Sand Flounder (Family Paralichthyidae) Diversity in North Carolina

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

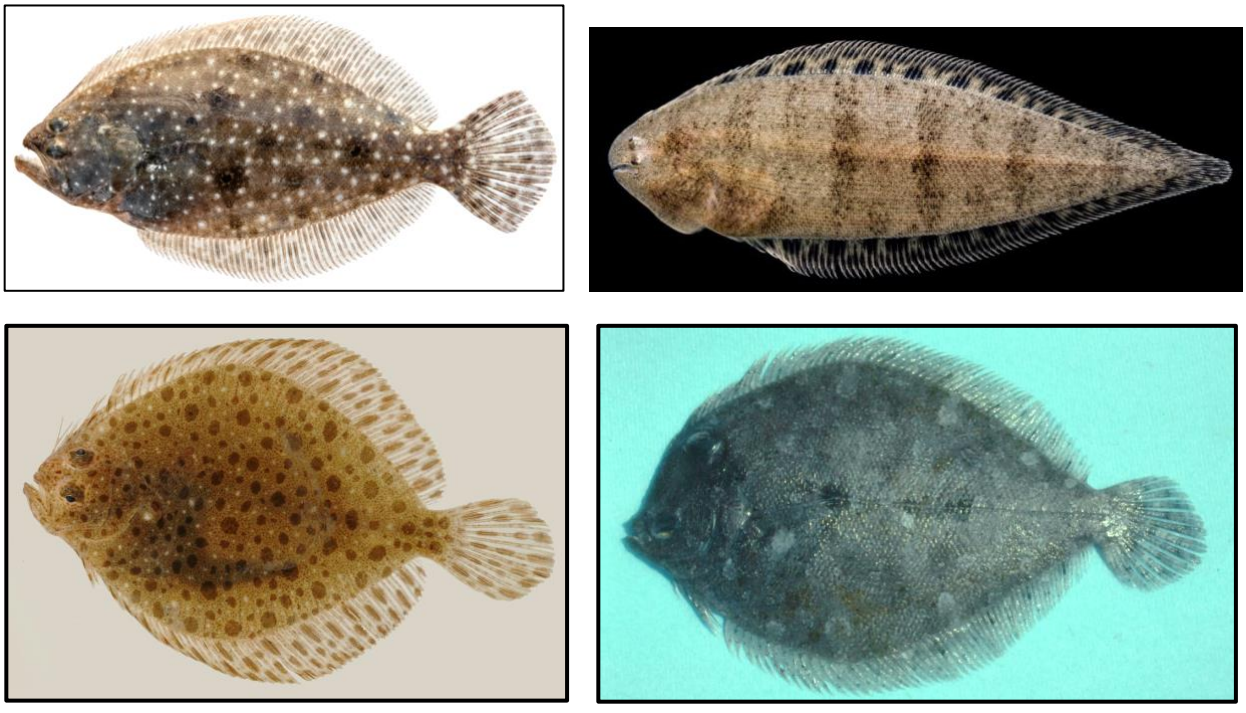

Figure 1. Examples of left-facing flatfishes found along the coast of North Carolina. From top left clockwise: Paralichthyidae (Gulf Flounder), Cynoglossidae (Blackcheek Tonguefish), Bothidae (Eyed Flounder), and Scophthalmidae (Window Pane). Photograph of Eyed Flounder courtesy of George H. Burgess.

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). 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).

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
Ancylopsetta dilecta – Three-eye Flounder	*Etropus microstomus* – Smallmouth Flounder
Ancylopsetta quadrocellata – Ocellated Flounder	*Etropus rimosus* – Gray Flounder
Citharichthys arctifrons – Gulf Stream Flounder	*Gastropsetta frontalis* – Shrimp Flounder
Citharichthys cornutus – Horned Whiff	*Paralichthys albigutta* – Gulf Flounder
Citharichthys gymnorhinus – Anglefin Whiff	*Paralichthys dentatus* – Summer Flounder
Citharichthys macrops – Spotted Whiff	*Paralichthys lethostigma* – Southern Flounder
Citharichthys spilopterus – Bay Whiff	*Paralichthys oblongus* – Fourspot Flounder
Cyclopsetta fimbriata – Spotfin Flounder	*Paralichthys squamilentus* – Broad Flounder
Etropus crossotus – Fringed Flounder	*Syacium micrurum* – Channel Flounder
Etropus cyclosquamus – Shelf Flounder	*Syacium papillosum* – 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 species has a scientific (Latin) name (Table 1; Appendix 1).

