

Goby (Family Gobiidae) Diversity in North Carolina

What exactly are gobies? To a freshwater-centric ichthyologist, gobies look like the marine equivalent of our freshwater darters (Family Percidae). In fact one of the species is named Darter Goby, *Ctenogobius boleosoma*, because of its resemblance to Tessellated Darter, *Etheostoma olmstedi*. But to the more widely learned and marine-centric ichthyologists, gobies are some of the most brightly colored and diverse family of fishes found around coral reefs. There are more than 220 genera and 1500 species worldwide primarily inhabiting shallow tropical and subtropical waters (Murdy and Hoese 2002). Along and off the North Carolina shoreline, one may encounter 24 indigenous species, 1 nonindigenous species, and 1 species who we are not really sure what species it is because of the condition of the specimen post-preservation (Table 1).

Scientific Name/ American Fisheries Society Accepted Common Name	Scientific Name/ American Fisheries Society Accepted Common Name
<i>Awaous banana</i> – River Goby	<i>Gnatholepis thompsoni</i> – Goldspot Goby
<i>Bathygobius soporator</i> – Frillfin Goby	<i>Gobioides broussonnetii</i> – Violet Goby
<i>Bollmannia</i> sp. – Goby sp.	<i>Gobionellus oceanicus</i> – Highfin Goby
<i>Coryphopterus glaucofraenum</i> – Bridled Goby	<i>Gobiosoma bosc</i> – Naked Goby
<i>Coryphopterus punctipectophorus</i> – Spotted Goby	<i>Gobiosoma ginsburgi</i> – Seaboard Goby
<i>Ctenogobius boleosoma</i> – Darter Goby	<i>Gobiosoma robustum</i> – Code Goby
<i>Ctenogobius saepepallens</i> – Dash Goby	<i>Lythrypnus elasson</i> – Dwarf Goby
<i>Ctenogobius shufeldti</i> – Freshwater Goby	<i>Lythrypnus phorellus</i> – Convict Goby
<i>Ctenogobius smaragdus</i> – Emerald Goby	<i>Lythrypnus spilus</i> – Bluegold Goby
<i>Ctenogobius stigmaticus</i> – Marked Goby	<i>Microgobius carri</i> – Seminole Goby
<i>Elacatinus xanthiprora</i> – Yellowprow Goby	<i>Microgobius gulosus</i> – Clown Goby
<i>Evermannichthys spongicola</i> – Sponge Goby	<i>Microgobius thalassinus</i> – Green Goby
<i>Evorthodus lyricus</i> – Lyre Goby	<i>Priolepis hipoliti</i> – Rusty Goby

All species seem to be known simply and collectively as gobies. However there are American Fisheries Society-accepted common names (Table 1; Page et al. 2013) and each species has a scientific (Latin) name (Table 1; Appendix 1).

Except for three species, most gobies are to be found along North Carolina's coast (NCFishes.com; Tracy et al. 2020). Highfin Goby and Naked Goby occasionally stray into fresh waters (Tracy et al. 2020), but spend most of their lives in estuarine or marine waters. Three species, River Goby, Freshwater Goby, and Lyre Goby, can also be found in freshwater habitats. Lyre Goby and Freshwater Goby have been found in the Cape Fear River basins as far upstream as near Riegelwood (Tracy et al. 2020).

Most gobies range in size from about 40 mm to about 80 mm (1.8 inches – 3.2 inches, respectively). However, like all things, there are exceptions at both ends of the spectrum. In North Carolina the three smallest gobies are in the genus *Lythrypnus* (Dwarf Goby, Convict Goby, and Bluegold Goby) - they are only 20-25 mm (0.8 inch – 1 inch, respectively) in length. At the other end are five species that range in size from 150-500 mm (6 inches – 20 inches, respectively). These five species are: 1) Violet Goby to 500 mm (about 20 inches), 2) Highfin Goby and River Goby to 300 mm (about 12 inches), and 3) Lyre Goby and Emerald Goby to 150 mm (about 6 inches) (Murdy and Hoese 2002).

Their occupied habitats are also variable, depending upon the species from shallow depths nearshore to offshore at depths more than 91 meters (about 330 ft.) in the case of Rusty Goby (Kells and Carpenter 2014). Most species can be found in coastal river mouths, in estuaries and bays with muddy, sandy, or grassy bottoms, or amongst submerged vegetation and oyster beds, or atop rock and rubble bottoms. One species, Sponge Goby, as its name implies, is associated with sponges. Species associated with coral reefs and rocky areas include Bridled Goby, Spotted Goby, Yellowprow Goby, Bluegold Goby, Convict Goby, and Rusty Goby (Kells and Carpenter 2014).

