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THREE PARTIALLY AMBICOLORATE FOUR-SPOTTED FLOUNDERS, *PARALICHTHYS OBLONGUS*, TWO EACH WITH A HOOKED DORSAL FIN AND A PARTIALLY ROTATED EYE

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INTRODUCTION

For a number of years, Gudger has been studying abnormalities in teleostean fishes, and particularly color, eye and dorsal fin anomalies in flatfishes—Heterosomata. Numbers of these specimens have been contributed to the collections of the American Museum by Firth. As an assistant in the U. S. Bureau of Fisheries, detailed as a collector of biological data at the fish piers of Boston and Gloucester (Mass.), New York, and Norfolk (Va.), he has been able to enlist the interest and good will of the fishermen, captains and crews, in bringing in abnormal and other unusual fishes. The collections of the Museum have profited by Firth's exceptional opportunities. Some of his latest contributions form the basis of this joint paper.

Our material consists of four specimens: one entirely normal, to serve as a standard of comparison, and the three partial ambicolorates which are described herein. These fish were taken 50–60 miles southeast of Chesapeake Light Vessel, which lies about 12 miles out from the mouth of the Chesapeake Bay. These flounders come then from the Atlantic about opposite Currituck Beach, N. C.

The four-spotted flounder, *Paralichthys oblongus*, is a west Atlantic species previously recorded from Gloucester south to the New York region. However, the capture of the specimens under consideration, greatly extends the southern limit and establishes this in the western Atlantic at about the parallel of 35° 50' North.

Fish of this species run small, rarely exceeding 12 inches with about 14 inches as the maximum length, and one pound as the maximum weight. Since the four-spotted flounders extend out to the 100 fathom line, they are found in deeper water than most flounders. Ours were trawled in about 50–60 fathoms. They are small, thin and semitransparent fish.

THE NORMAL FISH

Since our normal specimen was much battered in the net, and particularly since the upper side spots have almost entirely faded, it will not serve for an illustration. Instead we give here (Fig. 1) an outline sketch of the upper surface of a normal fish. As Fig. 1 shows, the four-spotted flounder is a sinistral or left-pointing fish which owes its name to the four prominent spots on its upper surface. These are in pairs above and below the lateral line. The anterior ones are near the dorsal and anal fins about midway between the tips of snout and tail. The other two spots are found on either side of the lateral line just anterior to the "small" of the tail and the hinder terminations of the dorsal and anal

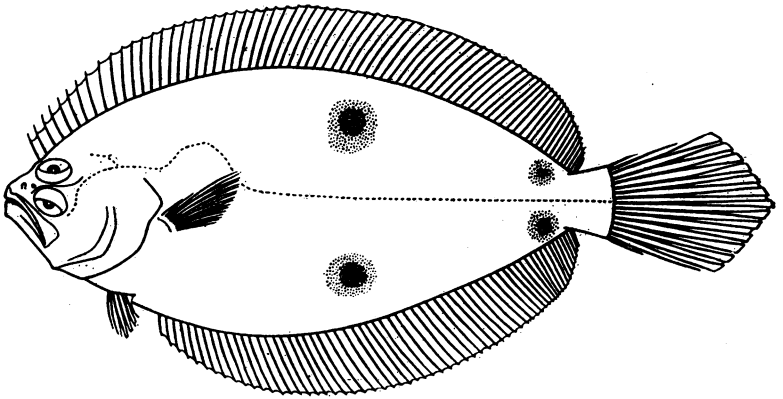


Fig. 1. Upper (left) surface of a normal four-spotted flounder, *Paralichthys oblongus*.

(After Norman, 1934.)

fins. The upper or rotated eye is on the left side well up toward but entirely across the dorsal ridge.

Our normal fish was taken by the Boston trawler, "Santina D.," Capt. Eugene Marino, about 50 mi. S. S. E. from Cape Henry, Va., in 50 fathoms late in January, 1936. It is the smallest of the entire lot, measuring 200 mm. (7.8 in.) to tip of tailfin. Its weight is 42.6 grams (1.5 oz.). Its upper surface is of the normal dark color, the posterior spots are fairly distinct, the anterior ones less so. These spots were none too clear in the just caught fish, and have faded badly in preservatives (formalin and alcohol). There is a faint bluish discoloration in the abdominal region, apparently due to some internal color. The whole under surface is an unmarred white.

I.—A PARTIALLY AMBICOLORATE SPECIMEN WITHOUT EYE OR DORSAL FIN ANOMALY

This fish, the largest of the group, measures, snout to tip of tail 240 mm. (9.5 in.). Its weight is 99.4 grams (3.5 oz.). This four-spotted flounder is about an average specimen. It was taken on February 29, 1936, by Capt. Frank Favaloro of the trawler "Grace F.," in 50 fathoms, about 60 mi. S. S. E. of the Chesapeake Light Vessel. This is not the first interesting specimen for which the American Museum is indebted to Capt. Favaloro.

