

Sand Flounder (Family Paralichthyidae) Diversity in North Carolina
By the NCFishes.com Team

Along North Carolina's shore there are four families of flatfish comprising 36 species having eyes on the left side of their body facing upward when lying in or atop the substrate (NCFishes.com; Table 1; Figure 1). The families and species can be confusing to tell apart. The key characteristics provided for in Table 1 should enable one to differentiate between the four families and this document will aid you in the identification of the species in the Family Paralichthyidae in North Carolina.

Table 1. The four families of left-facing flounders found along and off the coast of North Carolina.

Family	Common Name	Key Characteristics (adapted from Munroe 2002)	No. Species
Paralichthyidae	Sand Flounders	Preopercle exposed, its posterior margin free and visible, not hidden by skin or scales. Dorsal fin long, originating above, lateral to, or anterior to upper eye. Dorsal and anal fins not attached to caudal fin. Both pectoral fins present. Both pelvic fins present, with 5 or 6 rays.	20
Cynoglossidae	Tonguefishes	Margin of preopercle not free (hidden beneath skin and scales). Pectoral fins absent in adults. Lateral line absent on both sides of body. Dorsal and anal fins joined to caudal fin. No branched caudal-fin rays.	9
Bothidae	Lefteye Flounders	Lateral line absent or poorly developed on blind side; lateral line absent below lower eye. Lateral line of eyed side with high arch over pectoral fin. Pelvic fin of eyed side on midventral line.	6
Scophthalmidae	Turbots	Both pelvic fins elongate, placed close to midline and extending forward to urohyal. Pelvic fins free from anal fin, with first ray of blind-side fin opposite second or third ray of eyed-side fin. Lateral line equally developed on both sides of body, with strong arch above pectoral fin, and with distinct supratemporal branch.	1

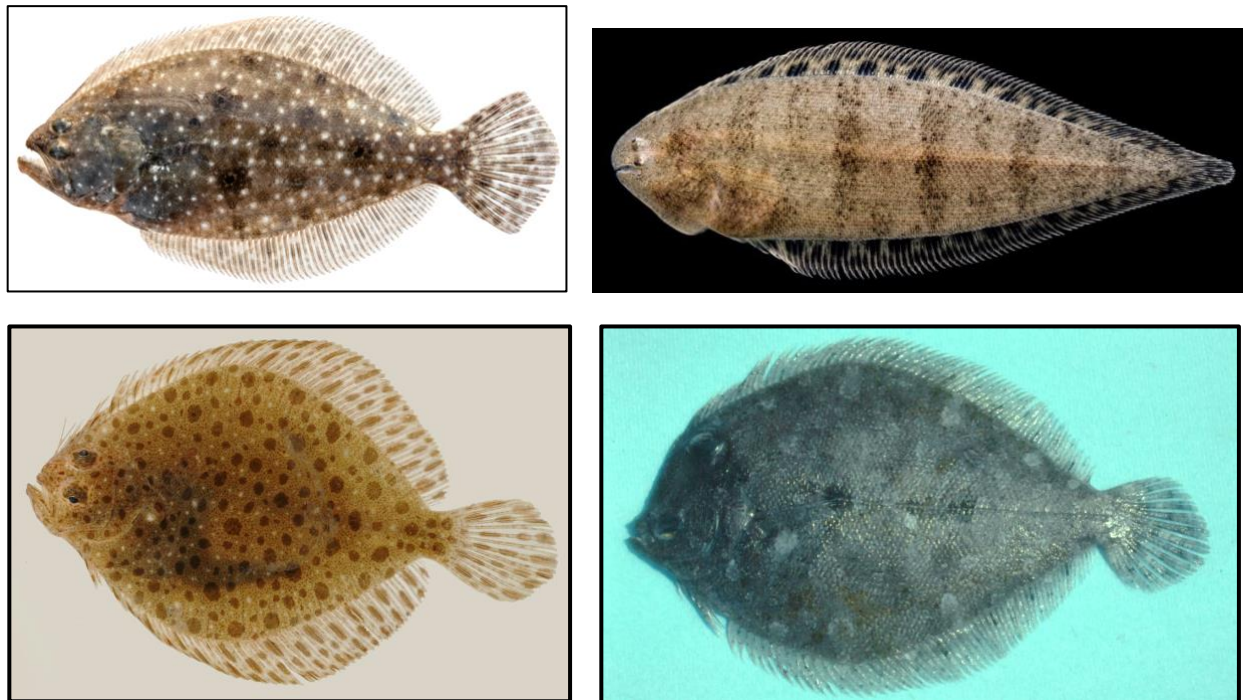


Figure 1. Examples of left-facing flatfishes found along the coast of North Carolina. From top left clockwise: Paralichthyidae (Gulf Flounder), Cynoglossidae (Blackcheek Tonguefish), Bothidae (Eyed Flounder), and Scophthalmidae (Window Pane). Photograph of Eyed Flounder courtesy of George H. Burgess.

The waters along and off the coast are where you will find 20 species within the Family Paralichthyidae (Table 2) known from North Carolina. (NCFishes.com; Tracy et al. 2020). [Please note: Tracy et al. (2020)

may be downloaded for free at: <https://trace.tennessee.edu/sfcproceedings/vol1/iss60/1>.] You may also encounter Southern Flounder as a seasonal inhabitant in freshwater habitats along the coast from the Shallotte to the Albemarle basins (Tracy et al. 2020). [Note: see Supplemental Maps 1-3, page 26, showing North Carolina’s 100 counties, 21 river basins, and 4 physiographic regions.]

Table 2. Species of Sand Flounders found in or along the coast of North Carolina.

Scientific Name/ American Fisheries Society Accepted Common Name	Scientific Name/ American Fisheries Society Accepted Common Name
<i>Ancylosetta dilecta</i> – Three-eye Flounder	<i>Etropus microstomus</i> – Smallmouth Flounder
<i>Ancylosetta quadrocellata</i> – Ocellated Flounder	<i>Etropus rimosus</i> – Gray Flounder
<i>Citharichthys arctifrons</i> – Gulf Stream Flounder	<i>Gastropsetta frontalis</i> – Shrimp Flounder
<i>Citharichthys cornutus</i> – Horned Whiff	<i>Paralichthys albigutta</i> – Gulf Flounder
<i>Citharichthys gymnorhinus</i> – Anglefin Whiff	<i>Paralichthys dentatus</i> – Summer Flounder
<i>Citharichthys macrops</i> – Spotted Whiff	<i>Paralichthys lethostigma</i> – Southern Flounder
<i>Citharichthys spilopterus</i> – Bay Whiff	<i>Paralichthys oblongus</i> – Fourspot Flounder
<i>Cyclopsetta fimbriata</i> – Spotfin Flounder	<i>Paralichthys squamilentus</i> – Broad Flounder
<i>Etropus crossotus</i> – Fringed Flounder	<i>Syacium micrurum</i> – Channel Flounder
<i>Etropus cyclosquamus</i> – Shelf Flounder	<i>Syacium papillosum</i> – Dusky Flounder

Unlike many families of fishes found in North Carolina’s waters, the Family Paralichthyidae is known only by a handful of local or vernacular names such as flounder, mud flounder, Plaice, sand flounder, Summer Flounder, and fluke. Often, any flatfish is simply called a flounder, regardless of its species or to which family it belongs. However there are American Fisheries Society-accepted common names (Table 2; Page et al. 2013) and each of the scientific (Latin) names actually means something (please refer to The Meanings of the Scientific Names of Sand Flounders, pages 24-25).

In 1585-1593, John White illustrated what is possibly Broad Flounder (or one of the other species of *Paralichthys*) labeled with the Algonquin word used by the Croatoan First Peoples, *Pashockshin* (<https://www.coastalcarolinaindians.com/updated-algonquian-word-list-by-scott-dawson/>), and noted: “The Playse. A foote and a halfe in length” (Figure 2).



Figure 2. Possibly Broad Flounder by John White, 1585-1593. Painting courtesy of the British Museum, Museum No. SL,5270.97 (https://www.britishmuseum.org/collection/object/P_SL-5270-97).

More than a century after John White painted this fish, flounder was mentioned as occurring in North Carolina’s waters by John Lawson in 1709 who described flounder as: “Plaice are here very large, and plentiful, being the same as in England” and “Flounders should have gone amongst the Fresh-Water Fish, because they are caught there, in great Plenty” (Lawson (1709), p.156-157). Perhaps, Lawson was referring to Southern Flounder which are often found far upstream in coastal rivers in fresh water. To this day, the larger species such as Summer Flounder and Southern Flounder are commercially and recreationally important species that continue to be sought after for delicious table food fare (Manooch 1984).

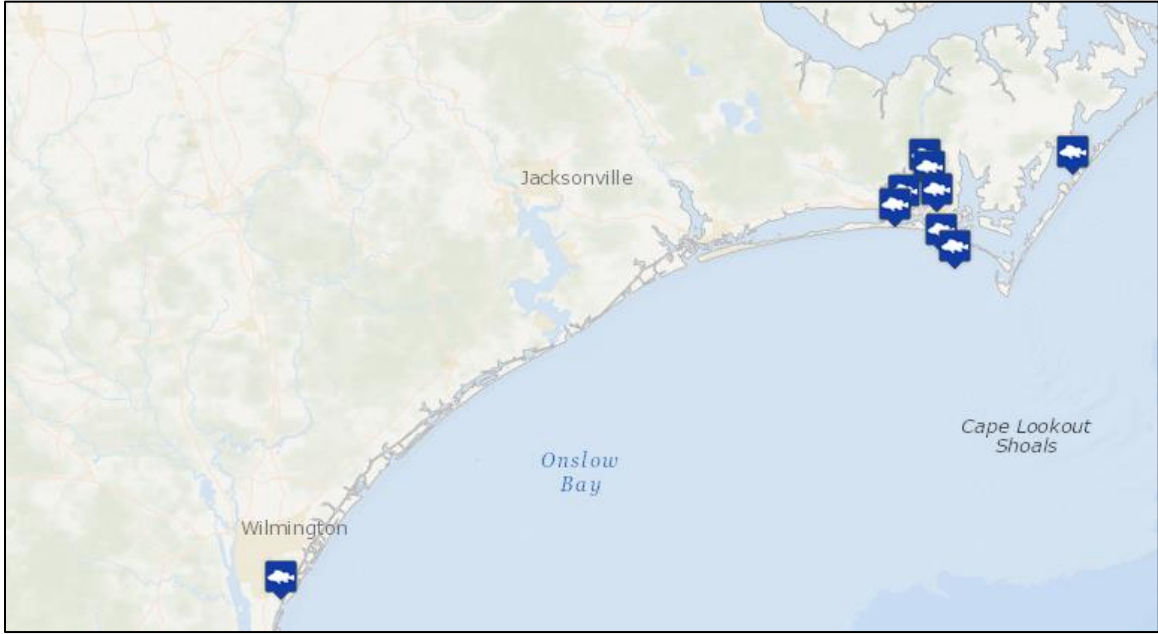
Our sand flounders vary substantially in size from the petite 76 mm (3 inches) Anglefin Whiff to the “doormat-sized” Summer Flounder which can reach 914 mm (36 inches). The smaller species, less than about 200 mm (8 inches), include *Citharichthys* spp., and *Etropus* spp. Larger species, more than 610 mm (24 inches) include *Paralichthys* spp.

Sand flounders are demersal fish meaning they live on or buried beneath the bottom substrates. These bottoms can be hard or soft sand, coarse shelly debris, or mud in lower coastal river channels and estuaries, inlets, and in seagrass beds. They often bury themselves into the sediment as they wait to ambush their prey. Like their size, depths to where they may be found also vary considerably. Many species are found in shallow waters along the shore, but some like Three-eye Flounder, Gulf Stream Flounder, Horned Whiff, and Channel Flounder may be found as deep as 1200-1300 feet near the edge of the Continental Shelf (Kells and Carpenter 2014).

