

Deep Sea Hatchet Fishes of the Gulf of Mexico

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THE silvery hatchet fishes (family Sternoptychidae) comprise a group of pelagic fishes found throughout the world. The family was recently revised by Schultz (1961, 1964), who published keys to the species and illustrated photophore and spine positions. Parr (1937) gave drawings of the postabdominal spines of the species of *Argyropelecus* occurring in the Gulf of Mexico.

The present paper lists the hatchet fishes known from the Gulf of Mexico (hereafter referred to as the Gulf), with observations on their abundance, geographical and vertical distribution, behavior, and taxonomy. Camera lucida drawings are given of the preopercular spines of all species of *Argyropelecus* collected by us. It is hoped that these, the photographs, and comments will aid in the identification of the Gulf species.

The data given below are based on collections made during four cruises of the Texas A&M research vessel *Alaminos* in 1965 and 1966. Most sampling was done seaward of the continental shelf using a 10 foot Isaacs-Kidd mid-water trawl. On three of the cruises the trawl was fitted with a Benthos depth recorder. On two cruises the cod end was successfully equipped with an opening-closing device modified after Bé (1962). In these cases each trawl consisted of three vertical sampling ranges between the surface and 950 meters. A time activated, electrical opening-closing device attached to the trawl was mostly unsuccessful though it provided several samples from known depths. Some samples taken with the Bongo Net (McGowan and Brown, 1966) in the summer of 1967 were also used.

ANNOTATED LIST OF SPECIES

Seven of the nine species of hatchet fishes already known from the Gulf appear in the *Alaminos* collection. The other two, *Argyropelecus amabilis* listed by Schultz (1961, 1964), and *Polyipnus laternatus* reported by Bullis and Thompson (1965), were not taken in our samples. A tenth species, *Argyropelecus hemigymnus*, was among the most abundant species in our collection but apparently has not been reported previously from the Gulf.

Argyropelecus affinis Garman (Figs. 1A, 3B)

Atlantic Ocean, Caribbean Sea, and possibly Indian Ocean. Gulfwide seaward of the continental shelf.