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. Southern Flounder also venture into fresh water - quite the upstream distance from their normal marine environments. 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 2020a).

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.

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

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 12 9

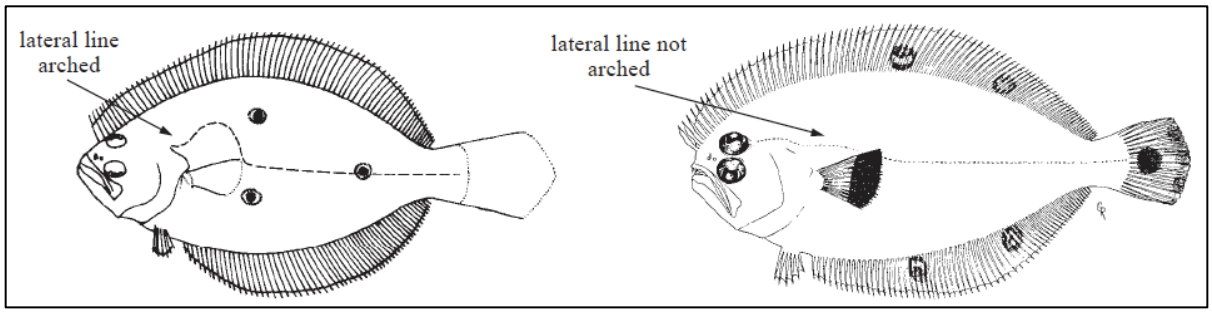

Figure 1. Shape of the lateral line. Left – *Paralichthys* spp.; Right – *Cyclopsetta* spp. Illustrations courtesy of Munroe (2002a).

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 62-84 3

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 71-104 5

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 62-84 4

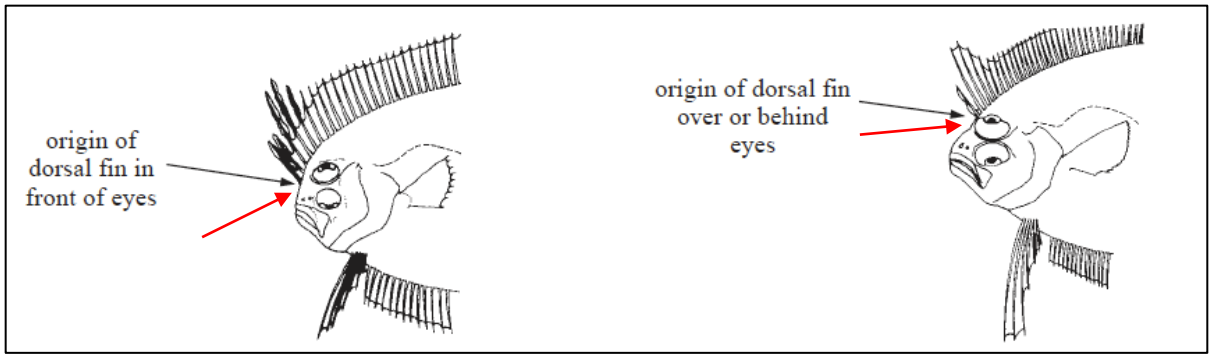

Figure 3. Positioning of the origin of the dorsal fin relative to the eyes. Red arrows point to the dorsal profile of the head. Left – Shrimp Flounder; Right – *Ancylopsetta* spp. Illustrations courtesy of Munroe (2002a).