Except for Southern Flounder, all sand flounders are found exclusively in coastal waters (Maps 1-14). However, some of the species’ mapped distributions may be an artifact of their rarity as vouchered specimens at North Carolina Museum of Natural Sciences (i.e., researchers being hesitant to preserve large-bodied specimens or recreationally important game species) and/or their rarity in North Carolina waters. Distributional maps, based upon vouchered specimens at the North Carolina Museum of Natural Sciences, are unavailable for Shelf Flounder, Shrimp Flounder, and Channel Flounder.



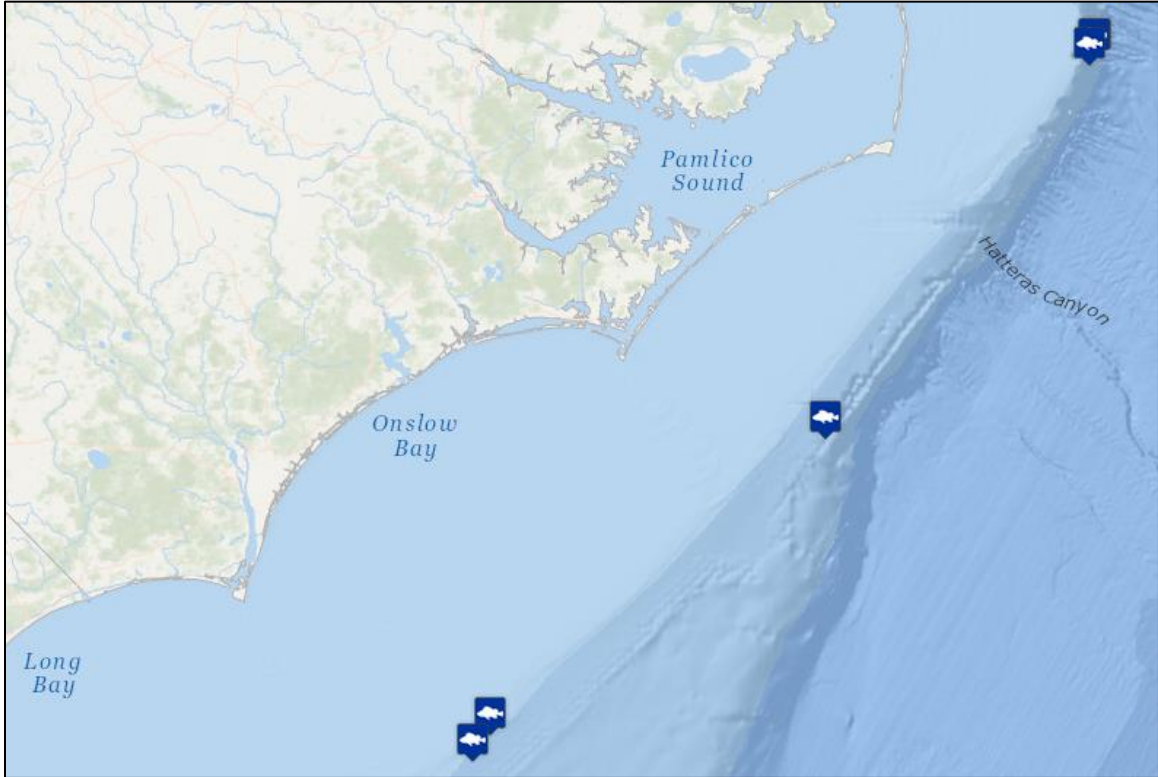
Map 1. Distribution of Three-eye Flounder, *Ancylosetta dilecta*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021. Note: locations are beyond “North Carolina” waters (> 13.8 miles = 22.2 km, and 12 nautical miles).



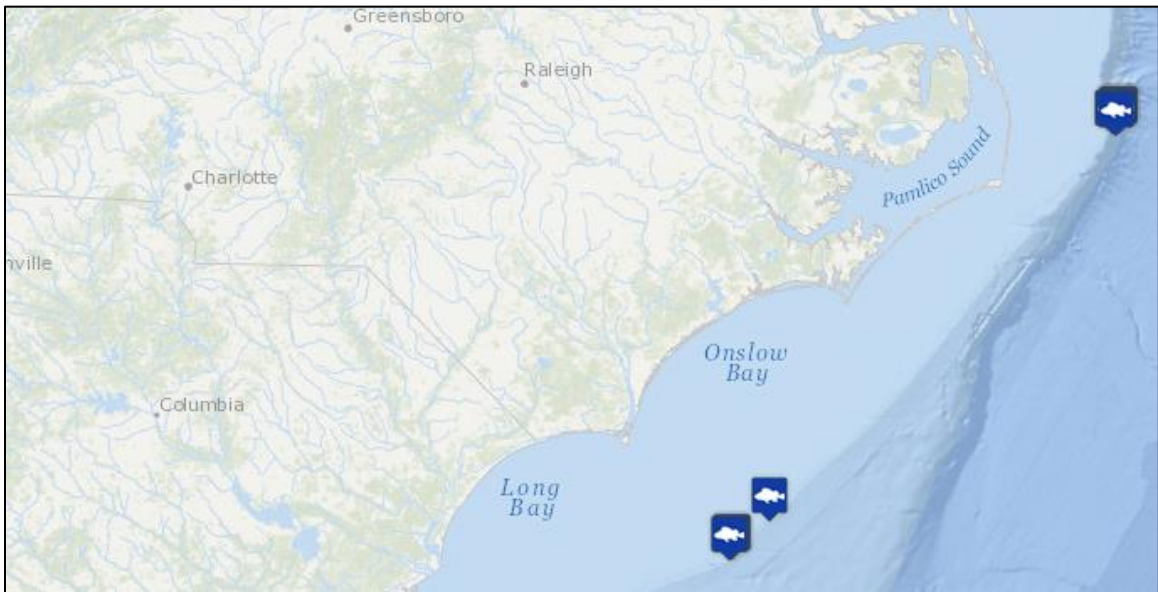
Map 2. Distribution of Ocellated Flounder, *Ancylopsetta quadrocellata*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021.



Map 3. Distribution of Gulf Stream Flounder, *Citharichthys arctifrons*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021. Note: locations are beyond “North Carolina” waters (> 13.8 miles = 22.2 km, and 12 nautical miles).



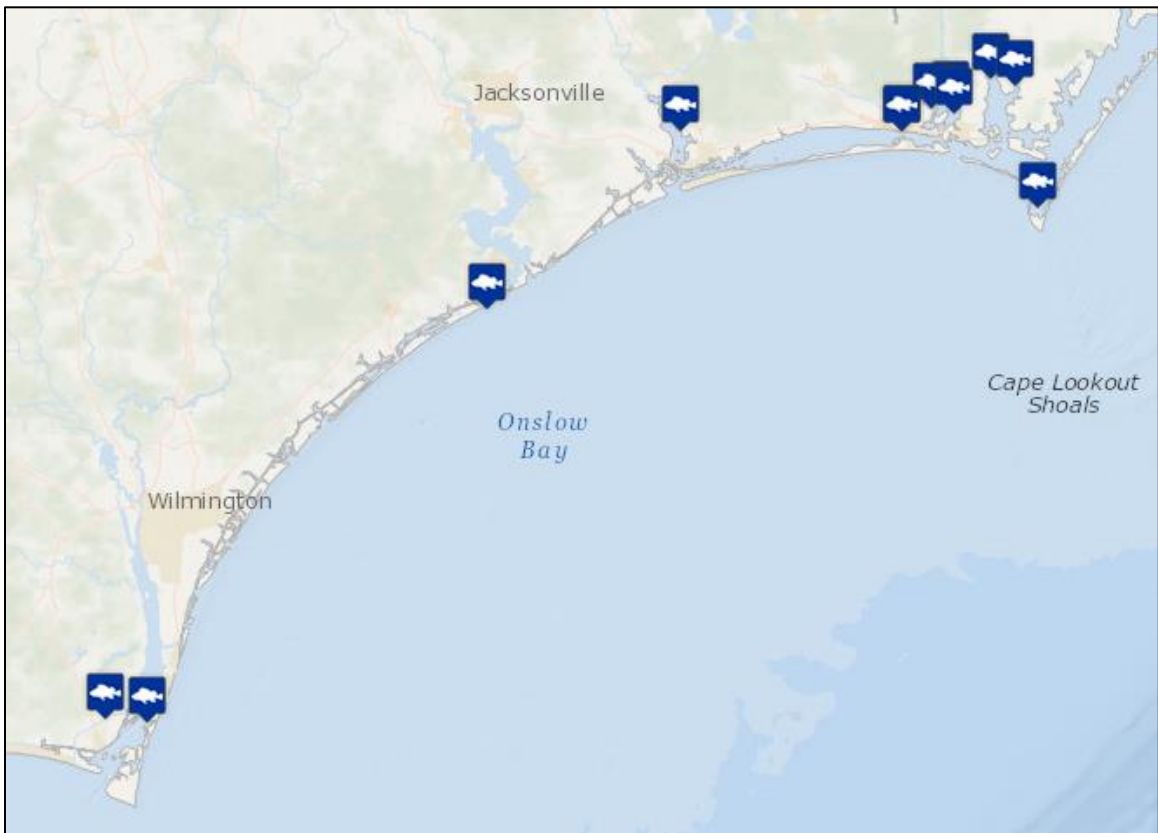
Map 4. Distribution of Horned Whiff, *Citharichthys cornutus*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021. Note: locations are beyond “North Carolina” waters (> 13.8 miles = 22.2 km, and 12 nautical miles).



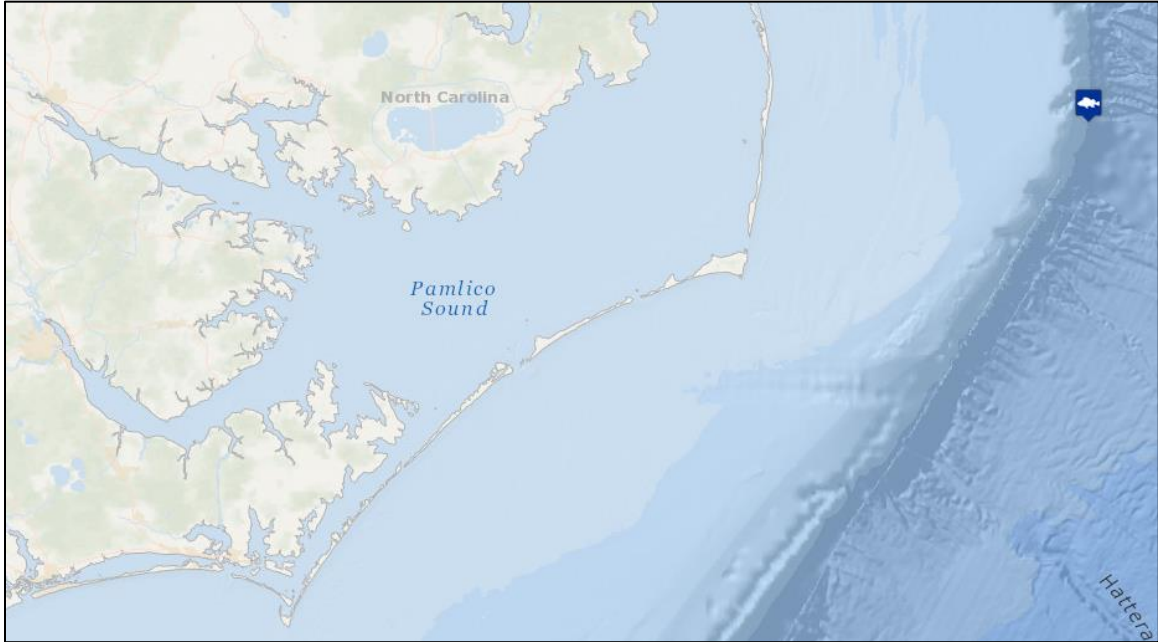
Map 5. Distribution of Angelfin Whiff, *Citharichthys gymnorhinus*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021. Note: locations are beyond “North Carolina” waters (> 13.8 miles = 22.2 km, and 12 nautical miles).