This species is easily confused with *A. gigas* (Fig. 3C). Shultz

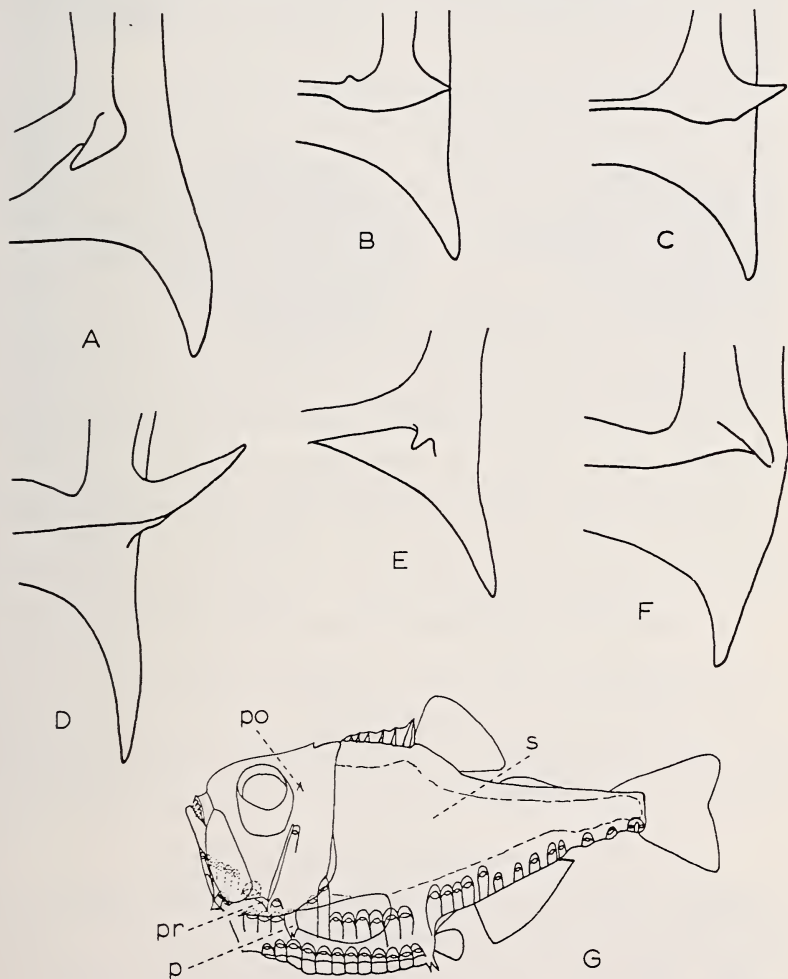


Fig. 1. Preopercular spines: A, *Argyropelecus affinis*; B, *A. olfersi*; C, *A. lynchus lynchus*; D, *A. hemigymnus*; E, *A. gigas*; F, *A. aculeatus*. Morphological features discussed in text as represented in *A. gigas*. (G): p, pectoral shield; po, postorbital spine; pr, preopercular spines; s, position of supra-anal photophore in *Sternoptyx diaphana* (not actually present in *A. gigas*).

(1961, 1964) lists distinguishing characteristics of both. Two of these characteristics, however, can be misleading under certain circumstances. *A. gigas* possesses a postorbital spine (Fig. 1G, po). In the same location *A. affinis* has only a low ridge. The spine is often broken off in *A. gigas* leaving only an apparent ridge. When present, the postorbital spine is best viewed from above or below the fish.

The ventral edge of the pectoral shield (Fig. 1G, p) in *A. affinis* is scalloped but without sharp points, whereas the sharp points are present in *A. gigas*. These points are also frequently broken off, so that absence of the aforementioned spine and points should not be taken as absolute proof that the specimen is *A. affinis*.

Argyrolepecus gigas Norman (Figs. 1E, 3C)

Atlantic Ocean. It is probably Gulfwide seaward of the continental shelf.

A. gigas was first reported from the Gulf off the Mississippi Delta (28° 58'N, 88° 00'W) and north of Yucatán (25° 58'N, 88° 00'W) by Grey 1956). Since then the only specimens from the Gulf have been taken by us in the Campeche Gulf (20° 52'N, 96° 15'W) and off the Mississippi Delta (27° 15'N, 88° 59'W).

Argyrolepecus hemigymnus Cocco (Figs. 1D, 2A)

Atlantic Ocean. Gulfwide in abundance seaward of the continental shelf.

To our knowledge this is the first report of this species in the Gulf. This is remarkable in view of the fact that it is quite abundant in our collection.

Argyrolepecus amabilis Ogilby

Atlantic, Pacific and Indian oceans to a depth of 1,000 meters and perhaps over 2,000 meters. Eastern Gulf.

This species is reported from the Florida Straits (23° 23'N, 80° 36'W) by Schultz (1961) and from the Gulf off north Florida (25° 12'N, 84° 05'W) by Springer and Bullis (1956). It is possibly only transient in the Gulf, following the Gulf Loop Current which enters through the Straits of Yucatan and often extends

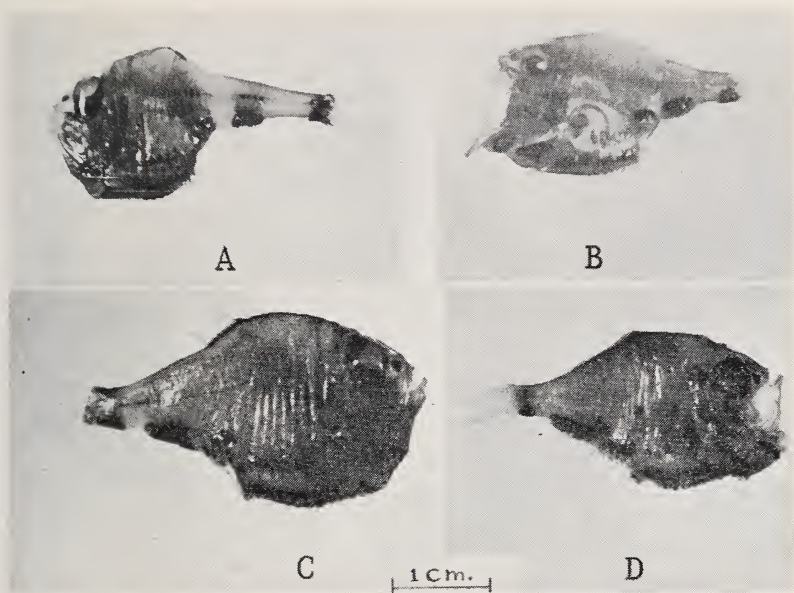


Fig. 2. A, *Argyropelecus hemigymnus*; B, *A. olfersi*; C, *A. lynchus lynchus*; D, *Polyipnus asteroides*. In Fig. 2B, note the bubble that formed in the abdominal cavity when the swim bladder ruptured during ascent of the trawl.

almost to the Mississippi Delta before turning south and leaving through the Florida Straits. Even though we sampled the Eastern Gulf extensively no specimens of *A. amabilis* were encountered.