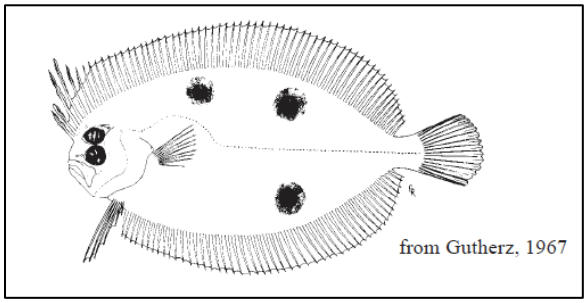

Figure 4. Shrimp Flounder. Illustration courtesy of Munroe (2002a).

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*

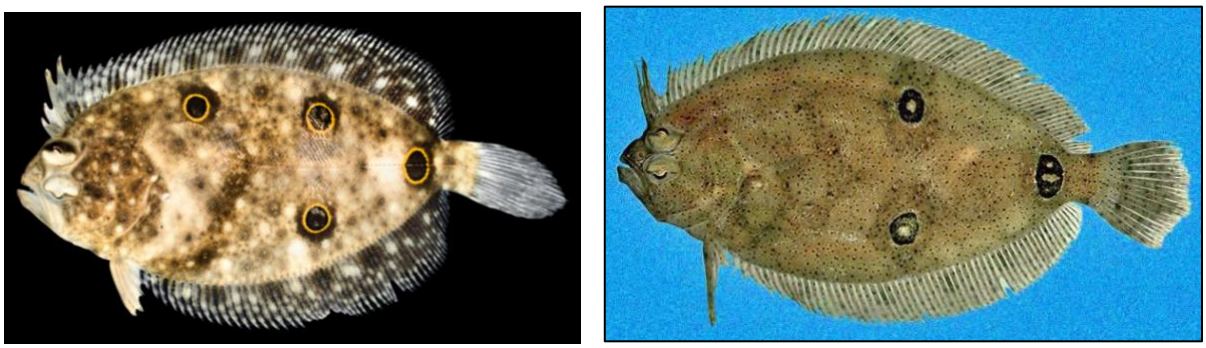

Figure 5. Left - Ocellated Flounder; Right - Three-eye Flounder. Photograph of the Three-eye Flounder courtesy of the Smithsonian Tropical Research Institute's Shorefishes of the Greater Caribbean online information system, https://biogeodb.stri.si.edu/caribbean/en/pages/random/888, accessed 02/12/2021.

5a. Prominent ocelli on eyed side 6

5b. No prominent ocelli on eyed side 8

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 53-74 7

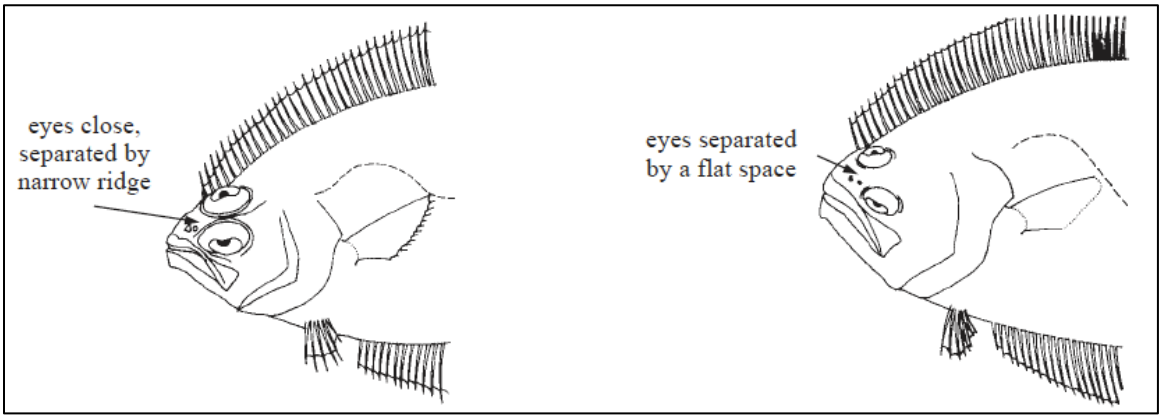

Figure 6. Proximity of the eyes to one another. Left – Fourspot Flounder; Right – *Paralichthys* spp. Illustrations courtesy of Munroe (2002a).