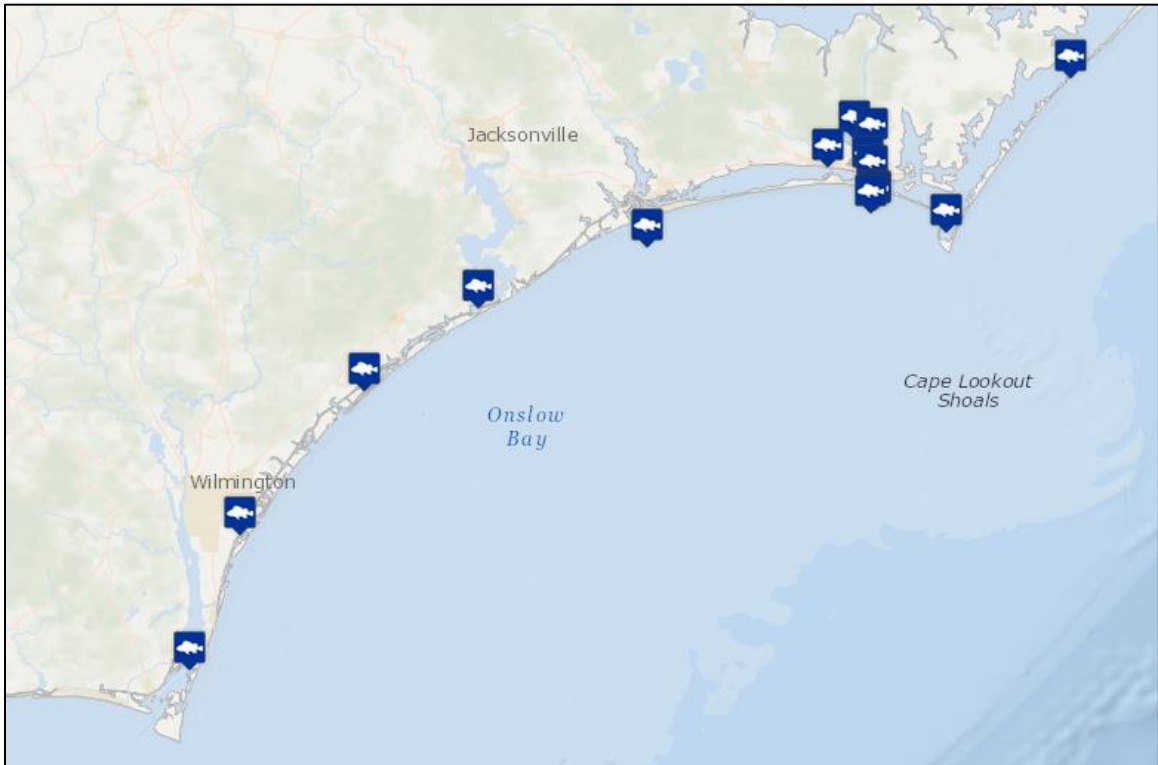
Map 6. Distribution of Spotted Whiff, *Citharichthys macrops*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021. Note: two locations are beyond “North Carolina” waters (> 13.8 miles = 22.2 km, and 12 nautical miles).



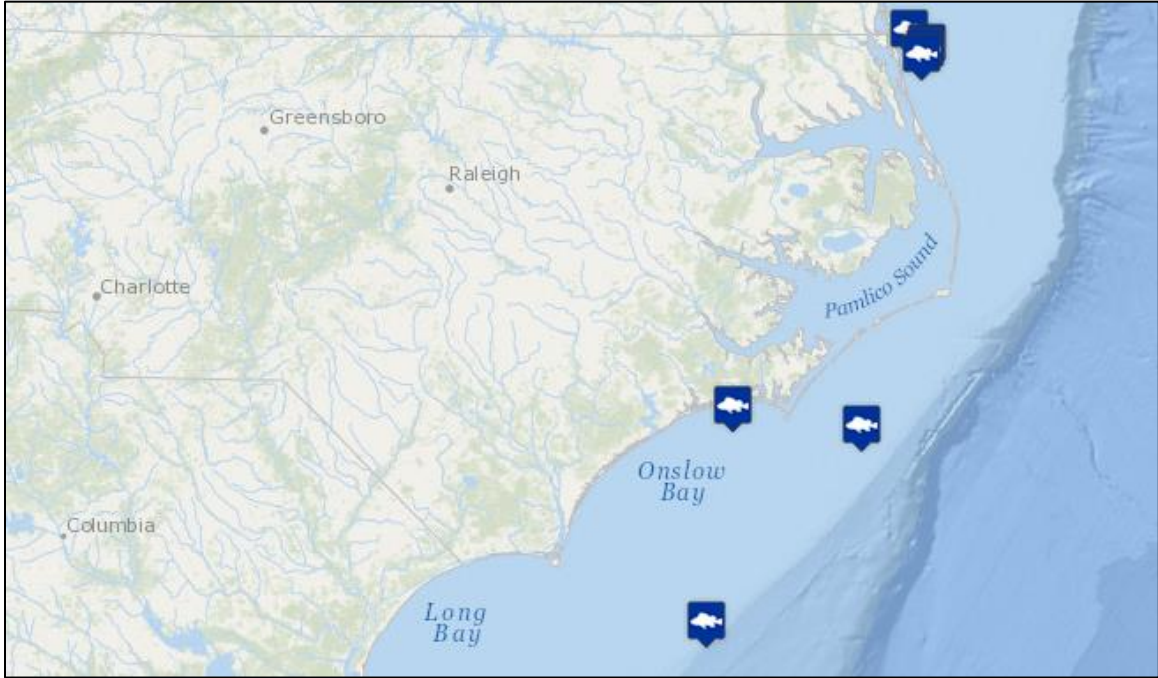
Map 7. Distribution of Bay Whiff, *Citharichthys spilopterus*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021.



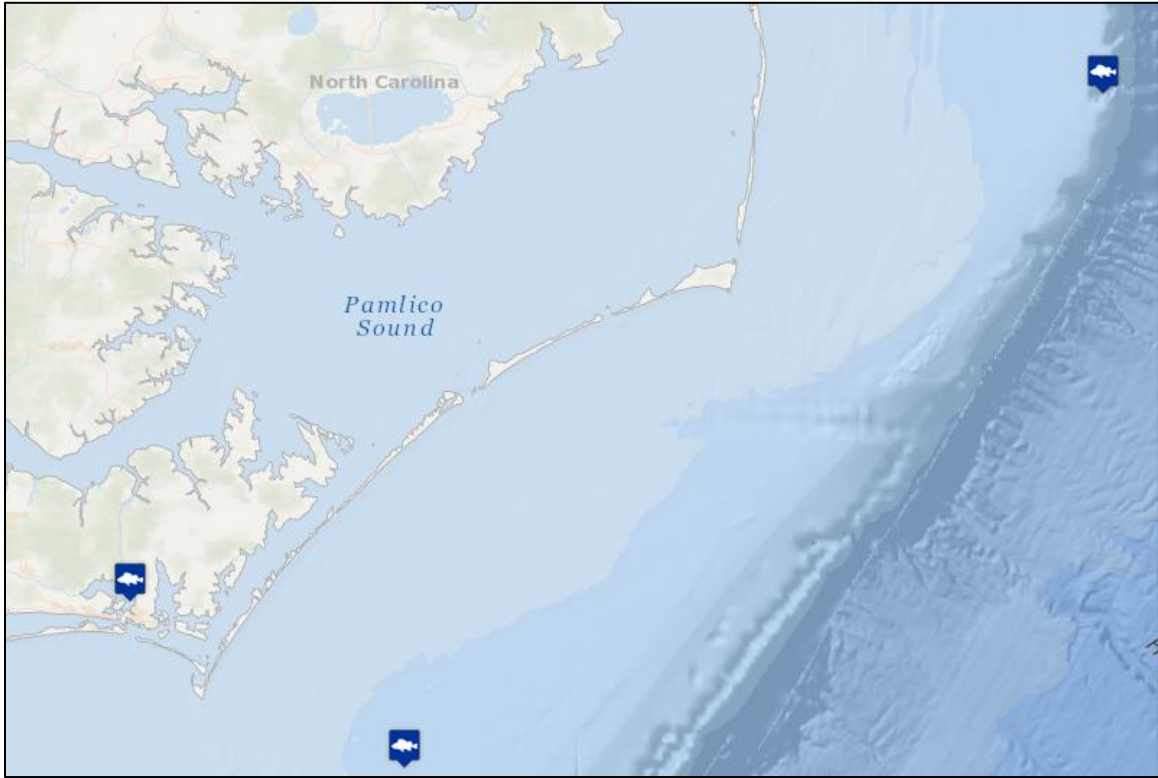
Map 8. Distribution of Spotfin Flounder, *Cyclopsetta fimbriata*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021. Note: location is beyond “North Carolina” waters (> 13.8 miles = 22.2 km, and 12 nautical miles).



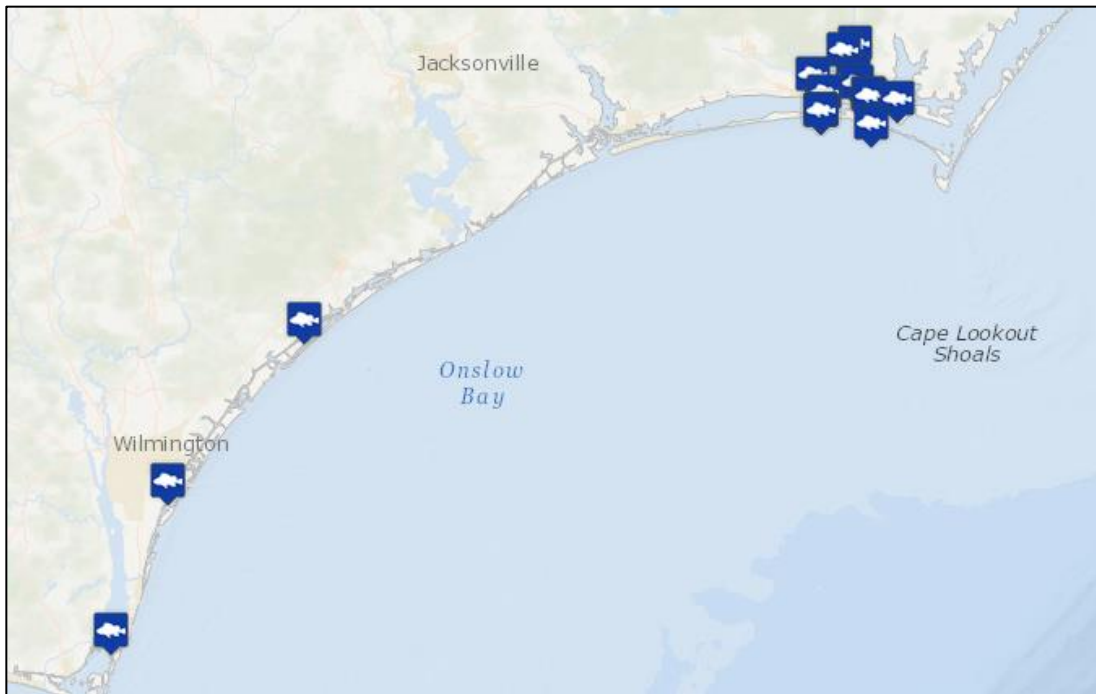
Map 9. Distribution of Fringed Flounder, *Etropus crossotus*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021.