Argyropelecus aculeatus Cuvier and Valenciennes
(Figs. 1F, 3D)

Abundant in Atlantic, Pacific, and Indian oceans. Abundant and Gulfwide seaward of the continental shelf.

Argyropelecus olfersi Cuvier (Figs. 1B, 2B)

Atlantic, Pacific and Indian oceans, Caribbean Sea. Gulfwide seaward of the continental shelf; rare.

Reported from Cuban waters by Rivero (1934, 1936), but the exact locations are unclear. Our specimens come from the following locations: Florida Straits ($24^{\circ} 05'N$, $83^{\circ} 03'W$), north of Yucatan ($25^{\circ} 28'N$, $86^{\circ} 16'W$), and the Campeche Gulf ($20^{\circ} 45'N$, $95^{\circ} 15'W$).

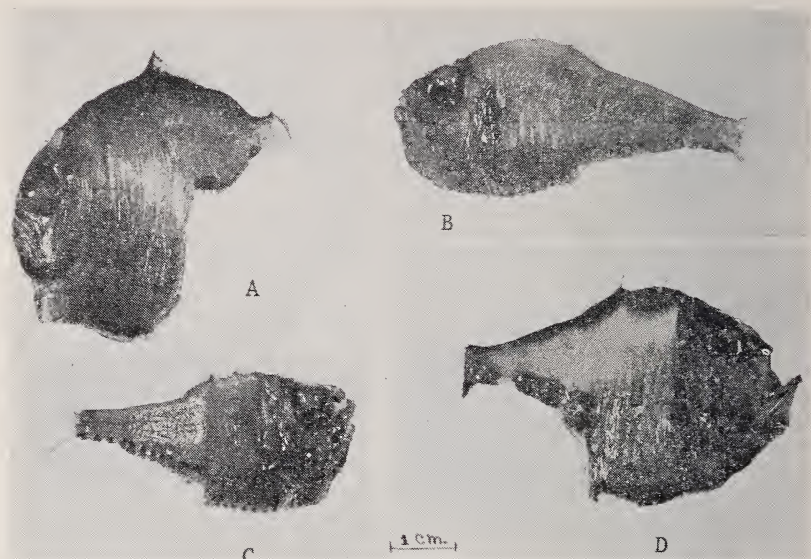


Fig. 3. A, *Sternoptyx diaphana*; B, *Argyropelecus affinis*; C, *gigas*; D, *A. aculeatus*.

Argyropelecus lynchus lynchus Garman (Figs. 1C, 2C)

Eastern Pacific and Atlantic Oceans, Caribbean Sea. Gulfwide seaward of the continental shelf.

Sternoptyx diaphana Hermann (Fig. 3A)

Atlantic and Pacific oceans. Abundant and Gulfwide seaward of the continental shelf.

Our specimens may be divided into two groups, one having the supra-anal photophore highly elevated dorsally, (Fig. 1G, s) and the other having it only slightly dorsal to the level of the anal photophores. Dissection showed this not to be a case of sexual dimorphism, nor does it show any correlation with the location of capture. Examination of the ovaries of nine females showed all the eggs to be of similar size, indicating a short spawning period rather than continual spawning throughout the year.

Polyipnus asteroides Schultz (Fig. 2D)

Western Atlantic Ocean and Caribbean Sea. Although we have taken no specimens from the southern Campeche Gulf, this species is probably Gulfwide seaward of the continental shelf.

All of our preserved specimens of this species have been found to contain large amounts of an oily substance which dissection has shown to be present in the coelomic cavity. An analysis performed by C. R. Arnold of our department's Chemical Oceanography division indicates that it is a phospholipid. No such substance was observed in any other species examined. Similar fatty material is reported to surround the swim bladders of a number of related fishes (Marshall, 1960).