[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*

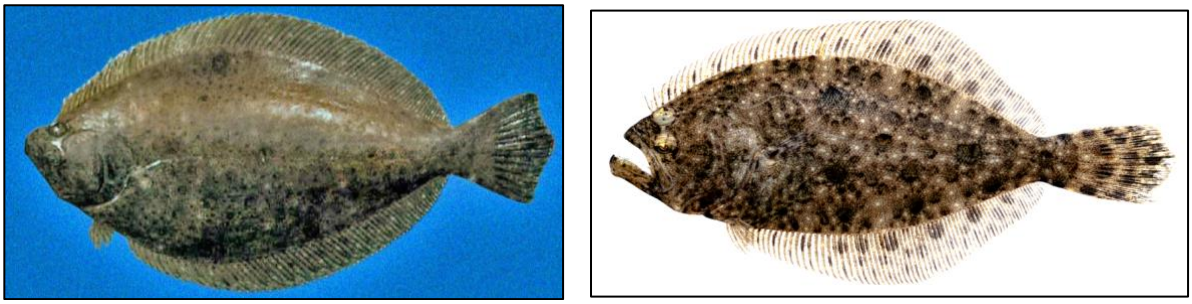

Figure 9. Left - Broad Flounder; Right - Southern Flounder. Photograph of the Broad Flounder courtesy of the Smithsonian Tropical Research Institute's Shorefishes of the Greater Caribbean online information system, https://biogeodb.stri.si.edu/caribbean/en/pages/random/5135, accessed 02/12/2021.

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

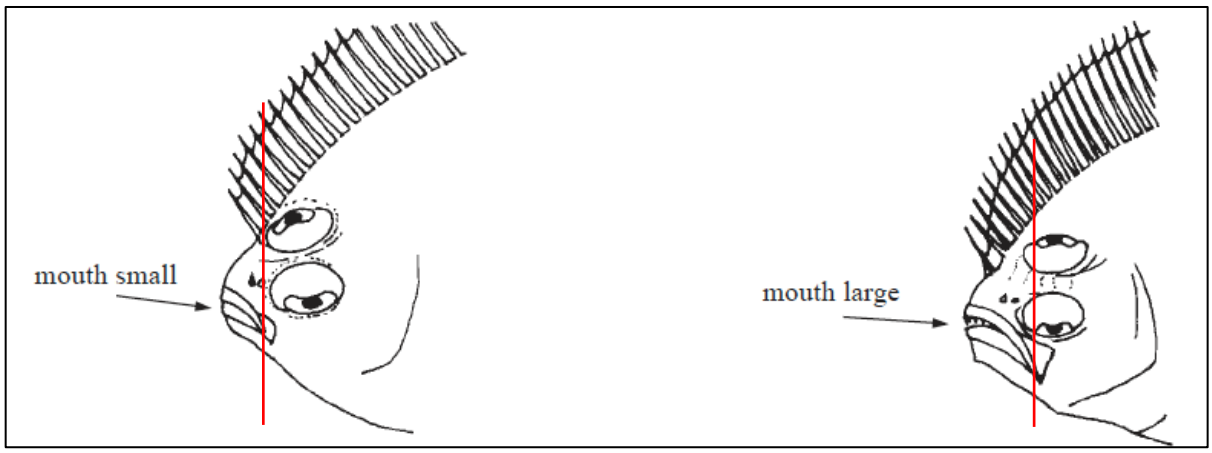

Figure 10. Relative size of the mouth and red bars showing the length of the maxilla relative to the positioning of the eyes. Left – *Etropus* spp.; Right – *Syacium* spp. Illustrations courtesy of Munroe (2002a).