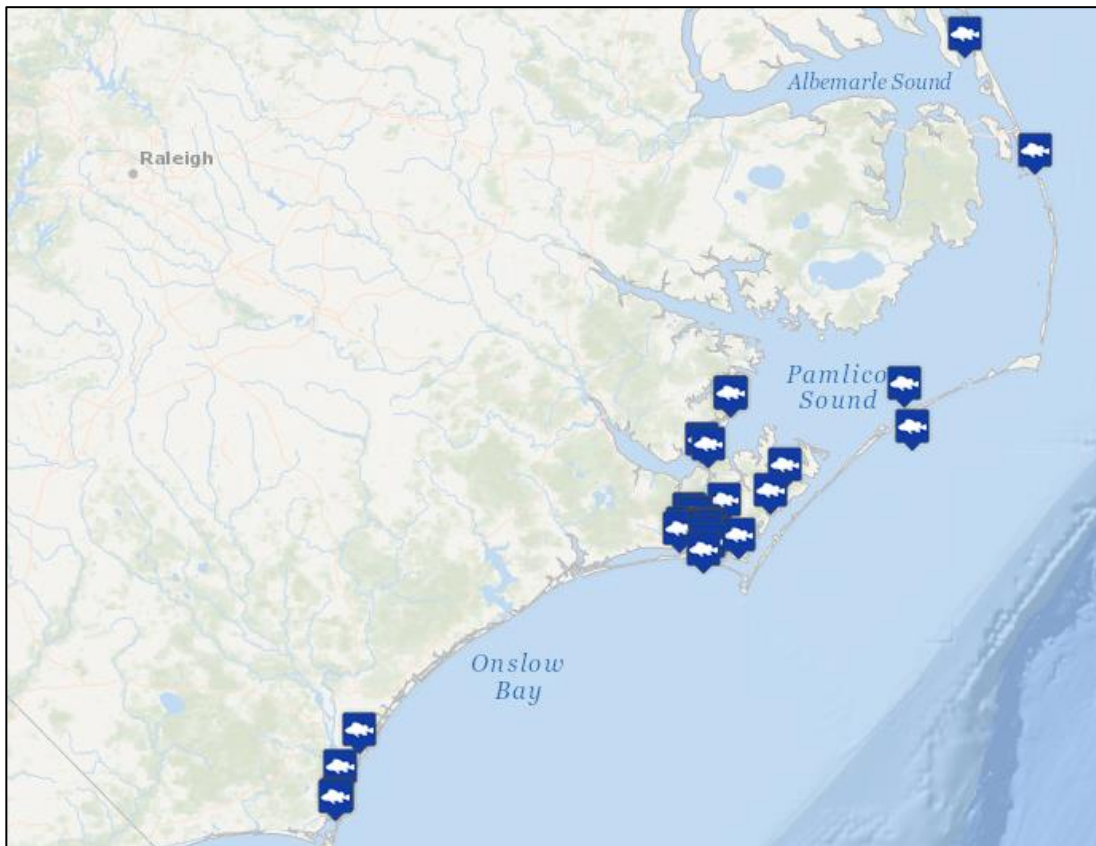
Map 10. Distribution of Smallmouth Flounder, *Etropus microstomus*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021. Note: two locations are beyond “North Carolina” waters (> 13.8 miles = 22.2 km, and 12 nautical miles).



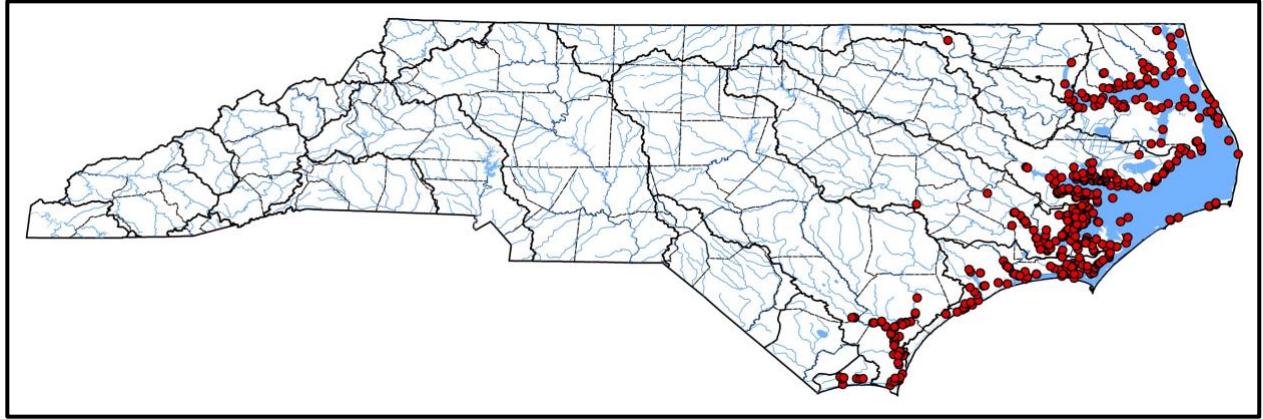
Map 11. Distribution of Gray Flounder, *Etropus rimosus*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021. Note: two locations are beyond “North Carolina” waters (> 13.8 miles = 22.2 km, and 12 nautical miles).



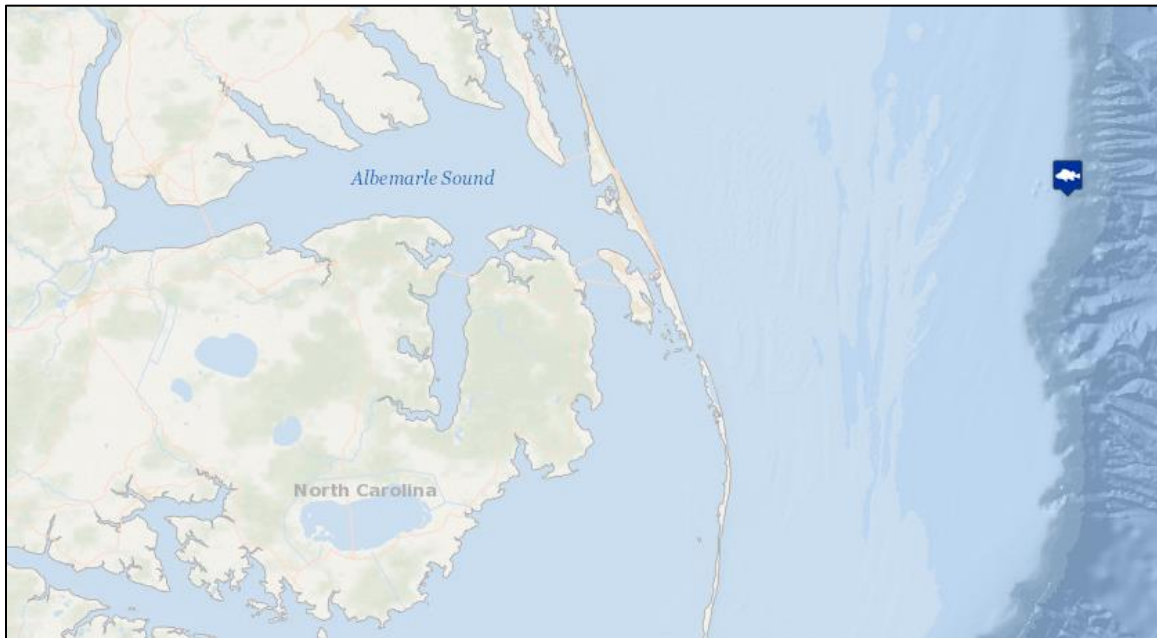
Map 12. Distribution of Gulf Flounder, *Paralichthys albigutta*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021.



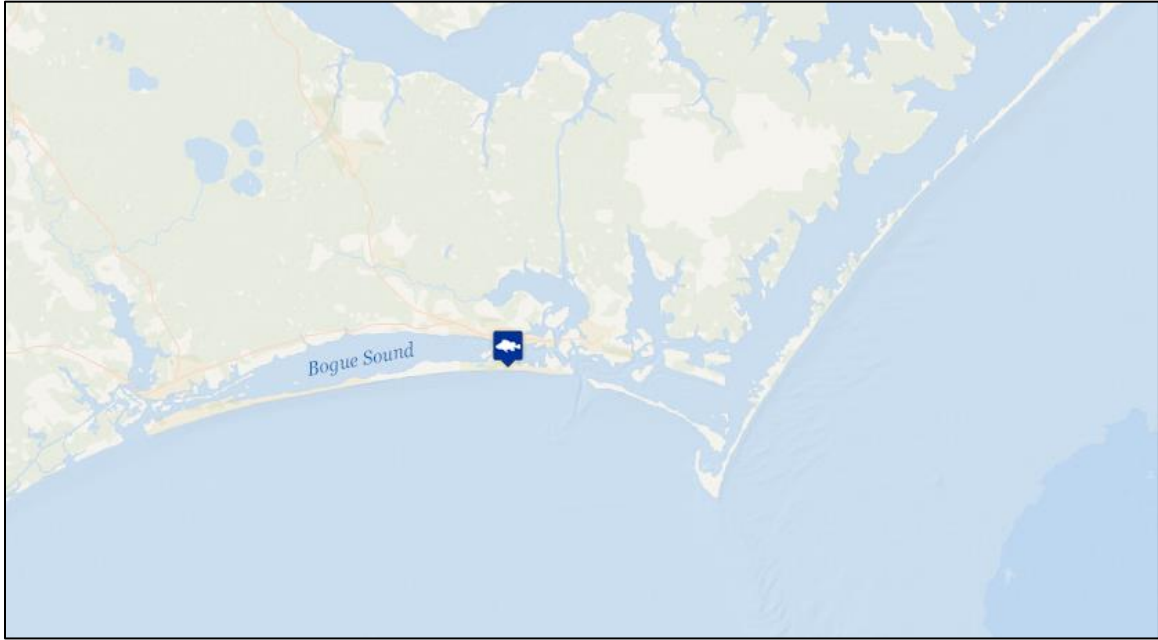
Map 13. Distribution of Summer Flounder, *Paralichthys dentatus*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021.



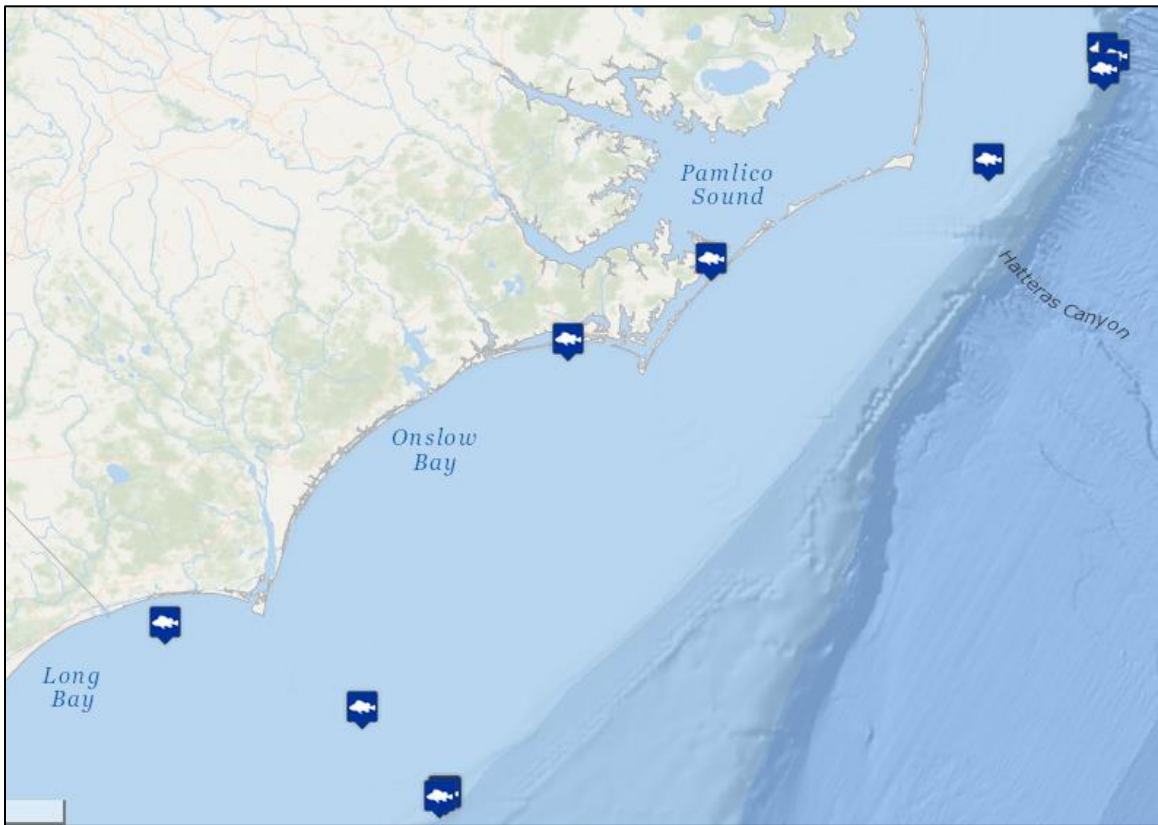
Map 14. Distribution of Southern Flounder, *Paralichthys lethostigma*. Map originally appeared in Tracy et al. (2020).



