

1 **Gobies (Perciformes: Gobiidae) in Bolinao, northwestern Philippines**

2 **Running head: Gobies of Bolinao**

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13 **Keywords:** Bolinao, Coral Reef, Fish, Gobiidae, Philippines

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17 **Abstract:**

18 We conducted a visual and photographic survey of the gobiidae in the Bolinao area of the
19 Philippines, located on the western tip of the Lingayen gulf, on the west coast of Luzon island. We
20 identified a total of 40 species, of which 18 are shrimp-associated. One species found (*Myersina*
21 *lachneri*) constitutes a range expansion into the Philippines. This number of species is in the
22 expected range compared to other studies of marine goby faunae in the coral triangle, despite the
23 significant anthropogenic pressures onto the marine ecosystem in the surveyed area.

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INTRODUCTION

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30 Gobies (Perciformes: Gobiidae) are the largest family of marine fishes, with over 1800 known
31 species (1834 listed on Fishbase, Froese & Pauly, 2010). In tropical coastal ecosystems, gobies
32 constitute a significant fraction of all fish species. Many species of gobies are cryptic, living as
33 epibionts on corals and sponges, or highly camouflaged in the sand. About 120 species of marine
34 gobies also live in a symbiotic relationship with alpheid shrimp, with which they share a burrow
35 excavated by the shrimp. In mangrove areas, mudskippers of the genus *Pteriophtalmus* are
36 amphibious and venture out onto the mud between the mangrove roots. Most species of gobies
37 are small, with *Schindleria brevipinis* possibly the smallest known vertebrate (7 mm adult length,
38 Watson & Walker, 2004). Generally, knowledge of the gobiid fauna provides a valuable window
39 into the fish diversity of a location.

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MATERIALS & METHODS

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44 We used visual and photographic identification by two or three observers during SCUBA dives
45 to survey an area of about 75 km² around Santiago island east of Bolinao on the western edge of
46 the Lingayen gulf (Fig. 1; 16° 24' 32" North, 119° 56 '13" East), northwestern Philippines.

47

48 The sampling sites were between 1 and 35 meters deep, with the majority of species found
49 shallower than 18 meters. Habitats included coral reefs, sandy areas adjacent to reefs, sandy/silty
50 areas not in proximity to coral reefs, as well as seagrass areas. An unusual sampling site is the

51 giant clam ocean hatchery of the University of the Philippines Marine Science Institute, which is
52 home to several thousand giant clams (*Tridacna* spp.). These clams provide 3-dimensional
53 structure similar to a coral reef. We excluded estuarine, brackish water and freshwater habitats.

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55 The anthropogenic disturbances of the marine environment in the western Lingayen gulf are
56 significant, with fish farms introducing a significant amount of nutrients, and strong artisanal and
57 large-scale fishing operations depleting fish stocks (McManus, 1992; Campos et al., 1994). The
58 drop in water quality caused by the fish farming on the west side of Santiago Island has led to
59 coral reef degradation and in some spots to a conversion of former reefs to silty areas devoid of
60 corals (Cabaitan et al., 2016).

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62 RESULTS

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64 We found a total of 40 species of gobiidae, of which 18 were shrimp-associated, 7 were coral
65 epibionts at least part of the time, 14 were sand-living, 1 found in rubble and 1 in rock crevices
66 (Table 1, Fig. 2).

67

68 We found individuals of all but two species (*Gobiodon* sp., *Gobiodon ceramenis*) multiple times,
69 indicating that while our sampling of the goby species in the area might not be complete, we had
70 found all but the most rare species.

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72 *Gobiodon* sp., a yellow fish with orange facial markings, is likely the undescribed species listed
73 in Allen & Erdmann (2012). *Myersina lachneri* (Hoese & Lubbock, 1982) is a range expansion

74 for the Philippines, having previously only been reported from Papua New Guinea and Indonesia
75 (Allen & Adrim, 2003).