Polyipnus laternatus Garman

Western North Atlantic Ocean and Caribbean Sea. Eastern Gulf.

Schultz (1964) considers all references to *P. spinosus* in the Atlantic Ocean to refer to *P. laternatus*. Thus the report of *P. spinosus* from the waters off Cuba by Rivero (1936) is assumed to be incorrect. Bullis and Thompson (1965) report *P. laternatus* from the Gulf off the Mississippi Delta (28° 55'N, 88° 00'W) and the Florida Straits (24° 28'N, 83° 29'W). Schultz (1964) reports this species from ten stations in the Florida Straits. As in the case of *Argyropelecus amabilis*, *P. laternatus* may be only transient in the Gulf. It is not represented in our collections.

This species is most often reported from depths of 440 to 2,200 meters.

VERTICAL DISTRIBUTION AND ABUNDANCE

Marshall (1951), Capen (1967), and others have discussed the role of small pelagic fishes in producing sound scattering layers commonly found in the oceans. Our data support the contention of Tucker (1951) that the scattering layers above approximately 200 meters are associated with invertebrates rather than fish. He correlates fish with deeper scattering layers.

Table 1 shows a definite scarcity of hatchet fishes above 175 meters. Other small fishes were equally scarce. During trawling, all scattering layers detected by the ship's Precision Depth Recorder were above 200 meters. The major distribution of hatchet fishes lies below this depth. It appears, therefore, that these fishes are in no way related to the scattering layers in the Gulf of Mexico above 200 meters.

Although our observations are few and scattered, some apparent

TABLE 1

Results of trawls made above 200 meters in relation to sound scattering layers

Maximum Depth of Tow meters	Duration of Tow minutes	Local Time of Day	Number of Hatchet Fishes	Scattering Layer Depth meters
50	66	1654-1800	0	SFC., 75 and 200
100	80	0725-0845	0	None
125	42	0005-0047	0	SFC.
135	15	1850-1905	1	SFC. and 35
150	29	2226-2255	2	None
150	95	1345-1520	0	SFC. and 75
175	250	2000-0010	0	SFC. to 90
175	218	1138-1500	0	110

trends in the data presented in Tables 2 and 3 may be pointed out. The greatest population densities for the species captured by us appear to occur between the following depths in the Gulf: *Argyropelecus affinis*, 200-800 meters; *A. gigas*, 500-1,000 meters; *A. hemigymnus*, 250-1,500 meters; *A. aculeatus*, 250-1,000 meters; *A. olfersi*, 200-800 meters; *A. lynchus lynchus* above 1,000 meters; *Sternoptyx diaphana* 500-1,500 meters; and *Polyipnus asteroides*, 200-1,000 meters. More individuals were encountered between 500 and 1,000 meters due primarily to the abundance of *Sternoptyx diaphana* there.

A reverse diurnal migratory pattern involving ascent during the day and descent at night is suggested for *Sternoptyx diaphana*, one of the deeper living species. Most vertical migrators in the sea, including other members of the Sternoptychidae migrate upward at night and downward during the day. The figures hint that *Argyropelecus hemigymnus* may also possess a reverse diurnal migration.

The relative abundance of specimens caught in all trawls was as follows: 423 *S. diaphana*, 74 *A. aculeatus*, 61 *A. hemigymnus*, 31 *A. lynchus lynchus*, 13 *P. asteroides*, 13 *A. affinis*, 5 *A. gigas*, and 5 *A. olfersi*.

Hatchet fishes may have a tendency to school, at least in the juvenile stage. If this is true, the implications of the data in