Map 15. Distribution of Fourspot Flounder, *Paralichthys oblongus*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021. Note: location is beyond “North Carolina” waters (> 13.8 miles = 22.2 km, and 12 nautical miles).



Map 16 Distribution of Broad Flounder, *Paralichthys squamilentus*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021.



Map 17. Distribution of Dusky Flounder, *Syacium papillosum*. Map based upon vouchered specimens at the North Carolina Museum of Natural Sciences; accessed 02/14/2021. Note: several locations are beyond “North Carolina” waters (> 13.8 miles = 22.2 km, and 12 nautical miles).

Southern Flounder also venture into fresh water - quite the upstream distance from their normal marine environments (Map 12). They have been found in the Cape Fear River upstream near Lock and Dam No. 1 (Cape Fear basin), in the Neuse River as far upstream as near the Town of LaGrange (Neuse basin), in the Roanoke River as far upstream as at the Town of Weldon (Roanoke basin), and in the Chowan River as far upstream as at Arrowhead Beach (Chowan basin) (Tracy et al. 2020).

None of the species is a federally- or state-listed species (NCAC 2017; NCNHP 2020; NCWRC 2017). The recreational and commercial harvesting (take) of some species of flounder are state regulated by the North Carolina Division of Marine Fisheries and the North Carolina Wildlife Resources Commission (NCDMF 2020; NCWRC 2020).

The identification of sand flounder can be challenging. Complicating that fact is that specimens captured inshore or offshore using a trawl are often “ragged looking” because of fin damage and scale loss during the collection process. Critical scale pigmentation patterns may be rendered impractical because all that remain are the scale pockets. If the specimen does not look like it has been “rung through the wringer” key characteristics for its proper identification include the shape of the lateral line; the length of the anterior dorsal fin rays; the origin of the dorsal fin; the presence or absence of pigmented spots (ocelli) and their placement; dorsal and anal fin and gill raker counts; size of mouth; body depth in relation to Standard Length; and the presence or absence of ctenoid scales (please refer to the Identification Key to the Sand Flounders (Family Paralichthyidae) in North Carolina).

If you have troubles with your identifications, just send us (<https://ncfishes.com/contact/>) an e-mail and include as many quality digital photographs as you can along with all the pertinent locality descriptors so that we will know from where the fish came.

**Identification Key to the Freshwater and Marine Sand Flounders (Family Paralichthyidae)
in North Carolina**

(Please refer to NCFishes.com for pictures and identifying characteristics all species)
(Identification Key and Illustrations adapted from Munroe (2002))

- 1a. Lateral line distinctly arched above pectoral fin on eyed side (Figure 1). Pelvic fins symmetrically or nearly symmetrically placed on either side of midventral line (base of neither pelvic fin on midventral line). Urinary papilla on eyed side. Branched caudal fin rays 13.....2
- 1b. No distinct arch in lateral line above pectoral fin on eyed side (Figure 1). Base of pelvic fin on eyed side on midventral line. Urinary papilla on blind side. Branched caudal fin rays 11, rarely 10 or 129

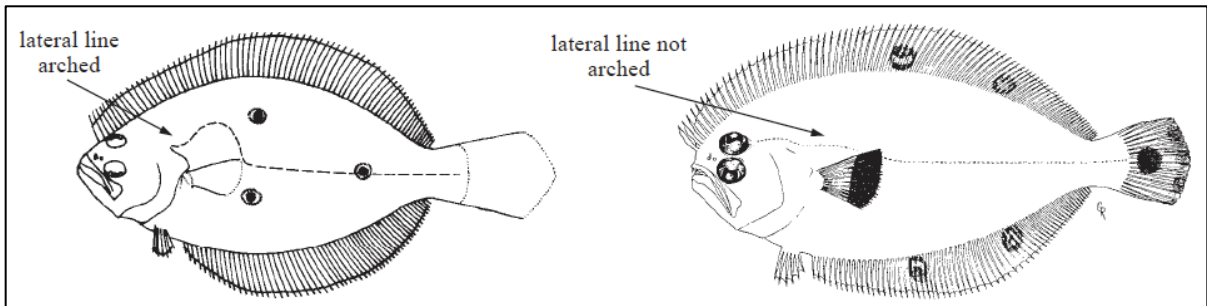


Figure 1. Shape of the lateral line. Left – *Paralichthys* spp.; Right – *Cyclopsetta* spp.

- 2a. Anterior rays of dorsal fin in adults prolonged beginning with second ray (Figure 2). 3 or 4 large, ocellated, dark spots on body (when only 3 ocelli present, arrangement is either with 1 above pectoral fin and 2 at midbody, one above the other, dorsal and ventral to lateral line; or with posteriormost ocellus dorsoventrally oval or elliptical and situated on lateral line just before caudal peduncle; when 4 ocelli present, anteriormost positioned above arch in lateral line). Pelvic fin rays of eyed side in adults longer than rays of blind side. Lower-limb gill rakers on first arch 6-9. Dorsal fin rays 62-843
- 2b. Anterior rays of dorsal fin not prolonged (Figure 2). Large ocellated, dark spots present or absent on body (when ocelli present, not arranged as above). Pelvic fin rays of eyed side not longer than rays of blind side. Lower-limb gill rakers on first arch 7-18. Dorsal fin rays 71-1045

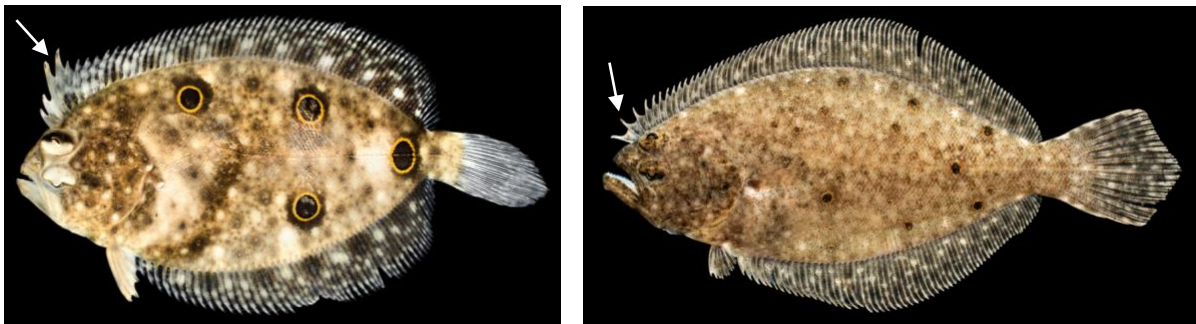


Figure 2. White arrows pointing to the relative lengths of the anterior rays of the dorsal fin. Left – Prolonged in Ocellated Flounder; Right – Not prolonged in Summer Flounder.

- 3a. Origin of dorsal fin well in advance of eyes (Figure 3). Dorsal profile of head smoothly convex. Scales on eyed side cycloid and embedded. 3 ocelli on eyed side, 1 above pectoral fin and 2 at midbody, one above the other, dorsal and ventral to lateral line (Figure 4). Dorsal fin rays 58-65..... Shrimp Flounder, *Gastropsetta frontalis*
- 3b. Origin of dorsal fin over or slightly anterior to front of eyes (Figure 3). Dorsal profile of head with a concavity in front of upper eye. Scales on eyed side ctenoid. 3 or 4 ocelli on eyed side, not arranged as above. Dorsal fin rays 62-844

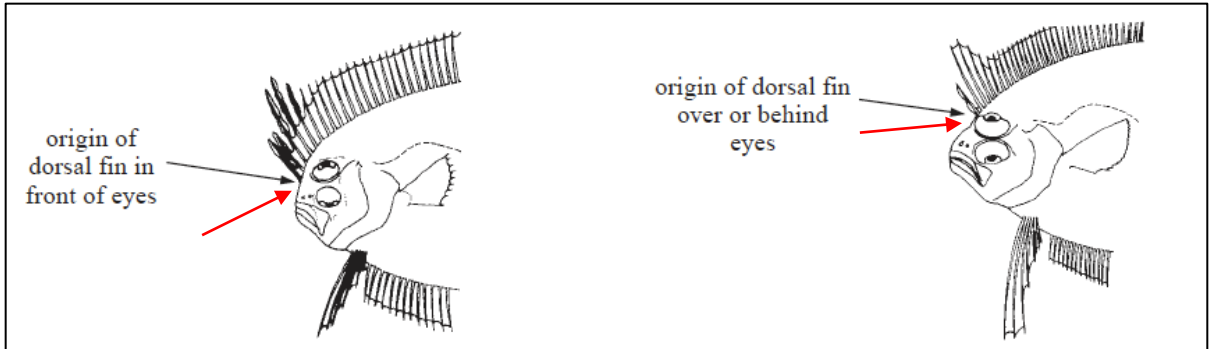


Figure 3. Positioning of the origin of the dorsal fin relative to the eyes. Red arrows point to the dorsal profile of the head. Left – Shrimp Flounder; Right – *Ancylopsetta* spp.

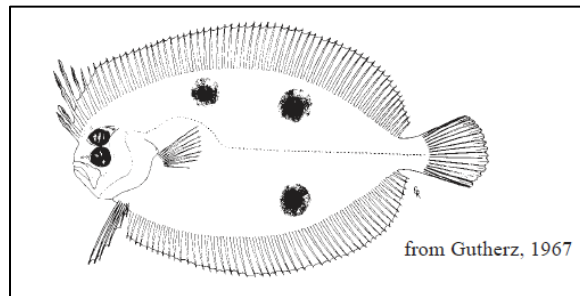


Figure 4. Shrimp Flounder.

- 4a. Four large ocellated spots on eyed side; anterior spot above curved portion of lateral line, posterior ocelli arranged in triangle with 2 (one above the other) in midbody and the third located on the lateral line caudally (Figure 5) Ocellated Flounder, *Ancylopsetta quadrocellata*
- 4b. Three large ocellated spots arranged in triangular pattern on eyed side, with posterior ocellus on lateral line. No spot above curved portion of lateral line (Figure 5) Three-eye Flounder, *Ancylopsetta dilecta*

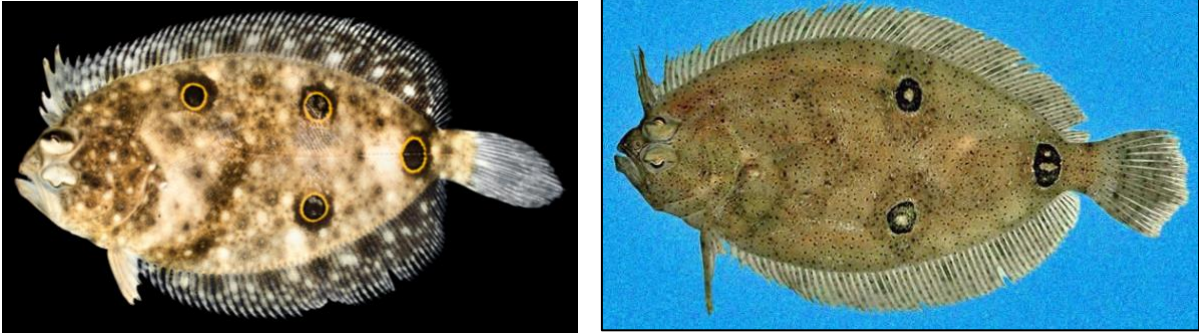


Figure 5. Left - Ocellated Flounder; Right - Three-eye Flounder. Photograph of the Three-eye Flounder courtesy of the Smithsonian Tropical Research Institute's Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/888>, accessed 02/12/2021.