River Goby is our only nonindigenous species. It was unknown from North Carolina until a single specimen was discovered in a fish kill in 1996 from Burnt Mill Creek in Wilmington. In 2015, an apparently self-sustaining population was discovered in a stormwater retention pond in Morehead City in Carteret County (White Oak basin). This population has been present for at least four years, despite some

mortalities from cold temperatures. In 2017 another population was discovered in an unnamed creek near the Visitors Center in Morehead City (Scott A. Smith, pers. comm.). All three locations are near North Carolina's two shipping ports and this species may have been introduced from the release of ballast water (Tracy et al. 2020).

Because of their lack of commercial or recreational importance, none of the species is a federally- or state-listed species (NCAC 2017; NCNHP 2020; NCWRC 2017).

One final piece of North Carolina goby trivia: In 1907 Dr. Hugh M. Smith published the 453 page "*The Fishes of North Carolina*" (Smith 1907). This was North Carolina's first truly baseline study of the fishes across the entire state. In it, Smith detailed 345 fresh and saltwater species, all described by other ichthyologists, except one species. Smith described that species, a goby: *Microgobius holmesi* and gave it the common name of Holmes' Goby (Figure 1). It was named after Professor J. A. Holmes, former State Geologist and former director of the North Carolina Geological and Economic Survey, who had requested that Smith produce a popular guide to the fishes of North Carolina. The species was known from a single specimen collected in 1904 from Uncle Israel Shoal in Beaufort Harbor. Unfortunately, this species and the other species of *Microgobius*, *M. eulepis* Eigenmann & Eigenmann, that Smith listed as occurring also in Beaufort Harbor at the same shoal, were later synonymized by Birdsong (1981) with *Microgobius thalassinus* and today are known as Green Goby.

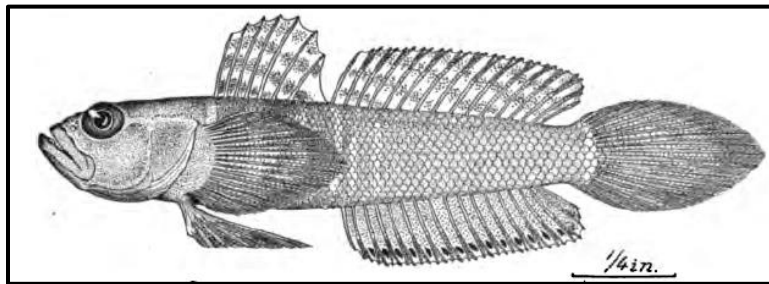


Figure 1. *Microgobius holmesi*, Smith 1907, Holmes' Goby. Illustration courtesy of Smith (1907).

The identification may benefit from the use of a dissecting compound microscope. Key characteristics for their proper identification include color and color patterns, length of dorsal fin, shape of the tongue, presence or absence of scales, scales cycloid or ctenoid, lateral scale row counts, dorsal fin, pectoral fin, and anal fin ray counts, dorsal fin spine counts, length of dorsal fin rays, and shape of caudal fin.

Identification Key to the Freshwater and Marine Species of Gobies (Family Gobiidae) in North Carolina¹

- 1a. Pelvic fins united by a shallow membrane or united but with innermost rays markedly shorter than fourth ray (Figure 1)..... Spotted Goby, [*Coryphopterus punctipectophorus*](#)
- 1b. Pelvic fins completely united to form a round sucking disc.....2



Figure 1. Spotted Goby. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/gallery/specie/4122>, accessed 02/21/2021.

- 2a. Dorsal fins long and continuous; body elongate and slender; dark chevron-like markings on sides; eyes very small (< 10% of head length) (Figure 2) Violet Goby, [*Gobioides broussonnetii*](#)
- 2b. Dorsal fins separated; body stout; no chevron markings on sides; eyes larger3



Figure 2. Violet Goby. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/3014>, accessed 02/21/2021.