76

77 Photographs of 31 of the 41 described species are available here:

78 <https://www.flickr.com/photos/pacificklaus/sets/72157685611197132>

79 Video footage of several species featured in the photographs, and two more are available here:

80 <https://www.youtube.com/watch?v=Q4KMPjV0qSg>

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DISCUSSION

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85 Our survey found 40 species of gobies in an area of about 75 km². This is close to an expected
86 number of species compared to other surveys of gobbiidae in the Indo-Pacific (see Fig. 3 for a
87 species-area plot as the basis for this prediction). Surveying an area of a comparable size (40
88 km²), Depczynski & Bellwood (2005) found 30 species around Lizard Island in the GBR.

89

90 The goby fauna in the western Lingayen near Bolinao gulf is likely determined by the physical
91 conditions as well as by anthropogenic disturbance. The area lacks deep walls which are habitats
92 for hovering gobies (such as *Trimma tevegae*), which are hence absent from the area.
93 Additionally, the eastern side of Santiago island is swept by powerful currents, known to limit
94 the occurrence of small marine fishes (Depczynski & Bellwood, 2005). The low number of
95 gobiid epibionts is most likely a consequence of the limited coral cover and diversity. This might
96 partially be a consequence of the severe anthropogenic stresses to marine habitats in the region.

97 Nevertheless, a gobiid fauna of 40 species, close to the expected value, indicates that small, often
98 cryptic, fishes low in the food web could be less likely affected by anthropogenic disturbances
99 than larger species.

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102

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105 Timothy Quimpo for helpful discussion. We also thank Andreas Völkers and Dr. Brett Tibbatts
106 for help with fish identification, and Dr. Rene Abesamis for discussion and pointers to the
107 literature.

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138 new paedomorphic species in the family Schindleriidae (Perciformes: Gobioidae).
139 Records-Australian Museum, 56: 139-142.
140