In form the upper surface is entirely normal. However, in the trawl-net the scales were partially scraped off, and thus it is difficult to distinguish all the spots. The one discoloration which is not clear is a

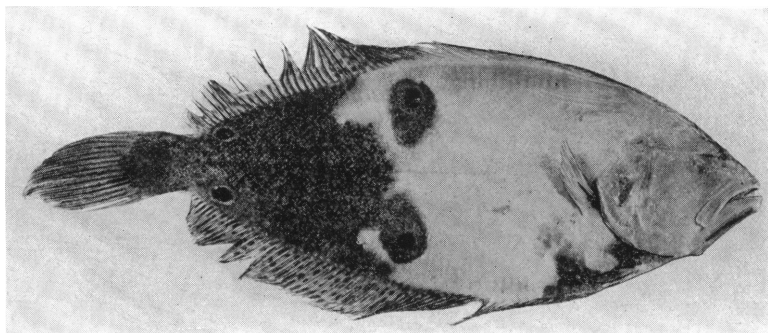


Fig. 2. Lower or right side of a partially ambicolorate four-spotted flounder. Note the perfect reproduction on the blind side of the four spots.

bluish inky area over the visceral region. This is in part due to color on the lower surface but mainly to something in the body cavity. The right or rotated eye is well clear of the dorsal crest. This and the anterior part of the dorsal fin are as entirely normal as are those of the fish shown in Fig. 1.

But, when one turns to the lower or right side (Fig. 2), an interesting and remarkable coloration is found. The caudal fin and about $2/5$ ths of the body are colored exactly as is the upper surface. A peninsula of dark color extends forward in the central region and a smaller peninsula extends to and includes the ventral one of the anterior pair of spots. An equal but isolated dark area surrounds the anterior dorsal spot. The dorsal fin is colored on its lower side forward to the region of the upper dark region and spot, but is white from this point on. The anal fin is

dark throughout its length save for a small white region about halfway between the lower forward spot and the vent.

Forward from this dark region, the whole under side of the fish is white save that in the visceral region there is externally a low inverted \wedge -shaped dark area, and above this a bluish internal discoloration. This bluish tinge is also noticeable under the upper part of the operculum and forward to the region of the eyes. Anterior to the inverted dark \wedge , the dark area covers the pelvic fin, extends along the left side of the throat and runs under the edge of the opercle up onto the base of the right pectoral fin. The bluish region under the dorsal fin in front of the anterior upper spot is due to the fin rays showing through the semi-transparent skin.

Most remarkable of all is the appearance and occurrence of the four spots on the lower, blind, white side. By pushing pins through the center of each spot on the upper surface, we find that, of these lower side spots, the hinder two spots and the anterior dorsal one are almost exactly under their correlative upper ones. The lower anterior one is somewhat smaller than the upper one and is slightly displaced forward. The spots are made up of dark centers and are surrounded by whitish rings.

Finally it may be pointed out that this partially ambicolorate flounder conforms to the rule for partial ambicoloration in heterosomate fishes. This is that, in ambicoloration, unless the whole lower body is colored like the upper and unless about $1/4$ th to $1/3$ rd of the head surface on the blind side is colored, the rotating eye will be found to have gone entirely past the dorsal crest and there will be no hooked anterior dorsal fin. It should be emphasized that to this general law, this specimen entirely conforms. The remarkable thing about this fish is the clear reproduction below of the four upper side spots which give the fish its name.

II.—TWO PARTIALLY AMBICOLORATE SPECIMENS EACH WITH A PARTIALLY ROTATED EYE AND A HOOKED DORSAL FIN

A.—The smaller and less abnormal fish measures "over all" 225 mm. (8.8 in.). Its weight is 71 grams (2.5 oz.). Its history can only be given approximately. It was taken late in March, 1936, by an otter trawler in 50 to 60 fathoms E. \times S. of Chesapeake Lightship.

The upper surface is normal in its general coloration but badly faded. The spots have been almost entirely obliterated. Due to rough handling in the trawl, the scales have been rubbed off and the pigment has

badly faded in the alcohol. In the region of the visceral cavity there is the same bluish discoloration noted in the same region on the preceding fish. The abdomen is much swollen due to a heavy intake of food, and about midway of the base of the dorsal fin just on the anterior upper spot is an injury acquired in capture or handling. These are artifacts not abnormalities. But in the head region there are two anomalies: 1.—The right or rotating eye has barely cleared the dorsal crest—in fact its right or ventral edge is on the dorsal ridge and it is slightly visible from the blind side. 2.—Overhanging this incompletely rotated eye is a short hook in the anterior base of the dorsal fin, perhaps the shortest we have seen. These things are all clearly shown in Fig. 3.