- 5a. Prominent ocelli on eyed side6
- 5b. No prominent ocelli on eyed side8
- 6a. Eyes relatively large and close set, nearly meeting, separated only by a narrow ridge (Figure 6). 4 large dark ocelli on eyed side of body, arranged in a trapezoid with 2 in midbody (one above the other on opposite sides of the lateral line) and 2 on the body (one above the other on opposite sides of the lateral line) at a point slightly anterior to caudal peduncle (Figure 7). Dorsal fin rays 71-86. Anal fin rays 58-72. Lower-limb gill rakers 7-11. Lateral-line scales 63-95
 Fourspot Flounder, *Paralichthys oblongus*¹
- 6b. Eyes separated by a flat space without a ridge (Figure 6). 3 or 5 prominent ocelli on eyed side not arranged as above. Lower-limb gill rakers 8-18. Lateral-line scales 85-117. Dorsal fin rays 71-96. Anal fin rays 53-747

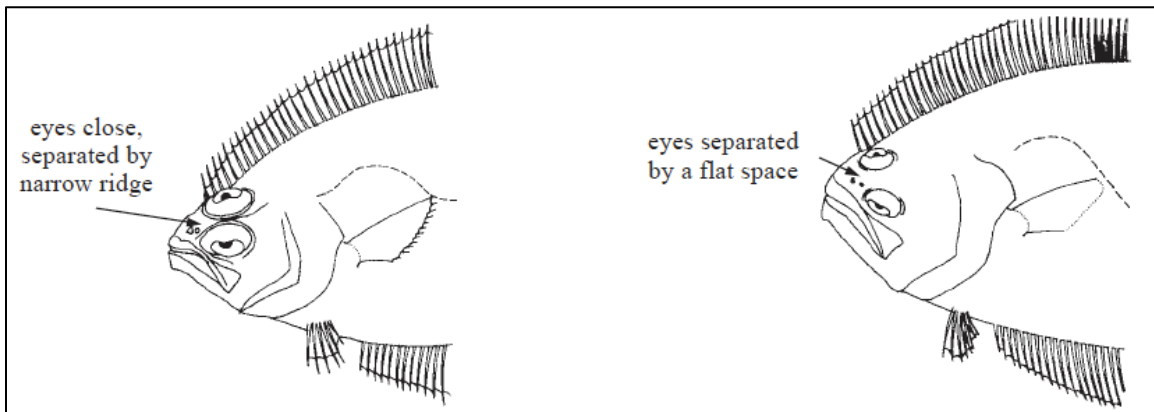


Figure 6. Proximity of the eyes to one another. Left – Fourspot Flounder; Right – *Paralichthys* spp.

¹ Listed as *Hippoglossina oblonga* (Mitchill 1815) in Munroe (2002)



Figure 7. Fourspot Flounder.

- 7a. Many ocelli on eyed side, but with 5 prominent ocellated dark spots on posterior half of body (Figure 8). Gill rakers on lower limb of first arch 14 or more (rarely 13). Dorsal fin rays 80-96. Anal fin rays 61-73. 91-106 scales in lateral line..... Summer Flounder, *Paralichthys dentatus*
- 7b. Three prominent ocellated dark spots on body arranged in a triangle with 2 (one above the other) in midbody and 1 on the lateral line in posterior part of body (Figure 8). Gill rakers on lower limb of first arch 9-12. Dorsal fin rays 71-85. Anal fin rays 53-63. 78-81 scales in lateral line..... Gulf Flounder, *Paralichthys albigutta*

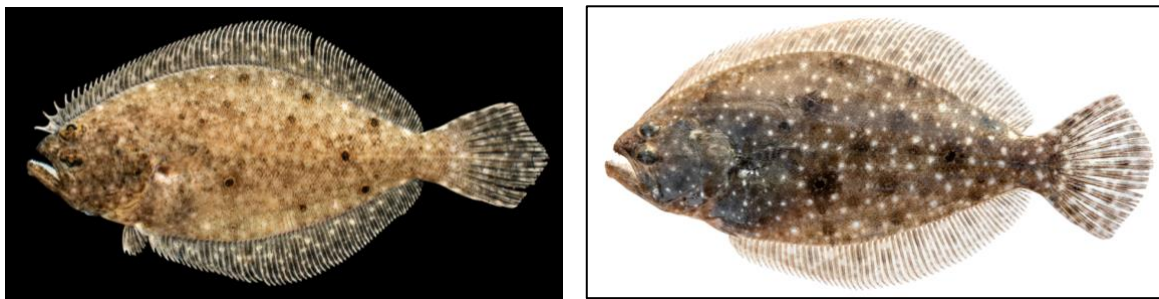


Figure 8. Left – Summer Flounder; Right – Gulf Flounder.

- 8a. Body depth greater than 47% SL (mean 50% SL) (Figure 9). Blind side on larger specimens dusky. 104-117 scales in lateral line..... Broad Flounder, *Paralichthys squamilentus*
- 8b. Body depth 47% or less SL (mean 44% SL) (Figure 9). Blind side immaculate or dusky. 78-100 scales in lateral line Southern Flounder, *Paralichthys lethostigma*

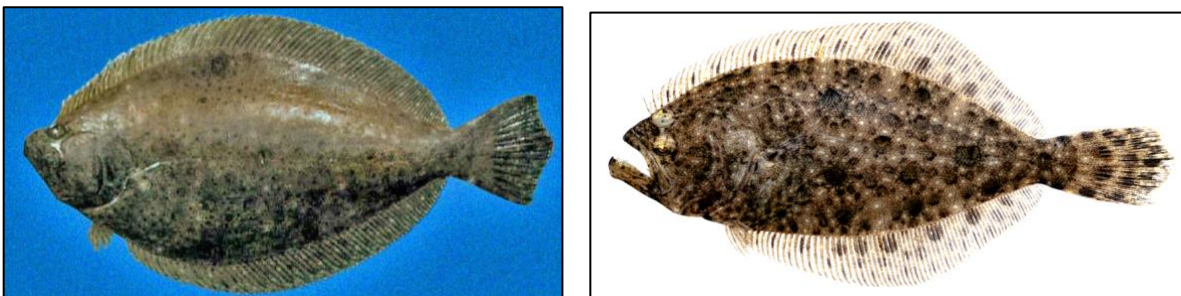


Figure 9. Left - Broad Flounder; Right - Southern Flounder. Photograph of the Broad Flounder courtesy of the Smithsonian Tropical Research Institute's Shorefishes of the Greater Caribbean online information system, <https://biogeodb.stri.si.edu/caribbean/en/pages/random/5135>, accessed 02/12/2021.

- 9a. Mouth small, maxilla 3.5-4.2 in head length nearly reaching vertical through front margin of eye (Figure 10). Jaws on blind side arched. No enlarged teeth, front teeth in both jaws equal in size to lateral teeth..... 10
- 9b. Mouth large, maxilla going less than 3.5 times in head length usually reaching posteriorly to vertical through mideye (Figure 10). Jaws on blind side not arched. Front teeth in jaws enlarged, larger than lateral teeth..... 13

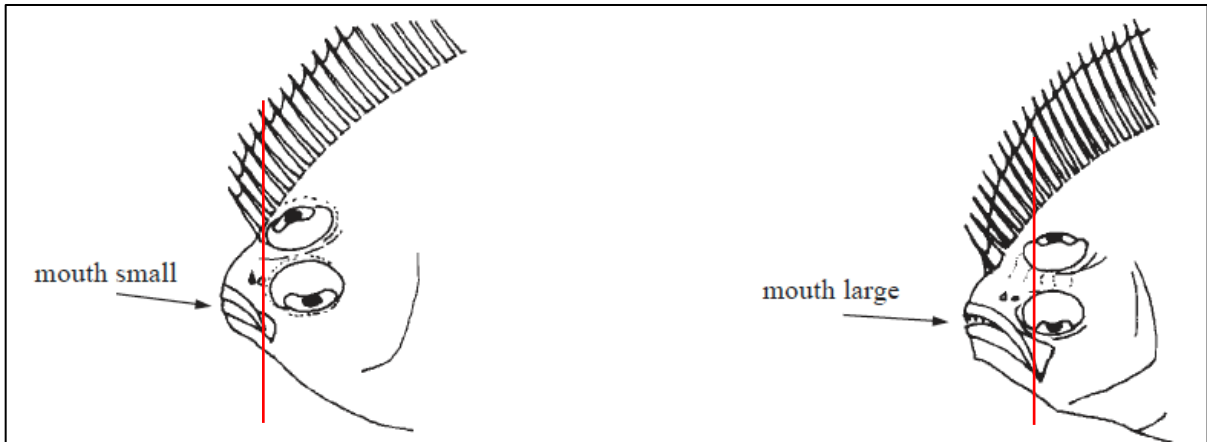


Figure 10. Relative size of the mouth and red bars showing the length of the maxilla relative to the positioning of the eyes. Left – *Etropus* spp.; Right – *Syacium* spp.

- 10a. Accessory scales (small scales found between the larger scales) present. Scales present on snout. Gill rakers on lower limb of first arch 3-6 (rarely 7) 11
- 10b. Accessory scales absent. Scales absent on snout. Gill rakers on lower limb of first arch 6-9, modally 7-8 (Figure 11) Fringed Flounder, *Etropus crossotus*



Figure 11. Fringed Flounder.

- 11a. Mandible (lower jaw) relatively symmetrical. Accessory scales cover 1/2 or less of exposed surface of primary scales in fish larger than about 60 mm SL. Greatest body depth usually less than 50% SL. Number of gill rakers on upper limb of first arch usually equal to or less than number on lower limb (Figure 12) Smallmouth Flounder, *Etropus microstomus*
- 11b. Mandible not symmetrical. Accessory scales cover 3/4 of exposed surface of primary scales in fish larger than about 60 mm SL. Greatest body depth usually more than 50% SL. Number of gill rakers on upper limb of first arch usually exceeds number on lower limb 12



Figure 12. Smallmouth Flounder. Photograph courtesy of the Maryland Biodiversity Project, <https://www.marylandbiodiversity.com/viewSpecies.php?species=5234>, accessed 02/12/2021.

- 12a. Snout with scales forward of the nostrils in fishes greater than 30 mm SL. Primary scales of blind side ctenoid, but ctenii may be indistinct on fish less than 50 mm SL. Without dark circles on eyed side (Figure 13) Gray Flounder, *Etropus rimosus*
- 12b. Snout without scales forward of a line between eyed- and blind-side nostrils in fishes greater than 30 mm SL, or rarely, with 1 or 2 scales present in large specimens. Often with row of 4-6 small dark circles on eyed side above and below lateral line, but circles may be indistinct on fish collected over dark substrate (Figure 13)..... Shelf Flounder, *Etropus cyclosquamus*

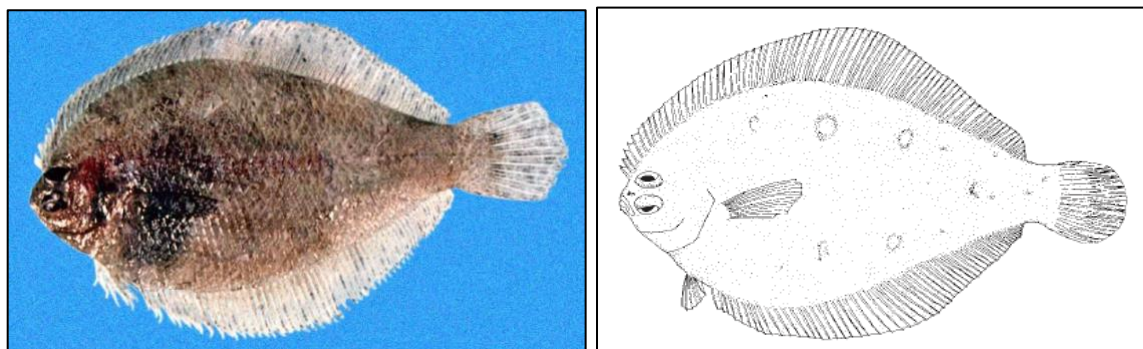


Figure 13. Left - Gray Flounder; Right – Shelf Flounder. Photograph of the Gray Flounder courtesy of the Smithsonian Tropical Research Institute’s Shorefishes of the Greater Caribbean online information system, -- <https://biogeodb.stri.si.edu/caribbean/en/pages/random/2729>, accessed 02/12/2021.

