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Robert L. Shipp
University of South Alabama

Thomas S. Hopkins
Dauphin Island Sea Lab

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PHYSICAL AND BIOLOGICAL OBSERVATIONS
OF THE NORTHERN RIM OF THE DE SOTO CANYON
MADE FROM A RESEARCH SUBMERSIBLE¹

Robert L. Shipp
Department of Biological Sciences
University of South Alabama
Mobile, AL 36688
and

Thomas S. Hopkins
University of Alabama
Dauphin Island Sea Lab
Dauphin Island, AL 36528

ABSTRACT: During June 1978, the research submersible DIAPHUS completed 27 dives in the north central Gulf of Mexico. Fourteen of these were concentrated on and around the high relief, northern ledge or rim of the De Soto Canyon, located at depths of 50-60 m, and approximately 25 km S of Navarre, Florida.

The ledge is composed of limestone outcroppings. The invertebrate fauna is characterized as two principle assemblages, one associated with a sand-shell-coraline-algae slope and the other with a limestone block ledge. The ichthyofauna is dominated by deep water reef species, thirty of which are identified and their habitat and abundance described.

In recent years, research submersibles have occasionally been used for prolonged observations at depths beyond the limitations of SCUBA. Bright and Pequagnat (1974) used submersible observations to supplement their data on the Flower Garden Banks fauna in the northwestern Gulf of Mexico. Similarly, Avant *et al.* (1977) used a submersible to document the biota off the central eastern Florida coast. The data reported herein are the first such for the north central Gulf of Mexico.

During June 1978, the research submersible (R/S) DIAPHUS was leased to the U. S. National Sea Grant for purposes of investigating slipper lobster (*Scyllarides nodifer*) populations in the north central Gulf of Mexico. A prime area for assessment was the irregular northern ledge of the De Soto Canyon (Fig. 1) from which area slipper lobsters

had been trawled during a previous trawling survey led by one of us (RLS).

Although the northern rim of the De Soto Canyon has been the focal point of several investigations (Ludwick and Walton, 1957; Moe, 1963; Nester, 1978) its depth (54-60 meters) has precluded direct observations by SCUBA with the exception of some undocumented personal communications. Foremost among trained personnel who reportedly have viewed the structures is Dr. James I. Jones, presently director of the Mississippi/Alabama Sea Grant Consortium, and field leader of several dives to the area by marine scientists from Florida State University. In addition, the RUFUS program of the National Marine Fisheries Service has recorded some portions of the canyon on videotape.

MATERIALS AND METHODS

The R/S DIAPHUS is a five metric ton, self contained research submersible cap-

¹Contribution no. 024 from the Dauphin Island Sea Lab.

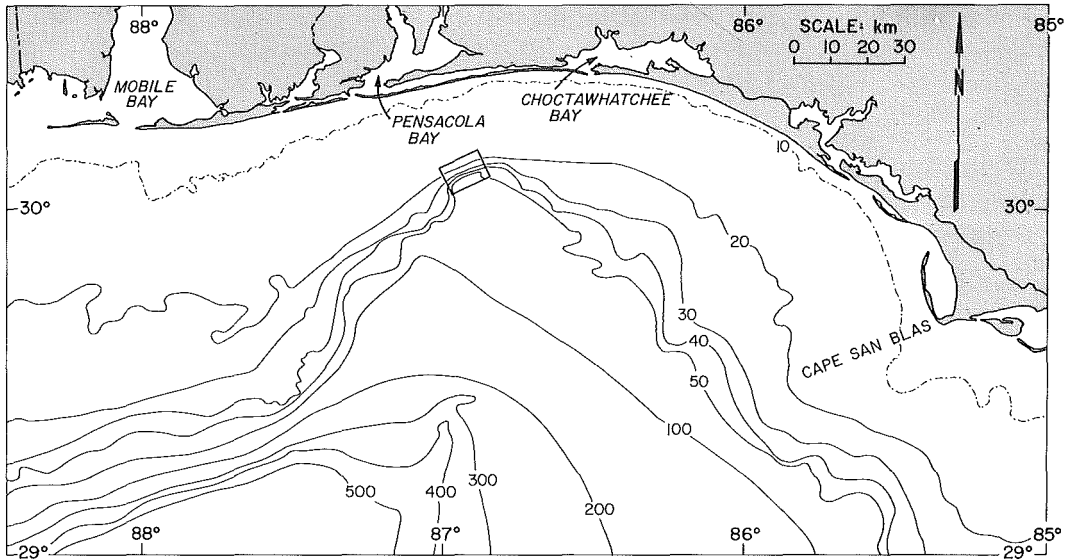


Figure 1. North central Gulf of Mexico, with the study area, traversed by the northern rim of the De Soto Canyon, indicated by rectangle. Chart depths in fathoms.

able of diving to approximately 400 m. It is battery powered and capable of a forward speed of 2 km/hour; it carries one observer and a pilot. The observer is positioned in the forward area, and views through the hemispherical anterior port (Fig. 2).

A total of 27 dives were made in R/S DIAPHUS, representing 67.5 man

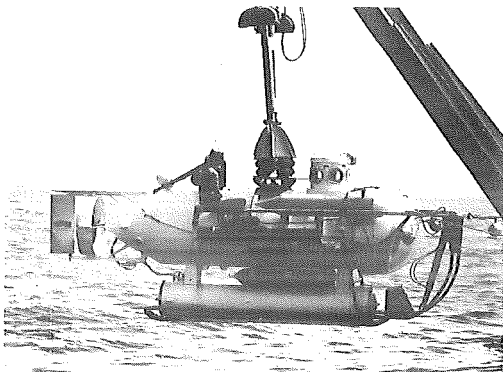


Figure 2. Research submersible DIAPHUS. Note anterior viewport, through which observations are made.

hours. Of these, 11 were over relatively uniform mud/shell hash areas approximately 50 km SSW of Dauphin Island, Alabama. Two dives were in sand/shell hash areas 20 km SSW of Destin, Florida. The remaining 14 dives, the subject of this report, were along the northern rim of the De Soto Canyon, a well defined high relief area, located in approximately 55 m depths. This region extends from about 25 km S of Navarre, Florida west south westerly for about 25 km. The relief is sufficient to be easily detected with inexpensive fathometers and thus is heavily fished by sport and commercial fishermen. There is considerable evidence of fishing pressure as evidenced by fishing lures, lines, weights, plastic utensils, and beverage cans.

