

Regional differences in duration of the planktonic larval stage of reef fishes in the eastern Pacific Ocean

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Date of final manuscript acceptance: February 28, 1992. Communicated by J. M. Lawrence, Tampa

Abstract. Regional variation in the duration of the planktonic larval phase of three species of reef fishes, *Thalassoma lucasanum* (Labridae), *Stegastes flavilatus*, and *Micropogonias dorsalis* (Pomacentridae) was investigated between 1982 and 1991 at several sites in the tropical eastern Pacific over a distance of 3500 km, encompassing virtually their entire range of distribution. Durations of the larval phase, determined from counts of daily otolith increments, were significantly different (1.3 to 1.6 x) between sites. Populations of all three species had a consistently shorter larval life at the most northern site, Cabo San Lucas (Mexico) compared to Panamá and the offshore islands of Galápagos and Cocos. Analyses of otolith increment width over the precompetent period revealed that this disparity in larval duration primarily reflected differences in larval growth rates: faster growing fish spent less time in the plankton. In *T. lucasanum*, some of the variation in larval duration between Panamá and offshore sites (Galápagos Islands and Cocos Island) may be accounted for by a higher frequency of individuals delaying metamorphosis at the offshore sites. These data indicate that conditions in the planktonic environment are not homogeneous throughout the tropical eastern Pacific and may have a profound effect on aspects of the larval ecology of reef fishes in this region.

Introduction

The larval life of nearly all reef fishes is spent in the plankton (Sale 1980, Doherty and Williams 1988). Since this habitat is still relatively unexplored, little is known about many of the basic aspects of the larval ecology of reef fishes. Direct assessment of the distribution and abundance of larvae has proven difficult, and problems of sampling have been further compounded by identifications limited to the familial or generic level (Leis and Rennis 1983). The most comprehensive information so far about the larval life of reef fishes has come from studies making use of aging by daily otolith increments

(Brothers et al. 1983, 1976, Victor 1986 a, b, c, 1987, Thresher and Brothers 1989, Thresher et al. 1989, Wellington and Victor 1989, Thorrold and Milicich 1990).

Studies of larval otoliths have proven useful in revealing several important aspects about larval and adult biology, such as the timing of settlement and geographic patch-size of recruitment events (Victor 1984, Wellington and Victor 1985), and the linkage between reproduction and recruitment (Robertson et al. 1988). Estimates of larval duration, combined with size at settlement, have been used to calculate overall growth rates of larvae during the planktonic phase (Victor 1986 b, 1987, Thresher and Brothers 1989, Thresher et al. 1989, Wellington and Victor 1989, Thorrold and Milicich 1990, Cowen 1991). Attempts have been made to relate larval duration with geographic range to explain patterns of species distribution (Brothers and Thresher 1985, Thresher et al. 1989, Wellington and Victor 1989). Yet, despite the potential wealth of information that can be derived from estimates of the length of time larvae spend in the plankton (i.e., the planktonic larval duration, hereafter referred to as PLD), very little is actually known about the ecological factors which influence the time larvae spend in the plankton. It is not known, for example, if environmental factors such as water temperature and food availability influence the PLD, or how much of the observed variation in PLD is genetically determined. This information would be fundamental to understanding the ecological significance of the variability in larval duration.

If planktonic larval duration varies temporally or spatially, inferences drawn from data collected from a locality at one time should not be generalized to other sites within the range of the species. Thus far, most estimates of planktonic larval duration for individual species are derived from collections from a single site (e.g. Brothers et al. 1983, Brothers and Thresher 1985, Thresher and Brothers 1985, Victor 1986 a, c, Robertson et al. 1988, Wellington and Victor 1989). There is usually an implicit assumption that the larval duration of a particular species varies little over time and space. Although studies