TABLE 2
Numbers of fish caught per hour without opening-closing device

Depths of Trawls (meters)	Hours	50- 175	250- 375	600- 750	825- 1000	1200- 1400	1875	2150- 2525	2575- 2900
	D*	4.8	1.9	3.8	5.5	2.9	10.4	24.8	33.0
trawling time	N†	1.9	6.4	5.9	10.3	11.7	—	—	—
<i>Argyroleleucus</i>	D	—	0.5	0.3	—	0.3	—	0.1	—
<i>affinis</i>	N	—	—	1.4	—	—	—	—	—
A.	D	—	—	—	—	—	—	0.1	—
<i>gigas</i>	N	—	—	—	—	0.1	—	—	—
A.	D	—	4.8	0.5	0.5	—	0.3	—	0.2
<i>hemigymnus</i>	N	—	—	1.4	0.7	1.3	—	—	—
A.	D	—	1.1	0.8	1.5	0.3	0.4	0.2	0.1
<i>aculeatus</i>	N	0.5	2.1	1.9	0.2	0.4	—	—	—
A.	D	—	—	—	—	—	0.1	0.1	—
<i>offersi</i>	N	—	—	0.2	—	—	—	—	—
A.	D	—	—	0.3	0.9	0.3	0.1	0.1	0.1
<i>lynchus</i>	N	1.0	—	0.5	0.3	0.3	—	—	—
<i>Sternoptyx</i>	D	—	0.5	8.0	4.3	7.5	1.2	1.2	0.7
<i>diaphana</i>	N	—	—	1.2	14.2	7.5	—	—	—
<i>Polyipnus</i>	D	—	—	—	0.2	—	—	—	—
<i>asteroides</i>	N	—	—	0.7	0.1	0.4	—	—	—
All	D	—	6.9	10.1	7.4	8.6	2.0	1.7	1.0
species	N	1.6	2.0	10.1	15.5	10.1	—	—	—

*D, Day

†N, Night

TABLE 3
Numbers of fish caught per hour using opening-closing device

Depth range (meters)		0-175	175-500	500-900
Hours	D*	4.8	3.0	0.8
trawling time	N†	1.9	4.4	2.4
<i>Argyrolepecus affinis</i>	D	—	—	—
	N	—	0.2	—
A. <i>gigas</i>	D	—	—	1.2
	N	—	—	—
A. <i>hemigymnus</i>	D	—	1.0	—
	N	—	1.1	—
A. <i>aculeatus</i>	D	—	3.3	2.4
	N	0.5	1.8	—
A. <i>olfersi</i>	D	—	—	—
	N	—	0.5	—
A. <i>lynchus</i>	D	—	—	—
<i>lynchus</i>	N	1.0	1.8	—
<i>Sternoptyx diaphana</i>	D	—	2.0	8.4
	N	—	0.2	6.8
<i>Polyipnus asteroides</i>	D	—	0.3	—
	N	—	0.2	—
All species	D	—	5.7	12.0
	N	1.6	6.0	6.8

*D, Day

†N, Night

Tables 2 and 3 become somewhat less reliable than they already are. One trawl of four hours duration caught 74 juvenile and 40 adults of *Sternoptyx diaphana*. Such high numbers may result from the capture of a school of fish.

Schooling is suggested by samples taken for the *Alaminos* with the Bongo Net (McGowan and Brown, 1966), a device having two half-meter plankton nets mounted side by side with opening-closing capabilities. One tow at 750 meters for 15 minutes caught two juveniles of *S. diaphana*, standard lengths of 2 cm. and 1.3 cm.,

in one net and one juvenile of the same species, 0.8 cm., in the other. Another tow at 400 meters caught one juvenile of *Argyropelecus lynchus lynchus*, 1.5 cm., in one net, and another, 0.8 cm., in the other. The two other Bongo Net tows made below 200 meters caught no hatchet fishes at all. The fact that the juveniles captured during these short tows were of one species for any one tow seems to suggest some degree of gregariousness in juveniles.

CONCLUSIONS

Ten species of deep-sea hatchet fishes are known from the Gulf of Mexico. These represent nearly half of the known species in this family. We have divided the ten into two groups. Eight are resident species distributed Gulfwide; the second group is comprised of two species, *Argyropelecus amabilis* and *Polyipnus later-natus*, that may be transients, riding the Gulf Loop Current in and out of the Eastern Gulf.

Hatchet fishes appear not to be associated with the sound scattering layers above 200 meters in the Gulf of Mexico.

The data suggest ascent at night and descent during the day for *Argyropelecus aculeatus* and most other members of the family. The reverse is suggested for *Sternoptyx diaphana* and possibly *A. hemigymnus*, both of which tend to inhabit the somewhat deeper layers. This apparent reversal warrants further, more orderly investigation since it may relate directly to the fishes' feeding habits and to the basic mechanisms of downward transfer of energy in the sea.

In the Gulf, the major depth distribution for the family lies between 250 and 1,500 meters. Records given in the literature of much deeper catches, up to 5,000 meters, in other locales may have resulted from captures during descent or ascent of the nets and need confirmation through the use of opening-closing devices.

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