141 Table 1. All gobiid species recorded in the vicinity of Bolinao, northwestern Philippines.

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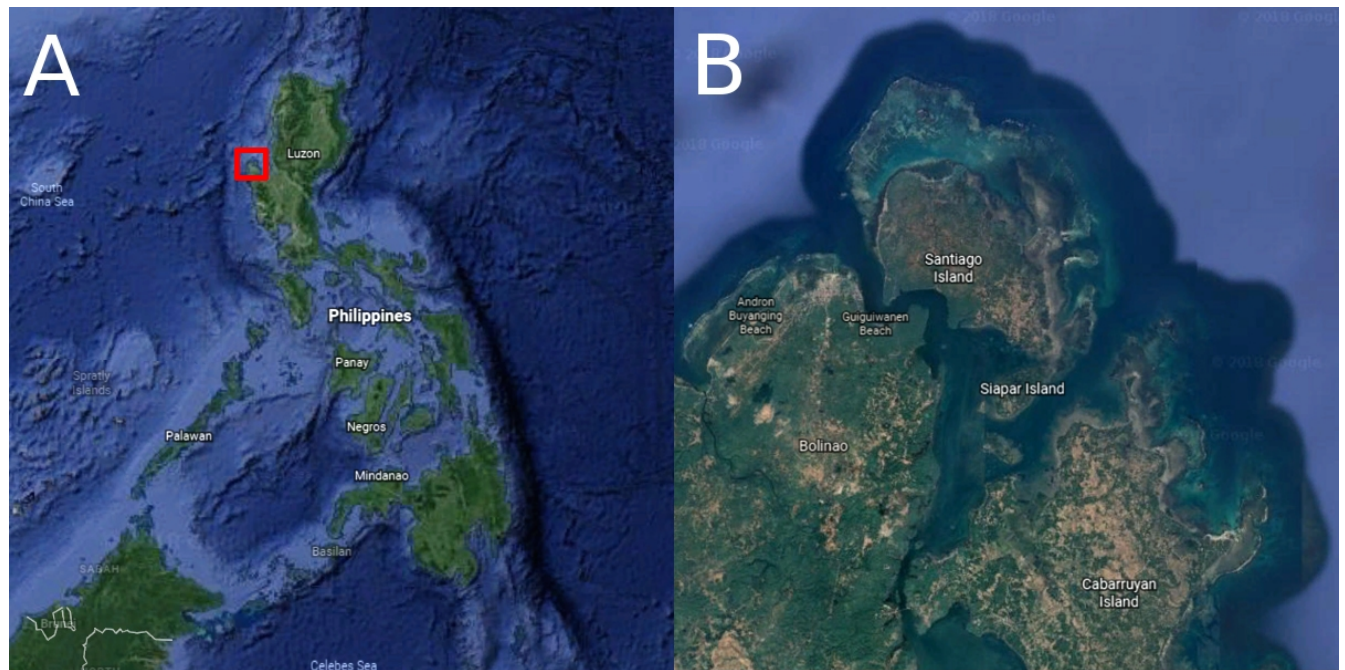
Shrimp-associated gobies		Niche
Genus	Species	
<i>Amblyeleotris</i>	<i>steinitzii</i>	shrimp
<i>Amblyeleotris</i>	<i>fortanesii</i>	shrimp
<i>Amblyeleotris</i>	<i>perioptalama</i>	shrimp
<i>Amblyeleotris</i>	<i>wheeleri</i>	shrimp
<i>Amblyeleotris</i>	<i>guttata</i>	shrimp
<i>Amblyeleotris</i>	<i>gymnocephala</i>	shrimp
<i>Cryptocentrus</i>	<i>ceruleomaculatus</i>	shrimp
<i>Cryptocentrus</i>	<i>leptocephalus</i>	shrimp
<i>Cryptocentrus</i>	<i>sericus</i>	shrimp
<i>Cryptocentrus</i>	<i>strigilliceps</i>	shrimp
<i>Cryptocentrus</i>	<i>cyanotaenia</i>	shrimp
<i>Mahidolia</i>	<i>mystacina</i>	shrimp
<i>Ctenogobiops</i>	<i>crocineus</i>	shrimp
<i>Vanderhorstia</i>	<i>dorsomaculata</i>	shrimp
<i>Vanderhorstia</i>	<i>macropteryx</i>	shrimp
<i>Vanderhorstia</i>	<i>ambanoro</i>	shrimp
<i>Vanderhorstia</i>	<i>ornatissima</i>	shrimp
<i>Tomiyamichthys</i>	<i>oni</i>	shrimp
<i>Myersina</i>	<i>lachneri</i>	shrimp
Non-shrimp associated gobies		
<i>Pleurosycia</i>	<i>michelii</i>	coral epibiota
<i>Bryaninops</i>	<i>yongei</i>	coral epibiota
<i>Gobiodon</i>	sp	coral epibiota
<i>Gobiodon</i>	<i>ceramenis</i>	coral epibiota
<i>Eviota</i>	<i>pellucida</i>	coral epibiota/rock
<i>Eviota</i>	<i>prasites</i>	coral epibiota/rock
<i>Eviota</i>	<i>stigillata</i>	coral epibiota/rock
<i>Trimma</i>	<i>caesuria</i>	rock crevice
<i>Asterropteryx</i>	<i>striatus</i>	rubble
<i>Acentrogobius</i>	<i>nebulosus</i>	sand
<i>Amblygobius</i>	<i>phalaena</i>	sand
<i>Amblygobius</i>	<i>nocturnus</i>	sand
<i>Amblygobius</i>	<i>buanensis</i>	sand
<i>Istigobius</i>	<i>decoratus</i>	sand
<i>Coryphopterus</i>	<i>aureus</i>	sand
<i>Valencienna</i>	<i>puellaris</i>	sand
<i>Valencienna</i>	<i>sexguttata</i>	sand

<i>Oplompus</i>	<i>oplompus</i>	sand
<i>Oplompus</i>	<i>caninoides</i>	sand
<i>Heteroplopomus</i>	<i>barbatus</i>	sand
<i>Exyrias</i>	<i>belissimus</i>	sand
<i>Exyrias</i>	<i>puntang</i>	sand/seagrass

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146 Fig. 1. Survey area around Santiago island (B) in the Bolinao region, Pangasinan province,
147 Luzon island, Philippines (A).