- 3a. Upper pectoral-fin rays almost entirely free (Figure 3); front of tongue notched Frillfin Goby, [*Bathygobius soporator*](#)
- 3b. Upper pectoral-fin rays broadly united; tongue sometimes slightly indented but not notched4

¹ *Bollmannia* sp. This goby (NCSM Catalogue No. 35970) was collected by trawl off the southern North Carolina coast in September 2001 at a depth of 63–85 m. The torso was damaged during collection; therefore, the identification was somewhat tentative. The specimen has pores on the head and pre-opercle, body with ctenoid scales, dorsal-fin counts of VII (first 3–4 elongated), 13, anal-fin rays 12, pelvic rays 15, divided and long (reaching to about the eighth anal ray). Regardless of which of the three species of western Atlantic *Bollmannia* is represented by this specimen, Shelf Goby, *B. eigenmanni* (Garman, 1896), Ragged Goby, *B. communis* Ginsburg, 1942, or White-eye Goby, *B. boqueronensis* Evermann and Marsh, 1899, it is a significant range extension. The reported ranges of this specimen was omitted from the key because of some uncertainty in the identification (Ross and Rohde 2004).



Figure 3. Frillfin Goby.

- 4a. Shoulder (under gill cover) with 2–3 distinct fleshy lobes; lateral scales rows > 57 (Figure 4)
River Goby, [Awaous banana](#)
- 4b. No lobes on shoulder girdle; lateral scales, if present, usually < 57 (except some *Microgobius carri*
 and *Gobionellus oceanicus*)5



Figure 4. River Goby.

- 5a. Body without scales, except possibly two small scales at base of caudal fin6
- 5b. Body mostly covered with scales (except reduced to only caudal area in *Evermannichthys*)9
- 6a. Two small ctenoid scales at base of caudal fin; body with six or seven white bars that are wider on
 lower half of body than on upper half; lateral line usually with elongate dark spots (Figure 5)
Seaboard Goby, [Gobiosoma ginsburgi](#)
- 6b. No scales anywhere; body bars, if present, not as above7



Figure 5. Seaboard Goby.

- 7a. No body bars; yellow stripe from eye to caudal fin (pale in preserved specimens) (Figure 6); yellow rectangle from tip of snout to interorbital..... Yellowprow Goby, [Elacatinus xanthiprora](#)
- 7b. Body bars present; no yellow stripes on body or head8

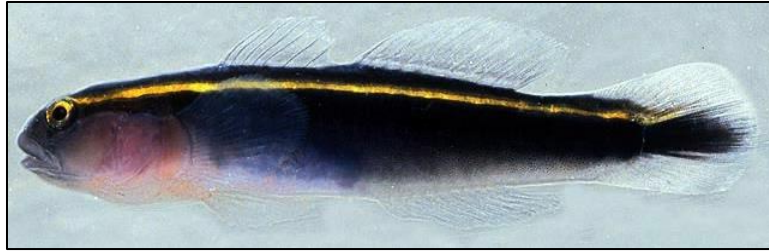


Figure 6. Yellowprow Goby. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/2505>, accessed 02/21/2021.

- 8a. Dorsal rays 13; anal rays 12; 9–11 body bars of even widths (Figure 7); no elongate dark spots on lateral line; posterior tips of pelvic-fin rays not reaching one-half distance to anal fin..... Naked Goby, [Gobiosoma bosc](#)
- 8b. Dorsal rays 12; anal rays 10; pale body with narrow, mostly interrupted, almost splotched bars (Figure 8); midlateral series of dashes; posterior tips of pelvic-fin rays reaching anusCode Goby, [Gobiosoma robustum](#)



Figure 7. Naked Goby.



Figure 8. Code Goby. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/13409>, accessed 02/21/2021.

- 9a. Dorsal fin with seven spines..... 10
- 9b. Dorsal fin with usually < seven spines (5–7 in *Evermannichthys*) 12

- 10a. Lateral scale rows 50–62; scales mostly ctenoid; body with golden lateral stripe from nape through caudal fin (lost in preservation) (Figure 9); dorsal spines elongated in larger specimens; no black spots on median fins Seminole Goby, *Microgobius carri*
- 10b. Lateral scale rows 44–54; scales mostly cycloid; body without lateral yellow stripes; dorsal spines slightly to greatly produced in males; median fins variously spotted 11



Figure 9. Seminole Goby, male. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/4379>, accessed 02/21/2021.

