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## **Abundance and Distribution of Hamlets (Teleostei: *Hypoplectrus*) in Coral Reefs off Southwestern Puerto Rico: Support for the Multiple-Species Hypothesis**

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Hamlets are small, predatory coral reef groupers of the genus *Hypoplectrus* (Serranidae: Serraninae) that inhabit relatively shallow reef areas in the western Atlantic (Böhlke and Chaplin, 1993; Randall, 1996). They feed mostly on small benthic crustaceans like crabs, shrimps, and stomatopods, and occasionally consume small fishes and polychaetes (Randall, 1967). Hamlet distribution is mostly centered in the Caribbean (Domeier, 1994) with geographic ranges overlapping extensively (Randall, 1996).

Species number within the genus *Hypoplectrus* has been debated extensively due to an apparent lack of specific differences other than coloration (Thresher, 1978). According to Graves and Rosenblatt (1980) and Robins et al. (1986), the genus contains one species (*H. unicolor* Walbaum, 1792) with various color patterns; but Randall and Randall (1960) and Böhlke and Chaplin (1993) suggested that these color variants possess slight morphological and ecological differences that justify the recognition of several species. In the latest and most comprehensive study on hamlets, Domeier (1994) offered ecological and biological data indicating that color variants in the genus deserve species rank. Ten species are generally recognized by many ichthyologists and ecologists: Butter Hamlet (*H. unicolor* Walbaum, 1792), Barred Hamlet (*H. puella* Cuvier and Valenciennes, 1828), Yellowtail Hamlet (*H. chlorurus* Cuvier and Valenciennes, 1828), Black Hamlet (*H. nigricans* Poey, 1852), Golden Hamlet (*H. gumigutta* Poey, 1852), Indigo Hamlet (*H. in-*

*indigo* Poey, 1852), Shy Hamlet (*H. guttavarius* Poey, 1852), Yellowbelly Hamlet (*H. aberrans* Poey, 1868), Blue Hamlet (*H. gemma* Goode and Bean, 1882), and Masked Hamlet (*H. providencianus* Acero and Garzon, 1994).

While information about hamlets is available in terms of behavior (Barlow, 1975; Lobel, 1992), ecology (Thresher, 1978; Fischer, 1980a), genetics (Graves and Rosenblatt, 1980), and reproduction (Fischer, 1980b; Lobel and Neudacker, 1985; Ramírez-Mella, 1985), aside from Domeier (1994) few studies clearly elucidate if *Hypoplectrus* species differ in ways other than color pattern. Hence, despite Domeier's comprehensive study, the one vs. multiple species controversy persists. Moreover, with the exception of the study by Barlow (1975), little is known about hamlets from Puerto Rican waters. This work aimed to discover differences in abundance and distribution among *Hypoplectrus* species inhabiting the coral reefs of southwestern Puerto Rico.

Field work was conducted from August to December 2000 in 16 coral reefs off La Parguera, Puerto Rico. Sampling sites in-

cluded nine inner reefs (< 15 m in depth; Lopez key, La Palma, La Gata, Media Luna, Mario, Enrique, Pinnacles, San Cristóbal and Las Pelotas) and seven outer reefs (> 15 m; Table 1). Underwater visual censuses (UVCs), with a maximum of 1 hr/man per location, were performed before noon (09:30-10:30 hrs) in randomly selected reef areas to determine presence, depth distribution, and relative abundance of hamlets. At the beginning, 25 m × 2 m transects were used, but since hamlets were widely spaced (one or no individuals per 100 m<sup>2</sup> in the outer reef and no more than three or none per 100 m<sup>2</sup> in the inner reef sites), the UVCs were done without measuring habitat. Relative fish abundance was transformed ( $\log_{10} [x + 1]$ ) for normality and a one-way ANOVA was applied. Abundance between shallow (< 6 m) and deep (> 6 m) areas within the inner reefs was compared using  $\chi^2$  (Sokal and Rohlf, 1995).