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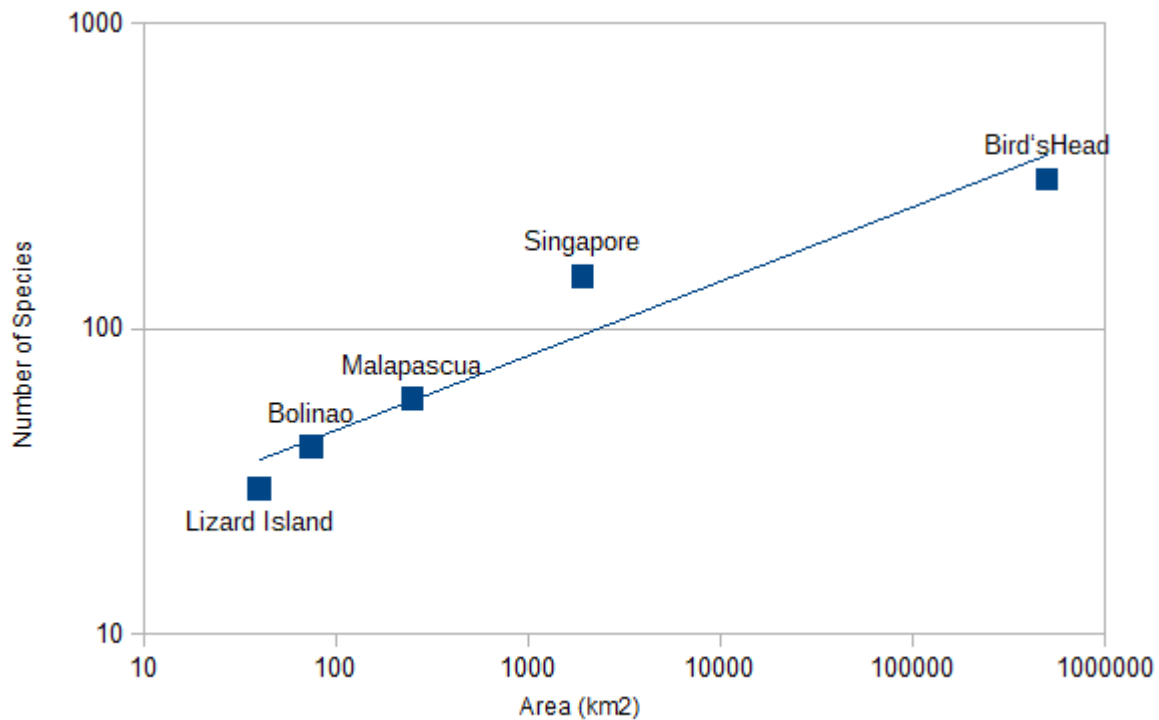
150

151 Fig. 2. Photographs of several species encountered in the Bolinao area (top to bottom, left to
152 right): *Mahidolia mystacina*, *Amblyeleotris fortanesii*, *Myersina lachneri*, *Amblygobius*
153 *buanensis*.



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156 Fig. 3. Species – area relationship for marine gobies. Plotted are the number of species against
157 the estimated survey area from this study (~ 75 km², 40 species), a study of the gobies of Lizard
158 Island (~ 40 km², 30 species), of Malapascua, Cebu province, Philippines (~ 250 km², 59
159 species), of Singapore (~ 1925 km², 149 species) and the Papuan Bird's Head Peninsula (~50 000
160 km², 308 species).

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