- 13a. Both jaws with a single row of fixed (immovable) teeth. Males with or without elongated pectoral fin rays on eyed side 14
- 13b. Upper jaw with 2 rows of fixed (immovable) teeth. Males with elongated pectoral fin rays on eyed side 19
- 14a. Scales ctenoid. Gill rakers slender and moderately long. Pectoral fin without a dark margin 15
- 14b. Scales cycloid. Gill rakers stout and short. Pectoral fin with a broad, dark margin (Figure 14)
 Spotfin Flounder, *Cyclopsetta fimbriata*

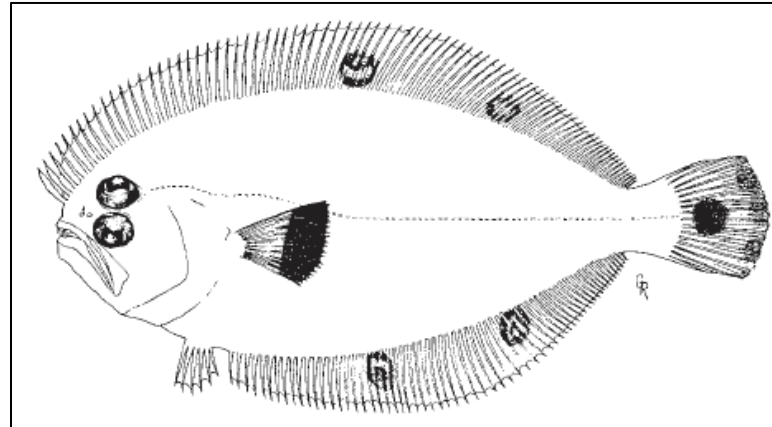


Figure 14. Spotfin Flounder.

- 15a. Stout hornlike projection on snout (Figure 15). Upper-jaw length less than 33% head length. Body depth 34-43% SL (usually less than 40%) Gulf Stream Flounder, *Citharichthys arctifrons*
- 15b. No stout hornlike projection on snout. Upper-jaw length usually greater than 33% head length (31% head length in some specimens of *C. spilopterus*). Body depth greater than 40% SL 16

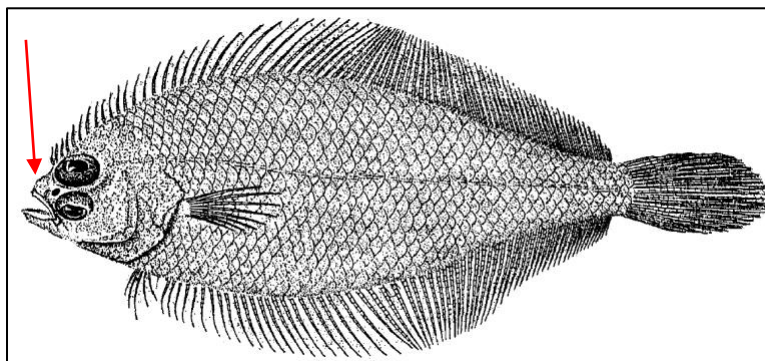


Figure 15. Gulf Stream Flounder with red arrow pointing to the location of the hornlike projection on the snout.

- 16a. Body and median fins profusely covered with regularly arranged spots and blotches (scales deciduous, spotting on body not so obvious when scales lost) (Figure 16)
 Spotted Whiff, *Citharichthys macrops*
- 16b. Body and median fins not profusely covered with regularly arranged spots and blotches 17

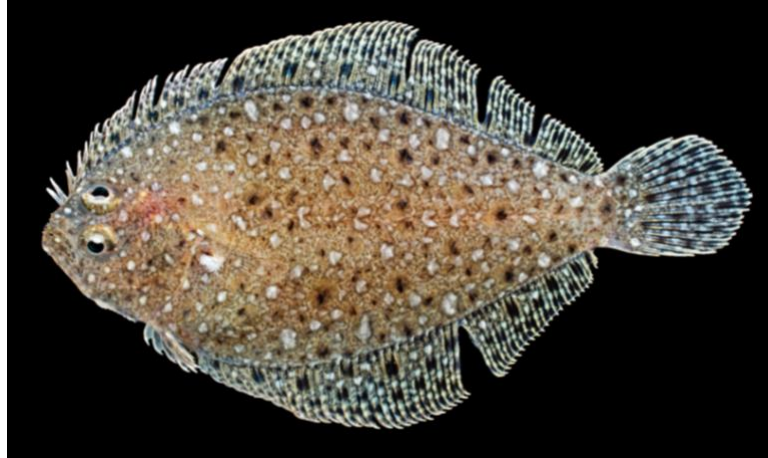


Figure 16. Spotted Whiff.

- 17a. Eye diameter usually 30% head length or greater. Males with spines on the head, absent on females 18
- 17b. Eye diameter 25% head length or less. Males lacking spines on the head (Figure 17) Bay Whiff, *Citharichthys spilopterus*



Figure 17. Bay Whiff.

- 18a. Snout partially covered with scales. Mature males with single horizontally directed spine projecting forward from snout region between eyes and extending well beyond margin of head (Figure 18). Small dark spot in axil of pectoral fin. Males without large black spot on middle of dorsal and anal fins. Eyed-side pelvic fin with 6 fin rays. Scales in lateral line 40 or moreHorned Whiff, *Citharichthys cornutus*
- 18b. Snout naked. Males with anterior continuation of spine from rim of orbit of upper eye directed horizontally and projecting forward beyond margin of head (Figure 18). No dark spot in axil of pectoral fin. Males with dark black spot on dorsal and anal fins immediately behind longest rays. Eyed-side pelvic fin with 5 fin rays. Scales in lateral line fewer than 40.....Angelfin Whiff, *Citharichthys gymnorhinus*

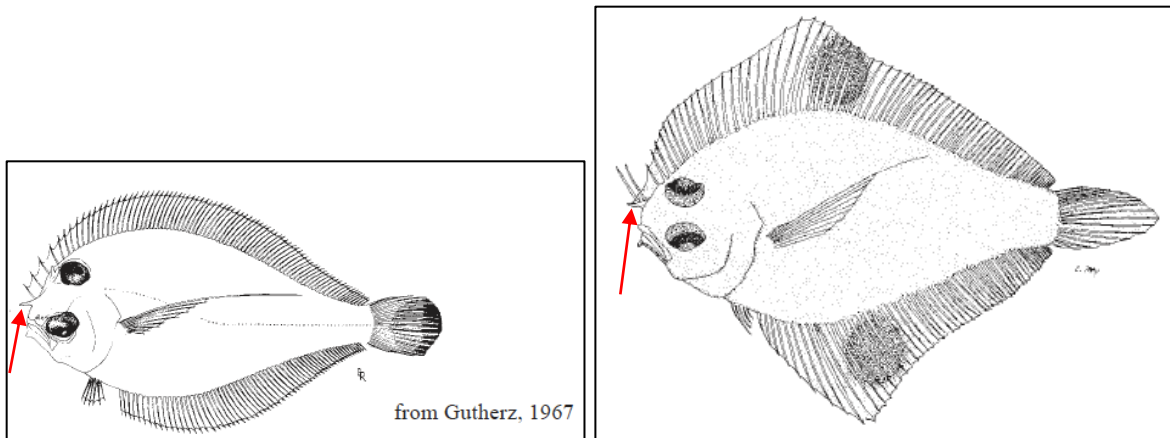


Figure 18. Red arrows pointing to the spine dorsal to the snout. Left - Horned Whiff; Right - Angelfin Whiff.

- 19a. Specimens greater than 120 mm SL 20
- 19b. Specimens less than 120 mm SL 24
- 20a. Interorbital width greater than 75% of lower eye diameter (Figure 19). Anterior rays of pectoral fin on eyed side elongate, exceeding 25% SL (Figure 19). Pigment lines (bluish in life, brown after preservation) running anteroventrally from upper eye, may also be present on interorbital region, lips, mandible, and urohyal. Blind side dusky male Dusky Flounder, *Syacium pappilosum*
- 20b. Interorbital width less than 75% of lower eye diameter21

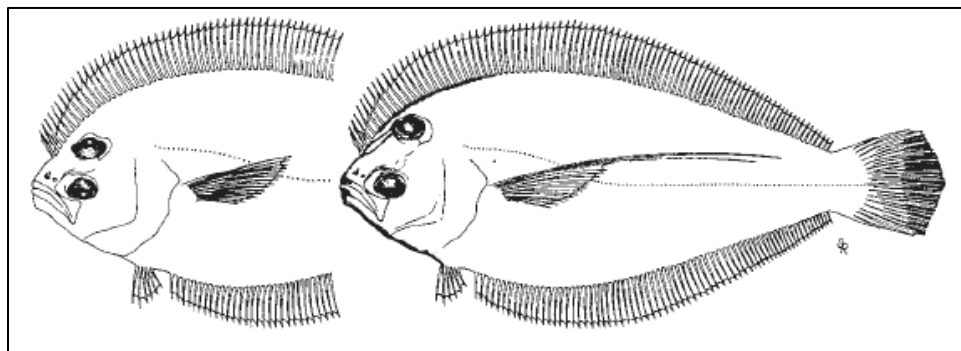


Figure 19. Dusky Flounder. Left – Female, Right – Male.

- 21a. Eyed-side pectoral fin rays not elongate, less than 25% SL (females) 22
- 21b. Eyed-side pectoral fin rays elongate, greater than 25% SL (males) 23
- 22a. Interorbital width 25-35% of lower eye diameter in specimens 120-150 mm SL, increasing to 60% in specimens about 220 mm SL. General body color dark brown, little or no mottling (Figure 20) female Dusky Flounder, *Syacium pappilosum*
- 22b. Interorbital width about 20% of lower eye diameter in specimens 120-150 mm SL, increasing to about 27% in specimens to 195 mm SL. General body color light tan to brown, mottling on body and fins, several large black blotches on lateral line female Channel Flounder, *Syacium micrum*



Figure 20. Female Dusky Flounder.

- 23a. Interorbital width usually 30-70% of lower eye diameter in specimens 120-150 mm SL, 50-90% in specimens 150-180 mm SL, and exceeding 75% of lower eye diameter in larger specimens (Figure 21) male Dusky Flounder, *Syacium pappilosum*
- 23a. Interorbital width less than 35% of lower eye diameter in specimens 120-150 mm SL, less than 50% in specimens 150-180 mm SL, and never exceeding 75% of lower eye diameter (Figure 22)
..... male Channel Flounder, *Syacium micrum*

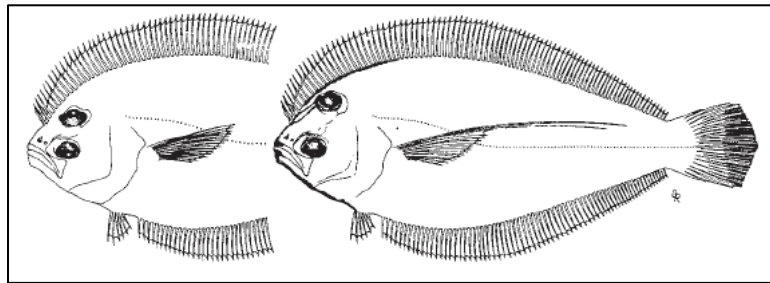


Figure 21. Dusky Flounder. Left – Female, Right – Male.

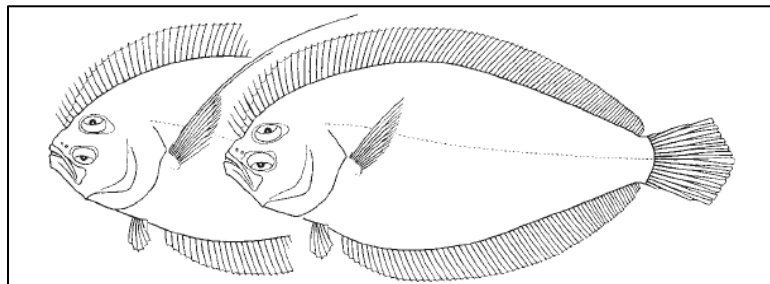


Figure 22. Channel Flounder. Left – Male, Right – Female.