A total of 176 individuals and 6 species were recorded (Table 1). Overall relative species abundance was significantly different (ANOVA,  $F = 5.915$ ,  $P < 0.001$ ), with *H. chlorurus* having the highest relative abundance (60.1%), followed by *H. puella*

TABLE 1. Relative abundances of *Hypoplectrus* species.

Location, depth (m) (latitude, longitud)	Species						Total	Rel. ab. (%)
	Hchl	Hnig	Hpue	Habe	Huni	Hind		
López Kay, 3 (17° 57'.903; 67° 03'.360)	11	0	0	0	0	1	12	8.1
La Palma, 5 (17° 57'.469; 67° 03'.407)	6	2	2	3	1	0	14	9.5
Mario Reef, 6 (17° 57'.166; 67° 03'.389)	22	4	4	5	3	0	28	18.9
La Gata, 10 (17° 57'.699; 67° 02'.252)	8	2	1	0	0	0	11	7.4
Media Luna, 10 (17° 56'.160; 67° 03'.107)	4	1	4	3	4	0	16	10.8
Pinnacles, 10 (17° 55'.957; 64° 00'.717)	6	1	2	0	1	4	14	9.5
Enrique, 3 (17° 57'.303; 67° 03'.195)	16	2	0	1	0	1	20	13.5
Las Pelotas (17° 57'.460; 67° 04'.298)	10	2	2	0	0	4	17	11.5
San Cristóbal, 8 (17° 56.300; 67° 04.100)	6	2	1	0	0	1	10	6.8
Outer reef 1, 18 (17° 54'.047; 67° 04'.899)	0	0	3	1	0	0	4	2.7
Outer reef 2, 18 (17° 54'.057; 67° 04'.909)	0	0	3	1	3	0	7	4.7
Outer reef 3, 16 (17° 54'.089; 67° 04'.517)	0	0	2	0	1	0	3	2.0
Outer reef 4, 16 (17° 54'.038; 67° 04'.751)	0	0	2	2	0	0	4	2.7
Outer reef 5, 16 (17° 54'.060; 67° 04'.800)	0	0	2	0	0	0	2	1.4
Outer reef 6, 16 (17° 54'.849; 67° 03'.600)	0	0	0	0	1	0	1	0.7
Outer reef 7, 15 (17° 54'.844; 67° 03'.195)	0	0	2	0	0	0	2	1.4
Total	8	16	30	16	14	11	176	
Rel. Ab (%)	60.1	10.8	20.2	10.8	9.4	7.4		

Hchl = *H. chlorurus*, Hnig = *H. nigricans*, Hpue = *H. puella*, Habe = *H. aberrans*, Huni = *H. unicolor*, Hind = *H. indigo*. Rel. Ab. = Relative abundance.

TABLE 2. Abundance of *Hypoplectrus* species according to depth. N = number of individuals, NS = not significant.

Species/depth	0-6 m		>6 m		$\chi^2$
	N	%	N	%	
<i>H. chlorurus</i>	53	63.9	38	58.5	2.47 NS
<i>H. nigricans</i>	16	19.3	0	0	—
<i>H. puella</i>	8	9.6	20	30.8	5.14 NS
<i>H. aberrans</i>	9	10.8	7	10.8	0.25 NS
<i>H. unicolor</i>	8	9.6	6	9.2	0.28 NS
<i>H. indigo</i>	7	8.4	4	6.2	0.81 NS
Total	101		75		3.84 NS

(20.3%); *H. indigo* had the lowest relative abundance (7.4%). Relative species abundance was not significantly different among inner reef sites (ANOVA,  $F = 0.882$ ,  $P > 0.05$ ), but it was between inner and outer reefs (ANOVA,  $F = 12.74$ ,  $P < 0.05$ ). The site with the highest relative abundance of hamlets was Mario reef (18.9%), followed by Enrique reef (13.5 %); the site with the lowest relative abundance was an outer reef (0.7%).