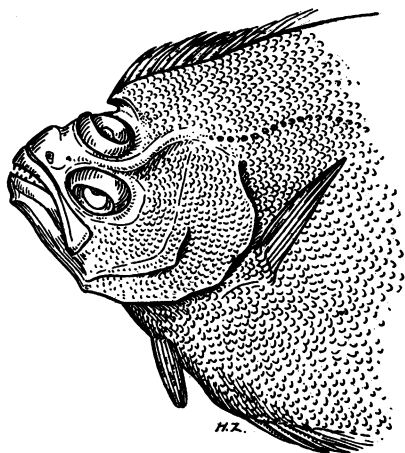


Fig. 3. Head only of the left side of a partially ambicolorate four-spotted flounder (IIA). The rotated eye is barely over the dorsal crest, and the anterior base of the dorsal fin has a small hook.

The lower, right, or blind side of this flounder (Fig. 4) is markedly like that of the other ambicolorate fish (Fig. 2). The tailfin and hinder 2/5ths of the body are dark like that of fish No. I. This dark area extends farther forward above the lateral line than below. The four spots show very plainly on this fish. The anterior dorsal one is completely surrounded by the forwardly extending dark area. The ventral anterior spot is partially enclosed in a peninsula and its outer and lower dark rim in front has an embayment opening into the spot. The forward half of the body and fins is entirely white save a tiny bit of color in the gular region, a small dark patch in front of the base of the pectoral and a small streak extending on the fin from the base back on the center of the fin. There is a faint internal discoloration below and behind the operculum.

The spots on the upper side are badly faded as noted, but those on

the under side are wonderfully clear and sharp. Careful insertion of pins shows that the anterior upper large spot on the lower side is displaced obliquely backward and downward; but the anterior ventral spot is elevated about one-half its diameter above the center of the upper side spot. The hinder spots on the lower side are about squarely under the upper ones and are of about the same size. It is significant that the lower side spots are much clearer than the upper ones.

This fish absolutely violates what Gudger has found in a study of a number of specimens of partially ambicolorate flatfishes and in a review of all the known literature of ambicoloration. With a relatively small

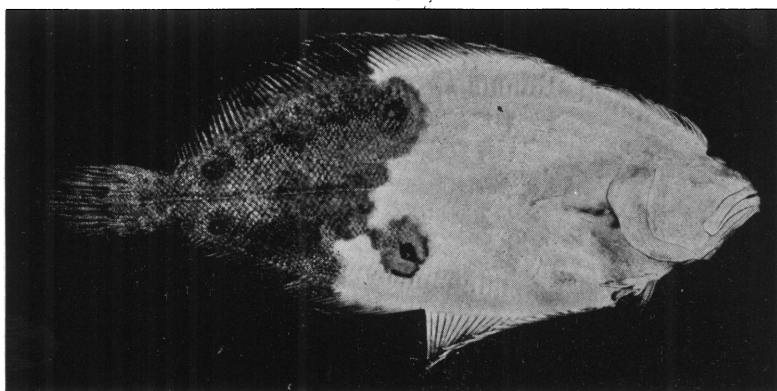


Fig. 4. The blind side of the partially ambicolorate four-spotted flounder (IIA) shown in Fig. 3. Note the spots and other coloration, the hooked dorsal fin and the rotated eye still visible from the lower side.

amount of lower side discoloration covering less than half the under side of the body, the right eye should be completely rotated and the anterior dorsal fin without trace of hook. On the contrary, as Fig. 4 shows, the right eye has stopped so nearly on the dorsal crest that the eyeball is just visible from the right or lower side, and overhanging this is a short hook in the anterior base of the dorsal fin. This hook, strange to say, has a dark point.

B.—The second fish of this division is the most abnormal of the lot as we shall see. From snout to tip of tail it measures 225 mm. (8.9 in.). It weight 71 grams (2.5 oz.). Seen from the upper or colored side the fish is entirely normal save for the lower side or rotated eye which is barely over the dorsal crest (farther over, however, than the rotating

eye in the fish IIA), and for the deep hook of the overhanging anterior dorsal fin (Fig. 5). The upper side has faded to a uniform brownish gray, and the spots have almost disappeared but there is found the same bluish discoloration in the visceral region that has been noted in the other three fish. The point of the hook is darker (Fig. 5) than that found in fish IIA (Fig. 3).

