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LIFE CYCLE, EARLY LIFE HISTORY, FISHERIES AND  
RECRUITMENT DYNAMICS OF DIADROMOUS  
GOBIES OF DOMINICA, W.I., EMPHASISING  
*SICYDIUM PUNCTATUM* PERUGIA

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ABSTRACT

Fisheries for diadromous gobies occur widely in the coastal inter-tropics. Yields are rarely documented in detail, but there are many reports of and allusions to declines, which have not been satisfactorily explained. Basic life-history information has been at best sketchily known, or not at all, such that various sicydiine gobies have been incorrectly described as catadromous on the basis of assumptions alone. *Sicydium punctatum* Perugia is shown to be diadromous, spawning in rivers and spending 50 to 150 days at sea before migrating to fresh waters.

Larval behaviour is described and experiments show that larvae have the ability to select particular salinity layers in stratified systems. Implications for early life history transport, survival and vulnerability to terrigenous toxins are discussed.

Larval fish occurring in the rheoplankton are shown to be separable into five types, using pigment and other characteristics. The five types numerically correspond to the number of goby species known in Dominica, and one type is verified as *S. punctatum* through several captive spawnings and collected nests. Separation into types permitted an analysis of mortality in rivers, using stream drift data in a manner not previously applied. The theory of this manner of estimation is discussed, and field results for *S. punctatum* are compared with two types of analysis of mortality *in captivo*. Field data are also considered for several other taxa to demonstrate the method. The mortality rates found for *S. punctatum* are unprecedentedly high, but the agreement among multiple samples and with the captive observations suggests that stream mortalities may be extreme, and that larvae nearest the coast have a significant advantage. Coastal habitat is therefore the most important in sustaining the fishery. Implications and questions arise for the reproductive ecology, competition and upstream migration of *Sicydium* spp.

While age-at-recruitment (AAR) has thus far been treated as a constant (each species) plus error, the duration of the postlarval period of *S. punctatum* is shown on the basis of otolith analyses to vary systematically with time of year. There is contrary variation in size-at-recruitment, indicating strong seasonal variation in growth rate. The variation in age-at-recruitment suggests population dynamics not previously acknowledged in either fact or theory, and these are discussed in principle and the dynamics modelled by numerical simulation. The

unavoidable conclusion is that, even where reproduction and daily risk of mortality remain constant in all seasons, observed levels of variation in AAR are sufficient to induce large variations in yield. The characteristics of the simulated yield patterns closely match the actual yield data. The amplitude of variation generated depends on level of (constant in each simulation) mortality. The same principle applies not only where changes are seasonal, but to any temporal trends, and may have implications in other systems. Further variation in reproduction or mortality could increase or decrease these amplitudes, but since the variation in AAR generates variations over 10- to 30-fold at plausible field mortality rates, large variations in any other factor would be required to mask these effects.

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#### LIST OF ABBREVIATIONS, TERMS AND SYMBOLS

DOY            day of year, numbered 1-365 from Jan. 1 to Dec. 31.

larva (in context of *Sicydium* spp.):            newly hatched, 1.8mm, rheoplanktonic, non-feeding, with yolk sac incompletely absorbed. Hatched from nests in rivers, and found in stream drift/river plankton.

postlarva (in context of *Sicydium* spp.):            the period or developmental stanza(s) following yolk absorption (early postlarva) to approx. 20mm SL (late postlarva), entering fresh waters from sea, with incomplete pigmentation (barring pattern on body may be 0 to 100% present, but no pigmentation on dorsal fins). Mouth in process of transforming from terminal to inferior, dentition incomplete. Late postlarvae cannot yet be diagnosed beyond "*Sicydium* spp." without pigmentation. May also be referred to as incompletely settled, settling, recruiting, a recruit. When placed over sand, incompletely settled fish swim free of the bottom, while over stones they skip from stone to stone. See also JUVENILE.

juvenile:            approx 20mm SL, recently entered fresh waters from the sea (as late postlarva), has completed development of characteristic juvenile pigmentation including somatic (permitting ready identification as *Sicydium punctatum* or *S. antillarum*) and dorsal fin pigmentation. Mouth completely transformed from terminal to inferior, dentition complete. May also be referred to as completely settled, recruited, metamorphosed.

- tri-tri: late postlarvae of diadromous gobies migrating from sea into rivers. Tri-tri have been fished in Dominica since the 1700's or earlier. Term probably derived from the early settlers' phrase 'trez-trez'.
- SL: Standard Length, from tip of snout to posteriormost fleshy part of caudal peduncle
- FL: Fork Length, from tip of snout to termination of central caudal fin rays (or caudal membrane in larvae) (because of shape of caudal fin, *Sicydium* spp. FL=TL)
- TL: Total Length, from tip of snout to termination of central caudal fin rays (because of shape of caudal fin, *Sicydium* spp. TL=FL). Note: Larval lengths are recorded as TL to avoid the suggestion that finrays are developed.
- AAR: age-at-recruitment
- S: survival.  $S_h$  = hourly survival.
- M: mortality,  $M = 1 - S$ .  $M_h$  = hourly survival.
- Early developmental stage names:
- NE,EE,LUP,LEP,LP: Stages of development according to development of eye. No Eye (no trace of), Early Eye (trace of outer margin but no lens), Lens Un-Pigmented (lens present, retina unpigmented), Lens Early Pigment (lens present and pigment beginning to appear on retina but no part of retina less transparent than smoked glass), Lens Pigmented (retina no longer translucent). See also J<#>.
- J<#>: Stage, numbered according to development of jaw. 0: no sign of jaw. J1: irregularities on snout indicating development of jaw structure. J2: posterior tip of mandible detectable as a bump or prominence, approximately below eye. J3: location of future opening of mouth is visible ("lips"). J4: ventral profile of mandible is clear. J5: intermediate. J6: mouth appears formed, but closed. J7: intermediate. J8: mouth open. J9: intermediate. J10: mandible seen to move at least once, presumed beginning of feeding capability. J11: mouth seen to be well formed, open and operating. See also NE, EE, LUP ... .
- Fyg, Frb, Y, W, P: designations for larval goby types recognised in the river plankton (defined in Chapter 5).
- Other symbols explained in text as they occur.