.

The actual speeds

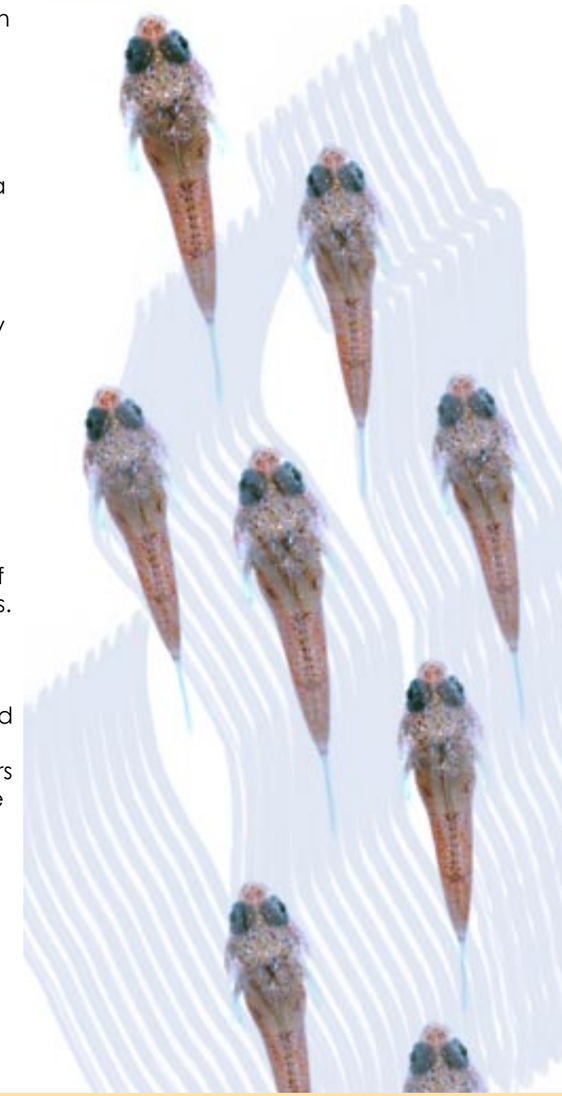
of reef fish larvae average 20.6 cm per second with some as fast as 65 cm per second. This is faster than the average ambient ocean current speed in the studied areas, so the average reef fish larva near the end of its pelagic stage is indeed an effective swimmer. Just as remarkable as their swimming speeds, these larvae have great endurance, being able to swim an average of 40.7 km (some up to 140 km) in laboratory experiments, unfed and without rest before exhaustion. The mean time to exhaustion was 83.7 hours (maximum 288.5 hours). On a persize basis, this is equivalent to a human swimming roughly 4000 km!

Swimming far and fast may simply increase the possibility of encountering a reef by chance alone, but pelagic reef fish larvae in blue water may be able to detect and orient to reefs. Orientation, combined with effective swimming abilities, would greatly increase the capacity of larvae to find a reef. In either case, this capacity would vary among species because swimming abilities vary among species.