Abundance did not differ significantly between shallow (< 6 m) and deep areas (> 6 m) within inner reefs, except for *H. nigricans* ( $\chi^2$ ,  $P > 0.001$ , Table 2). This species was restricted to shallow water (< 6 m in depth), while *H. puella* was widely distributed at 13 sites regardless of depth. The latter species was found in shallow inner reefs (e.g., Lopez kay, Mario, La Gata, La Palma, Media Luna) and in deeper outer reefs. The distribution of *H. aberrans* resembled that of *H. puella*, but the former was found only at 7 sites (outer or inner reefs).

Hamlet species exhibited variation in ways other than color pattern, showing marked differences in abundance and distribution. *Hypoplectrus chlorurus* was the commonest and most abundant species, found mainly in shallow and mid-depth locations, while *H. indigo* was the least abundant after *H. aberrans*. While *H. unicolor* and *H. puella* were moderately abundant and were distributed along a wide depth gradient, *H. nigricans* was strongly restricted to shallow water. *Hypoplectrus aberrans* and *H. puella* had similar distributions.

According to Domeier (1994), population centers exist for some hamlet species (suggesting historic and geographic isolation),

with many species being rare outside their centers. Expatriates can be explained through larval transport, but such transport is not large enough to allow all hamlet species to occur sympatrically. According to Domeier, the population center for *H. chlorurus* is in Netherlands Antilles. Although following this hypothesis, *H. chlorurus* in Puerto Rico would be considered rare or an expatriate because it was found far from its population center, it is very difficult to regard it as such when it was the most common and abundant hamlet at La Parguera.

Randall (1996) pointed out that *H. indigo* is rare in the western Atlantic, having been collected only in Cuba, Haiti, Jamaica, the Bahamas, Florida, and Honduras, at depths from 12 to 40 m. Moreover, Domeier (1994) argued that this species does not occur in Puerto Rico, the Virgin Islands, and the Lesser Antilles. While this species was the least abundant in La Parguera, it does occur in Puerto Rico (Dyer et al., 1985; Kimmel, 1985; Bortone et al., 1989; Turingan and Acosta, 1994) and in the Virgin Islands (Smith and Tyler, 1975; Mateo and Tobias, 2001), Saint Lucia (Lieske and Myers, 1994), and Trinidad and Tobago (Ramjohn, 1999). In La Parguera, I found *H. indigo* at Pinnacles, Enrique, San Cristóbal, López key, and Las Pelotas, from 3 to 10 m. There are records of this species in La Parguera area for the last 28 years (E.H. Williams, pers. comm.). Following Domeier's hypothesis of population centers, the center for *H. indigo* is in La Hispaniola and the species would be considered an expatriate in Puerto Rico. However, since the predominant marine current patterns in Puerto Rico run to the west (Kioroglou, 1992), the possibility for this species to arrive from such a population center is reduced.

Of the ten hamlet species considered in the literature, only six were found in this study at La Parguera, Puerto Rico. Nonetheless, Kimmel (1985) and Turingan and Acosta (1994) found *H. guttavarius* in the same area. Likewise, Colin and Clavijo (1988) found *H. gummigutta* in Guanica, a location close to the study area. While the latter is a rare species for Puerto Rico, it is common in the Dominican Republic (Williams et al., 1983; Domeier, 1994; Schmitt et

al., 2002), Cuba (Claro and Parenti, 2001), Caymans islands, and Jamaica (Domeier, 1994). The Tan hamlet, an undescribed species, has been recorded for Puerto Rico but only at Culebra Island (Humann, 2002; Hernández-Delgado et al., 2000). This fish has been found also in Anguilla (Humann, 2002), Panamá (Graves and Rosenblatt, 1980), Colombia (Acero and Garzón-Ferreira, 1994), Cuba (Bustamante et al., 2000), and México (Schmitter-Soto et al., 2000).

One important contribution of the present study at La Parguera, Puerto Rico was to demonstrate that hamlets showed clear differences in abundance and distribution. The study supports the multiple-species hypothesis within the genus *Hypoplectrus* and shows that not all hamlets are similar, at least ecologically, to the sole species (*H. unicolor*) recognized by some authors. Studies about genetics and morphology, combined with geographic regions (e.g., phylogeography; Avise, 2000; Rocha et al., 2002), would further strengthen the multiple-species hypothesis.

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