However, when one turns to the lower side (Fig. 6) a most anomalous situation is revealed. The anterior spots, which are so marked on our other two fish, are here lacking. The hinder ones are present but very much faded. By the use of pins, we found that these are squarely under the upper side spots. These spots are embedded in a dark area which extends forward a distance about equal to the length of the tail-fin, which

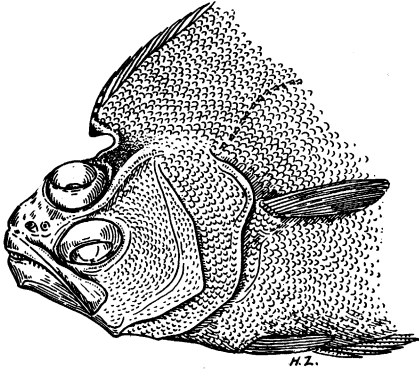


Fig. 5. Head only of left side of a partially ambicolorate four-spotted flounder (IIB). The right eye is farther over and the hook of the dorsal fin larger than are those shown in Fig. 3.

is also colored like the upper side. This colored region has a forward-pointing wedge-shaped area below the lateral line and just in front of it a dark island (not a spot) 7 mm. in diameter. The forward $\frac{3}{5}$ ths of the dorsal fin is white. The anal fin is almost entirely white in its forward half. There is a narrow dark area extending from the tip of the pelvic fin forward over the gular region. There is also a dark area at the base of the pectoral and a tiny elongated spot on the fin. Everywhere else on the lower surface, the fish is white. The body and head from the base of tail to tip of snout is 7 in. long; of this the dark narrow tail region measures 1.5 in., the wider anterior 5.5 in. is the unchanged lower white surface.

That the eye is barely across the dorsal ridge (but farther across than in the preceding fish) is seen when one looks at Fig. 6. And far larger than that shown in Fig. 4 is the hook of the anterior dorsal fin

base. Note that the tip of this is colored. And all these things here accompany a nearly white lower surface of the fish.

With two exceptions, this is the most anomalous ambicolorate flatfish that either of us has seen or handled. The exceptions are two REVERSED almost totally ambicolorate halibuts, and a REVERSED ambicolorate flounder which will be described later. Each of us has handled a fair number of ambicolorate flatfishes and together we have described several. Gudger has studied and described others and has made a survey of all the cases of ambicoloration in the literature of which he has been able to get track—hundreds of fishes in all. Yet in none of these cases (studied in fish or in literature) has there been any case of an eye on or

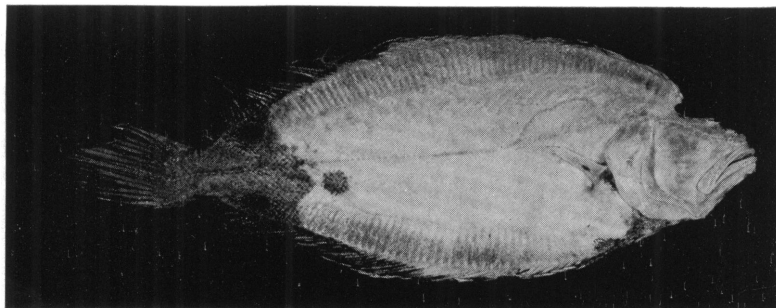


Fig. 6. Lower side of another partially ambicolorate four-spotted flounder (IIB). Despite the small amount of ambicoloration (with two spots only), this fish has the rotated eye still slightly visible, and has a markedly hooked dorsal fin.

close to the dorsal crest with an overhanging or hooked dorsal fin UNLESS the whole under surface of the body proper was colored like the upper and unless AT LEAST $1/4$ th to $1/3$ rd of the under surface of the head was also colored.

For the phenomena found in fishes A and B no explanation can be offered at this time. Later, when the senior author has reviewed all the known cases of partial and complete ambicoloration and has studied the manner in which the eye moves over the dorsal crest, it may be possible to offer some explanation.

HISTORICAL NOTE

We have looked into the literature of the four-spotted flounder, but, save for one brief account now to be given, we have found no reference to anomalies. This is true even of J. R. Norman's 'Monograph

of the Flatfishes' (1934, I, pp. 79-80. London). The sole account is by D. H. Storer, in his 'History of the Fishes of Massachusetts' (1863, Mem. Amer. Acad. Arts and Sciences, VIII, pt. 2, p. 396). He wrote: "I have seen a single specimen [of the four-spotted flounder] having both sides dark-colored—and both bearing the peculiarly marked ocelli—with the exception of the head, which was, as usual, colorless beneath."

This was plainly a simple ambicolorate without any head deformity. This, we judge, because on a preceding page Storer had described and figured a completely ambicolorate "*Platessa oblonga*" with cyclopean eye and hooked dorsal fin. Hence he knew this condition. That this fish was our species is attested by his fine figure of the upper surface of a normal four-spotted flounder.