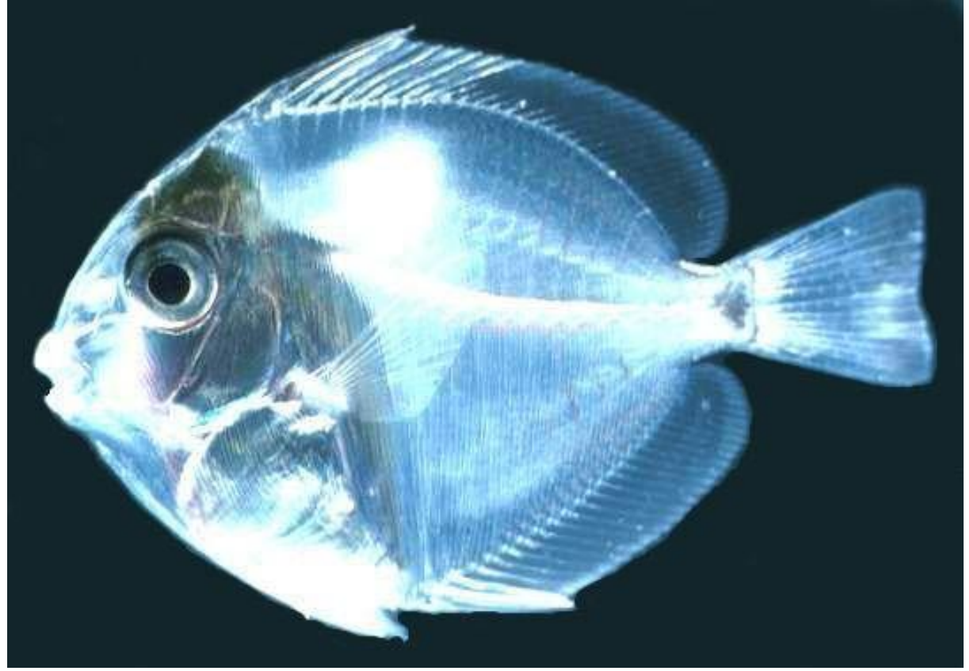
Comparison and contrast

Why are temperate fish larvae so different from reef fish larvae?

Coral reef fishes are overwhelmingly of the order Perciformes, or perch-like fishes. In contrast, most research on temperate marine fish larvae has been on herrings, sardines, and anchovies, cods, flatfishes. These latter five types of fish are so-called non-perciform fishes. Most of the literature on fish larvae from temperate waters concerns species that are pelagic or live on soft bottoms (sand or mud) as adults rather than species from (rocky) reefs. This alone may confound temperate/coral reef comparisons. Adult pelagic fishes usually have habitat requirements that differ from those of their larvae, but



Marathon Fish Larvae



they never make the abrupt changes entailed by settlement out of the pelagic environment and into the benthos. Except on oceanic islands, soft-bottom habitats are usually far more extensive and less discrete than reef habitats, so larvae of reef fishes have a much smaller target to find at the end of the pelagic phase than do fishes of soft bottoms. Further, it is thought that most reef fishes are relatively sedentary as adults, whereas adults of many pelagic and soft-bottom species undertake extensive migrations. A major difference between coral reef fishes and temperate marine fishes is the incubation period of their eggs. Pelagic eggs of most coral reef fish species hatch within 1 day, far more rapidly than pelagic eggs of temperate fishes, which commonly have incubation periods of 3–20 days. A second major difference between coral reef fish and most temperate fish larvae is that, at any given size, the reef fish larvae are more developed. This is particularly apparent if one compares the state of development of well-studied temperate larvae such as herring and cod at the sizes at which reef fish larvae commonly settle (1–2 cm). At all sizes, the reef fish larvae have more complete fins. They develop scales at a smaller size, seemingly have better developed sensory apparatus at any size, and are morphologically equipped for effective feeding within a few days of hatching, and at a smaller size than the herring and cod.

Looking ahead

So what of the future in research of coral reef fish larvae?

Recent research on the pelagic stage of reef fishes has given coral reef fish ecologist an excellent look into the black box of larval biology. This look reveals that these pelagic stages are real fishes with capabilities in excess of the larvae of well-studied temperate fishes. This has changed thinking about the behavior and ecology of reef fish larvae. We now know that reef fish larvae and their behaviour have a major influence on the dynamics of reef fish populations In the foreseeable future, we should have a firm and defendable basis for design of marine reserves and of the geographical size of reef fish population units for management purposes, based on this increased understanding of reef fish larval biology.

Litterature

This text has mainly been based on: Leis, J.M. & McCormick, M.I. 2002. The biology, behaviour, and ecology of the pelagic larval stage of coral reef fishes, *Coral reef fishes: Dynamics and diversity in a complex ecosystem* (P.F. Sale, ed.) Academic Press: San Diego & London, pp. 171−199. ■

Pictures of Fish Larvae, courtesy of Northwest Fisheries Science Center, National Atmospheric and Oceanographic Administration