- 11a. Body without prominent stripes or blotches (Figure 10); lateral cephalic sensory canal (just behind orbits) with two pores; large males with only slightly produced dorsal spines; mouth gape strongly inclined Green Goby, *Microgobius thalassinus*
- 11b. Body with large dark blotches (Figure 11); lateral cephalic sensory canal with three pores; large males with dorsal spines 2–5 produced; mouth gape moderately inclined Clown Goby, *Microgobius gulosus*



Figure 10. Green Goby.

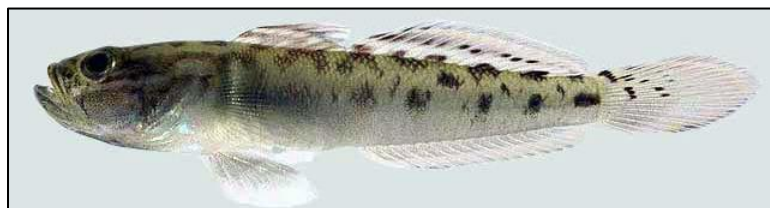


Figure 11. Clown Goby. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/4386>, accessed 02/21/2021.

- 12a. No pores in lateral line system on head; body robust but short (maximum size usually < 23 mm Standard Length, and lateral scale rows 25–28) 13
- 12b. Pores present in lateral line system on head (sometimes difficult to see or missing in *Evermannichthys* - usually visible on the interorbit); lateral scale rows usually > 29 (except *C. glaucofraenum* where lateral scales equal 25–26 and *Evermannichthys*) 16

- 13a. Nape, top of head, chest, and pectoral-fin base completely covered with scales (Figure 12)
Rusty Goby, [Priolepis hipoliti](#)
- 13b. Top of head, nape, chest, and pectoral-fin base naked 14



Figure 12. Rusty Goby. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/5423>, accessed 02/21/2021.

- 14a. Body usually uniformly pigmented, lacking bands, bars, or stripes (Figure 13)
 Dwarf Goby, [Lythrypnus elasson](#)
- 14b. Body with bands, bars, and/or stripes 15



Figure 13. Dwarf Goby, male. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/9712>, accessed 02/21/2021.

- 15a. Two dark spots (one above other, ventral one larger) on pectoral-fin base; spots on cheek usually in 3–4 rows; dark bands on body divided by pale central stripes (Figure 14); dorsal spines not prolonged Convict Goby, [Lythrypnus phorellus](#)
- 15b. Single dark spot on pectoral-fin base occupying nearly entire width of base; no spots on cheek; body bands with fine dark lines down their centers; first two dorsal spines prolonged (Figure 15) ...
 Bluegold Goby, [Lythrypnus spilus](#)



Figure 14. Convict Goby. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/9731>, accessed 02/21/2021.



Figure 15. Bluegold Goby. Photograph courtesy of the Smithsonian Tropical Research Institute's Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/4205>, accessed 02/21/2021.

- 16a. Body naked except for three longitudinal rows of ctenoid scales between posterior end of anal fin and caudal fin base; two dorsal fins widely separated (Figure 16).....
..... Sponge Goby, [Evermannichthys spongicola](#)
- 16b. Body completely covered with scales; dorsal fins close together 17

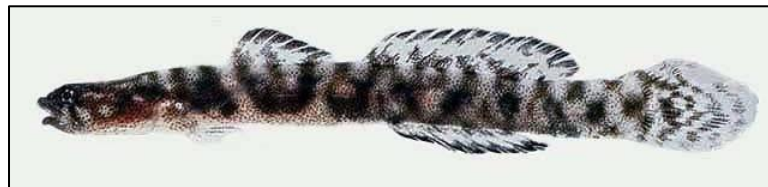


Figure 16. Sponge Goby. Photograph courtesy of the Smithsonian Tropical Research Institute's Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/2789>, accessed 02/21/2021.

- 17a. Opercle entirely or partially covered with scales..... 18
- 17b. Opercle naked 20
- 18a. More than 60 lateral scale rows; posterior tips of pectoral-fin rays not reaching anus; eye diameter < one-half upper jaw length; prominent dark spot on trunk below first dorsal fin (Figure 17)
.....Highfin Goby, [Gobionellus oceanicus](#)
- 18b. Fewer than 40 lateral scale rows; posterior tips of pectoral-fin rays reaching anus; eye diameter > one-half upper jaw length; no dark trunk spot but shoulder spot present or absent 19



Figure 17. Highfin Goby.