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

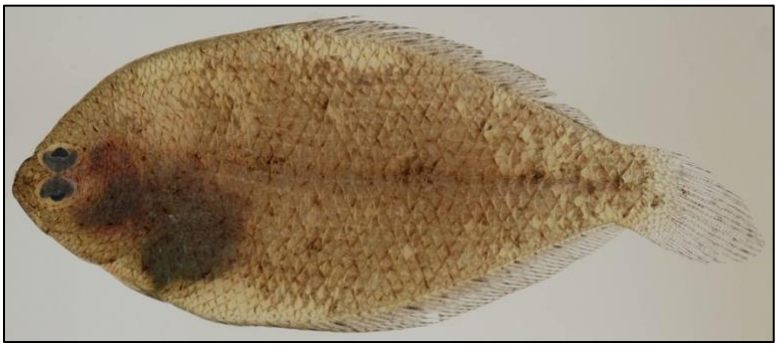

Figure 12. Smallmouth Flounder. Photograph courtesy of the Maryland Biodiversity Project, https://www.marylandbiodiversity.com/viewSpecies.php?species=5234, accessed 02/12/2021.

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*

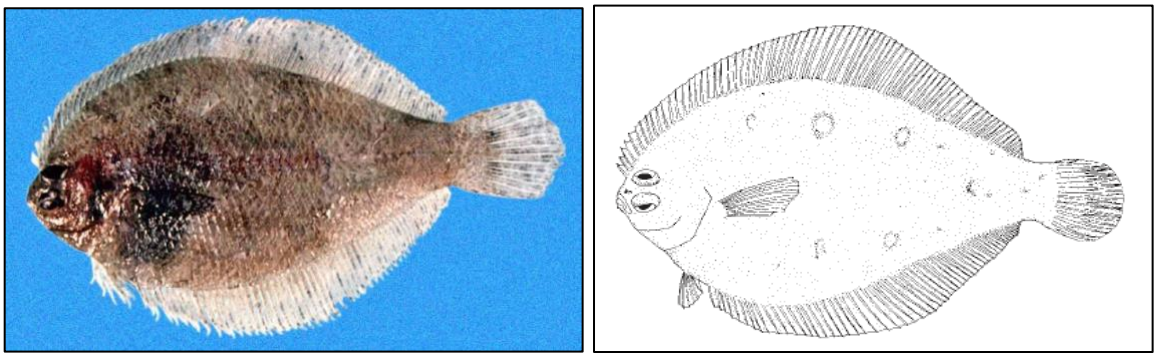

Figure 13. Left - Gray Flounder; Right – Shelf Flounder. Photograph of the Gray Flounder courtesy of the Smithsonian Tropical Research Institute's Shorefishes of the Greater Caribbean online information system, -- https://biogeodb.stri.si.edu/caribbean/en/pages/random/2729, accessed 02/12/2021. Illustration courtesy of Munroe (2002a).

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*

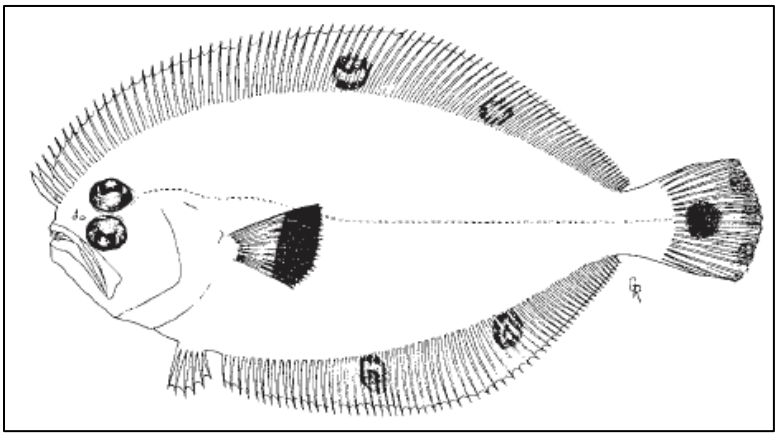

Figure 14. Spotfin Flounder. Illustration courtesy of Munroe (2002a).