- 24a. Snout length 54-74% (mean 66%) of shortest distance from tip of snout to orbit of upper eye. Interorbital width generally greater than 15% of lower eye diameter. Two dark lines from upper eye to snout..... Dusky Flounder, *Syacium pappilosum*
- 24b. Snout length 80-92% (mean 83%) of shortest distance from tip of snout to orbit of upper eye. Interorbital width generally less than 15% of lower eye diameter. No dark lines on head.
..... Channel Flounder, *Syacium micrum*

Glossary

(Adapted from Fishbase Glossary (<https://www.fishbase.in/Glossary/Glossary.php?q=a&s=index>, accessed 02/14/2021); and Rohde et al. (2009))

Accessory Scales – Small scales found between the larger scales

Ctenii - The teeth or spinules characteristic of ctenoid scales

Ctenoid Scales – Thins, light, flexible scale with numerous small backward-pointing “teeth” on the outer edge

Cycloid Scales – Thin, light, flexible scale lacking small, rear-pointing teeth

Hypural Plate – Expanded bone that form the support for the caudal fin rays. The endo of the plate usually appears as a crease across the caudal peduncle

Ocellus (plural Ocelli) – An eye-like spot in which the central color is surrounded by one or more differently colored rings

Standard Length (SL) – Distance from the anteriormost point on a fish to the posterior end of the bony caudal fin base (hypural plate)

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The Meanings of the Scientific Names of Sand Flounders

Adopted from the ETYFish Project by Christopher Scharpf and Kenneth J. Lazara,
accessed February 12, 2021, <http://www.etyfish.org/>

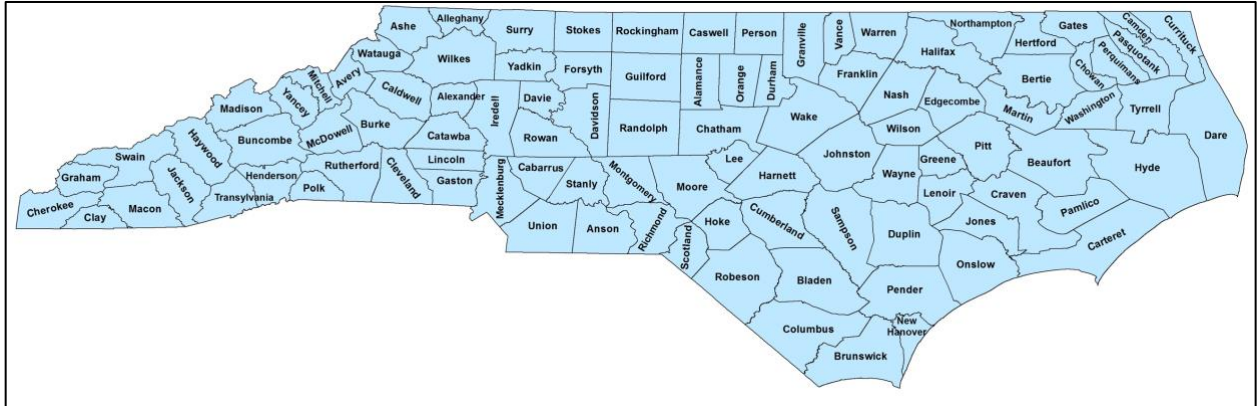
Family PARALICHTHYIDAE Regan 1910, SAND FLOUNDERS

- i. ***Ancylopsetta* Gill 1864** - *ankylos*, bent, hooked or crooked, probably referring to “*falciform* arch” (italics in original) of lateral line of *A. quadrocellata* (= *ommata*); *psetta*, Greek for flatfish
 - a. ***Ancylopsetta dilecta* (Goode & Bean 1883)** - per Goode & Bean (1896), admired or beloved, “in allusion to the beauty of the species”
 - b. ***Ancylopsetta quadrocellata* Gill 1864** – four-eyed, referring to four large, oblong, ocellated spots (eyespot) on eyed side of body
- ii. ***Citharichthys* Bleeker 1862** – *Citharus* (Citharidae), presumably referring to similarity to this genus; *ichthys*, fish
 - a. ***Citharichthys arctifrons* Goode 1880** - *arctus*, narrow; *frons*, forehead, probably referring to “very narrow” interorbital space
 - b. ***Citharichthys cornutus* (Günther 1880)** - horned, presumably referring “three pointed projections” on snout in front of upper eye (at least in adults)
 - c. ***Citharichthys gymnorhinus* Gutherz & Blackman 1970** - *gymnos*, bare or naked; *rhinus*, snout, referring to absence of scales on snout (from anterior edge of head to vertical through posterior margin of pupil of lower eye)
 - d. ***Citharichthys macrops* Dresel 1885** - *macro-*, long or large; *ops*, eye, referring to “much larger” eyes compared to *C. spilopterus*
 - e. ***Citharichthys spilopterus* Günther 1862** - *spilos*, spot; *pterus*, fin, referring to series of “distant” blackish spots along basal portions of anal and dorsal fins
- iii. ***Cyclopsetta* Gill 1889** - *cyclo-*, circle, referring to “regularly” cycloid scales (some weakly ctenoid) on eyed side of *C. fimbriata*
 - a. ***Cyclopsetta fimbriata* (Goode & Bean 1885)** - fringed, allusion not explained, presumably referring to produced rays of dorsal fin
- iv. ***Etropus* Jordan & Gilbert 1882** - *etron*, abdomen; *pous*, foot, referring to ventral fin of *E. crossotus* on ridge of abdomen
 - a. ***Etropus crossotus* Jordan & Gilbert 1882** - fringed, referring to row of “conspicuous” white cilia on edge of opercle on blind side
 - b. ***Etropus cyclosquamus* Leslie & Stewart 1986** - *cyclo-*, circle; *squama*, scale, referring to cycloid scales on blind side, which distinguishes it from *E. rimosus*
 - c. ***Etropus microstomus* (Gill 1864)** - *micro-*, small; *stomus*, mouth, referring to “rather small” mouth, “length of the upper jaw only equalling a quarter of the length, and that of the lower two-fifths of the head’s length”
 - d. ***Etropus rimosus* Goode & Bean 1885** - per Goode & Bean (1896), rough-looking, full of cracks and fissures, allusion not explained, perhaps referring to “strongly pectinated” scales on both sides of body (Jordan & Evermann [1898] state, apparently incorrectly, that name means “frosted”]
- v. ***Gastropsetta* Bean 1895** - *gaster*, belly, allusion not explained, presumably referring to produced ventral fin of eyed side, ending in a long filamentous ray in the young; *psetta*, Greek for flatfish
 - a. ***Gastropsetta frontalis* Bean 1895** - pertaining to forehead, allusion not explained, perhaps referring to dorsal fin beginning in front of eyes

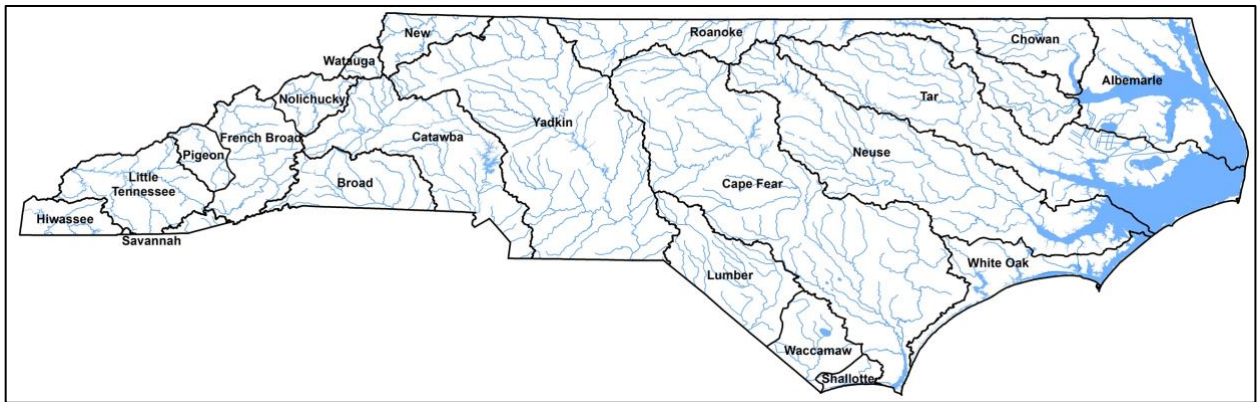
- vi. ***Paralichthys* Girard 1858** - *parallens*, parallel, allusion not explained, perhaps referring to oblong body of *P. maculosus* (= *californicus*)
 - a. ***Paralichthys albigutta* Jordan & Gilbert 1882** - *albus*, white; *gutta*, spot, referring to “very small pale spots” on dark greenish body (eyed side)
 - b. ***Paralichthys dentatus* (Linnaeus 1766)** - toothed, referring to large canine teeth
 - c. ***Paralichthys lethostigma* Jordan & Gilbert 1884** - *lethos*, to forget; *stigma*, mark or spot, referring to absence of spots compared to the spotted *P. dentatus*, which it otherwise resembles
 - d. ***Paralichthys oblongus* (Mitchill 1815)** - oblong, allusion not explained, presumably referring to four oblong blackish ocelli or eyespots on eyed side
 - e. ***Paralichthys squamilentus* Jordan & Gilbert 1882** - scaly, allusion not explained, perhaps referring to small scales compared to the similar *P. albigutta*, described in the same publication

- vii. ***Syacium* Ranzani 1842** - latinization of *Syacia*, ancient Greek name for flatfishes according to Gesner (1558)
 - a. ***Syacium micrurum* Ranzani 1842** - *micro-*, small; [*o*]ura, tailed, referring to short caudal fin, possibly in comparison with two other species mentioned by Ranzani, *S. soleaeformis* (= *papillosum*) and *S. ocellatum* (= *micrurum*)
 - b. ***Syacium papillosum* (Linnaeus 1758)** - having papillae, described as having a papillous body

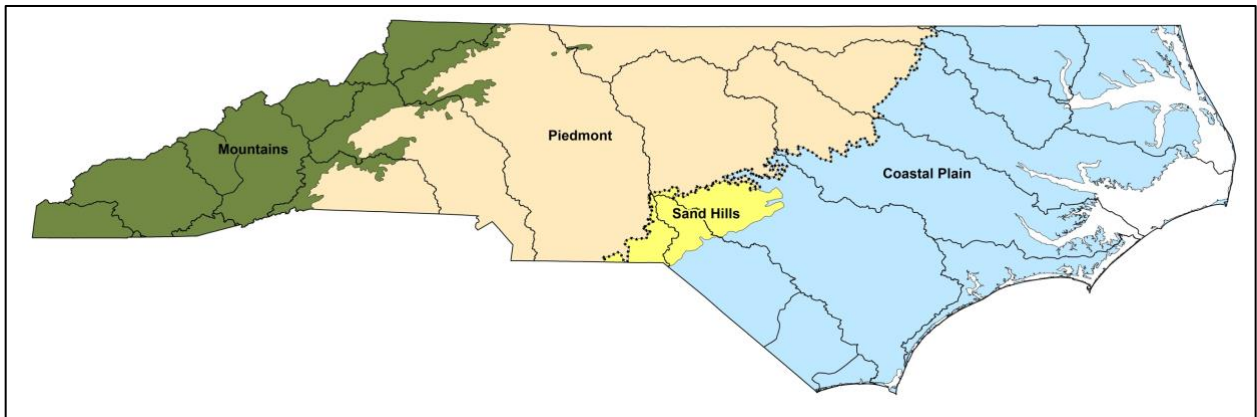
Supplemental Maps



Map No. 1. North Carolina's 100 counties. Map originally appeared in Tracy et al. (2020).



Map No. 2. North Carolina's 21 river basins. Map originally appeared in Tracy et al. (2020).



Map No. 3. North Carolina's four physiographic regions. Map originally appeared in Tracy et al. (2020).