- 19a. Prominent shoulder spot (gold in life) (Figure 18); dorsal spines not elongated; dark subocular bar; no blotches on caudal fin base Goldspot Goby, [Gnatholepis thompsoni](#)
- 19b. No shoulder spot; dorsal spines elongated in mature males; no subocular bar; two dark blotches on caudal fin base (Figure 19) Lyre Goby, [Evorthodus lyricus](#)

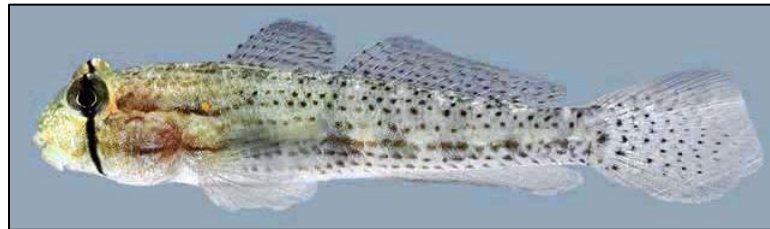


Figure 18. Goldspot Goby. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/2978>, accessed 02/21/2021.



Figure 19. Lyre Goby.

- 20a. Caudal fin rounded or truncate; usually < 28 lateral scale rows; body nearly transparent; prominent black spot above opercle (Figure 20).....Bridled Goby, [Coryphopterus glaucofraenum](#)
- 20b. Caudal fin pointed; usually > 28 lateral scale rows; body not usually transparent; no black spot above opercle..... 21



Figure 20. Bridled Goby. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/2046>, accessed 02/21/2021.

- 21a. Dorsal and anal-fin rays usually 11 and 12, respectively; distinct shoulder spot present (sometimes faded in preservative)..... 22
- 21b. Dorsal and anal-fin rays usually 12 and 13, respectively; shoulder spot usually absent (present in *C. stigmaticus*) 23

- 22a. Predorsal area always with scales; head and body with many black-encircled, cream-colored spots (Figure 21); lateral scale rows 39–46; large canine teeth in both jaws Emerald Goby, *Ctenogobius smaragdus*
- 22b. Predorsal area almost always naked (a few scales occasionally present); no large black-encircled spots on head or body (Figure 22); lateral scale rows 27–35; canine teeth smaller Darter Goby, *Ctenogobius boleosoma*

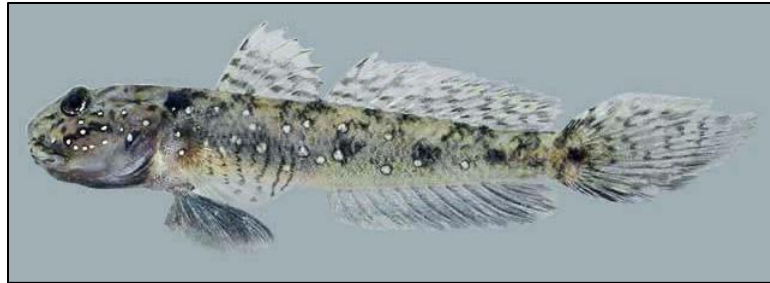


Figure 21. Emerald Goby. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/2137>, accessed 02/21/2021.



Figure 22. Darter Goby.

- 23a. Three or five distinct vertical bars on lower cheek (Figure 23); no suborbital bar; small dark shoulder spot present; narrow, vertical, yellow (pale in preservative) bars present on body Marked Goby, *Ctenogobius stigmaticus*
- 23b. No bars on lower cheek; suborbital bar present or absent; shoulder spot absent (or faint in some *C. shufeldti*); no yellow body bars 24



Figure 23. Marked Goby. Photograph courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/13400>, accessed 02/21/2021.

- 24a. Pectoral-fin rays usually 15 or 16; predorsal area always naked; thin suborbital bar present (sometimes faint); dash-like markings present along body midline (Figure 24); 29–34 scales in lateral series Dash Goby, [*Ctenogobius saepepallens*](#)
- 24b. Pectoral-fin rays 17 or 18; predorsal area (just anterior to dorsal origin) usually with some scales; suborbital bar absent, but with stripe crossing cheek from upper jaw to opercle; large blotches (usually five) present along body midline (Figure 25); 31–40 scales in lateral series
..... Freshwater Goby, [*Ctenogobius shufeldti*](#)



Figure 24. Dash Goby. Photograph courtesy of the Smithsonian Tropical Research Institute's Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/13397>, accessed 02/21/2021.



Figure 25. Freshwater Goby.