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

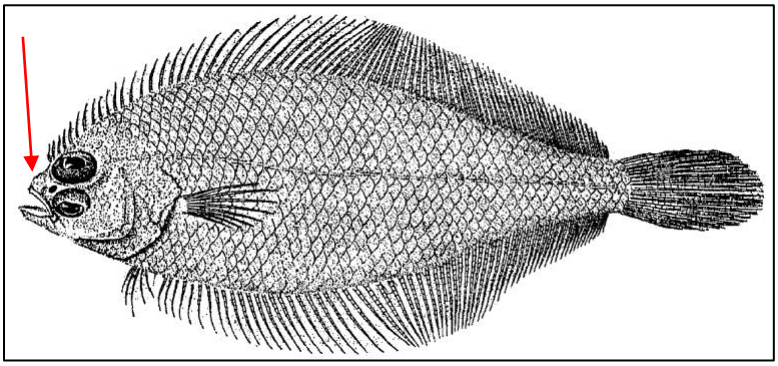

Figure 15. Gulf Stream Flounder with red arrow pointing to the location of the hornlike projection on the snout. Illustration courtesy of Munroe (2002a).

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

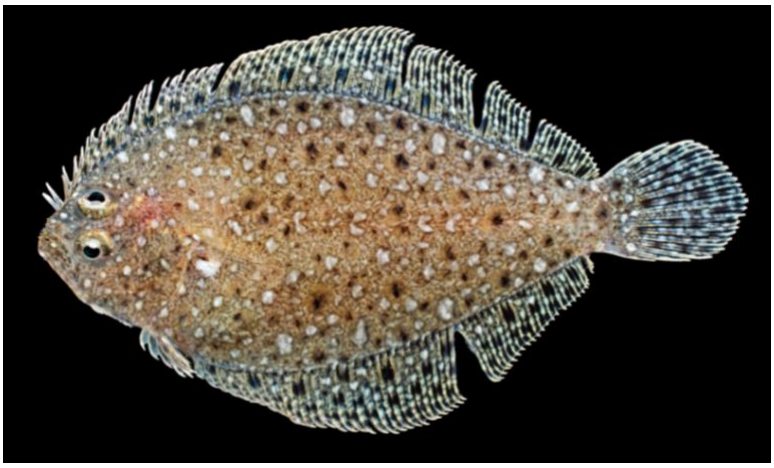

Figure 16. Spotted Whiff.

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*

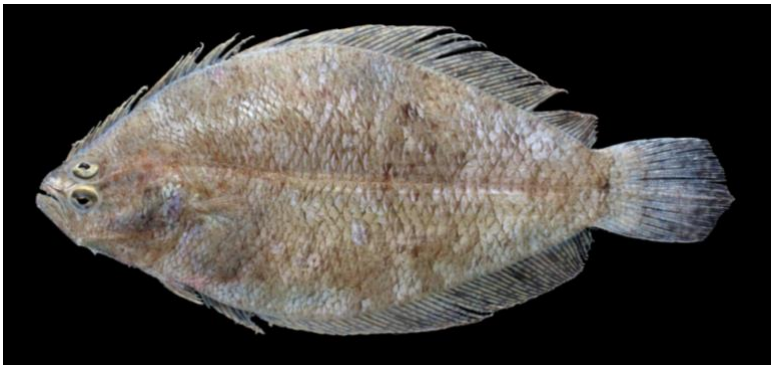

Figure 17. Bay Whiff.

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 more ....Horned 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*

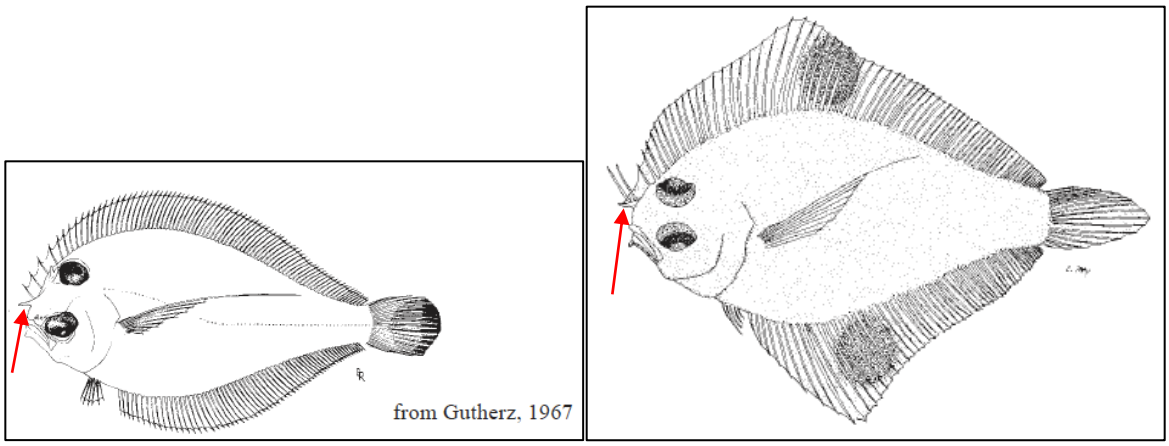

Figure 18. Red arrows pointing to the spine dorsal to the snout. Left - Horned Whiff; Right - Angelfin Whiff. Illustrations courtesy of Munroe (2002a).

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 pappillosum*

20b. Interorbital width less than 75% of lower eye diameter 21

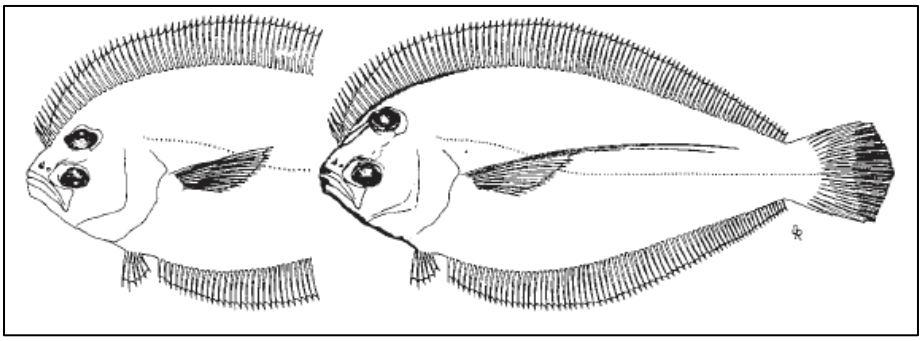

Figure 19. Dusky Flounder. Left – Female, Right – Male. Illustrations courtesy of Munroe (2002a).

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 pappillosum*

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 micrurum*

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 pappillosum*

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 micrurum*

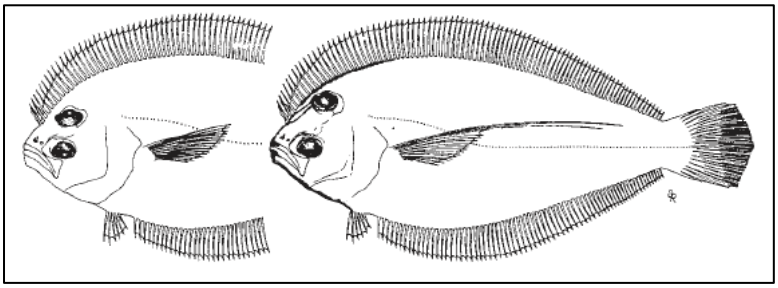

Figure 21. Dusky Flounder. Left – Female, Right – Male. Illustration courtesy of Munroe (2002a).

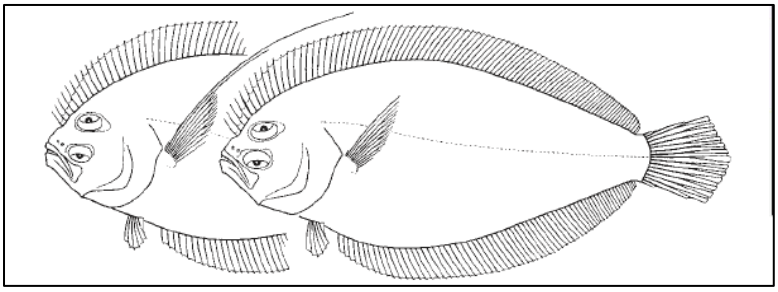

Figure 22. Channel Flounder. Left – Male, Right – Female. Illustration courtesy of Munroe (2002a).

24a. Snout length 54-74% (mean 66%) of shortest distance from tip of snout to orbit of upper eye. Interorbital width generally greater than15% of lower eye diameter. Two dark lines from upper eye to snout..... Dusky Flounder, *Syacium pappillosum*

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 micrurum*