Diurnal, crepuscular, and nocturnal dives, usually of about three hours duration, were made on the canyon rim from 27 to 30 June, 1978. During diving operations data were recorded on audio tape, black and white videotape, 8 mm

color motion pictures, and 35 mm still color photos. Although the submersible was equipped with three external, 250 watt lights, these frequently failed; consequently artificial light was sporadic and of varying intensity. Thus, especially during daylight dives, ambient light was the principal light source. Clear skies and seas of less than 1 m characterized meteorological conditions allowing good visibility and enhancing the quality of the photographic record.

GENERAL OBSERVATIONS

The northern rim of the De Soto Canyon is composed of continuous ridges of granular limestone outcroppings, oriented from ENE to WSW, encrusted with biota representing numerous invertebrate taxa. The observed segments were composed of one to three ridges, each of which was bordered by sandy flats. The ridges were approximately 20 m wide, but sometimes narrower in segments where multiple ridges comprised the rim. In these ridge segments, the intervening sand zones were about equal width with the ridges.

Relief of the ridges varied from barely detectable along the northeast segment to nearly 10 m along the southwestern extremity of the canyon rim. Fathometer traces further to the southwest indicate the ridges become discontinuous, but form numerous "spire-like" ledges of high (10-15 m) relief.

Rectangular blocks of granular limestone (planer dimensions from $\frac{1}{2}$ to 3 m) form the substrate which comprises the ridges. The joints between blocks varied from hairline separations to a width of several cm. The joint angles were remarkably close to 90° , and series of blocks were frequently so uniform in size and arrangement as to appear as

artifacts. More detailed geological analysis must await further investigation.

The southern face of the southern ridge had the highest relief, and appeared to support the most diverse biota. When viewed from the south, this area rises abruptly from the surrounding sand, with few or no preceding boulders. The northern face rises more gradually, and surrounding sand would appear to respond to local currents by moving up and down the barely emergent limestone boulders along this zone (Fig. 3).

Along the area of the rim explored there was circumstantial evidence which suggests localized current regimes; in some areas, the echinoderm *Clypeaster* sp. (a flat sand dwelling echinoid) was found on edge in cracks or crevices and in others there were unusually turbid zones accompanied by a reduced invertebrate and fish community. During one dive, such a region measured close to a kilometer along the 54 meter contour.

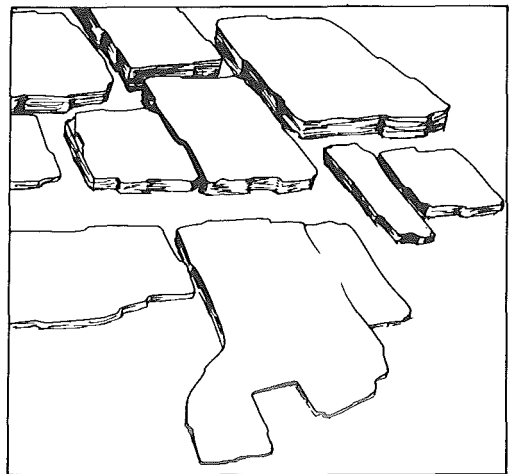


Figure 3. Illustrator's reconstruction of videotape record of the north margin of reef structure. Note variation in joint widths between granular limestone blocks, and gradual inclination of ledge toward the south.

INVERTEBRATE FAUNA

The observations of the invertebrate fauna are divided according to substrate: (a) the sand-shell-coraline-algae slope immediately above and below the block ridges of limestone, and (b) the block substrate of the ridges.

a) The sand-shell-coraline-algae slope: Two distinct forms of attached pennatulaceid coelenterates were encountered along with *Renilla* sp., decapod crustaceans, (*Calappa flammea*, *Calappa sulcata*, *Sicyonia* sp., and *Scyllarus* sp.), and the asteroid echinoderms *Astropecten articulatus*, *Luidia clathrata*, *Narcissia trigonias*, *Linckia nodosa*, *Goniaster tessellatus*, and the echinoid *Clypeaster* sp. Additionally there was evidence of bioturbation by worms and molluscs not directly observed.

b) The block-like substrate: The rocky ridges were colonized by sponges (limited in diversity and quantity), the scleractinian *Oculina diffusa*, the octocorallinas *Lophogorgia cardinalis*, and *L. hebes*, along with a solitary antipatherian (*Antipathes* sp.?). Hydroids were present but not common. Prominent among the rock inhabiting decapod crustacea were the majid crabs *Mithrax* sp., *Stenocionops furcata*, and *Stenorhynchus* sp. and *Syccarides nodifer* (Fig. 4). Less conspicuous decapods were the hermit crabs *Dardanus* sp. and *Petrochirus diogenes*. The only molluscs positively observed were the gastropods *Fasciolaria* sp. (whelk) and *Scaphella* sp. Echinoderms observed on and between portions of this substrate include the chinoids *Arbacia puntulata*, *Diadema antillarum*, *Eucidaris tribuloides*, *Lytechinus variegatus* and occasionally a misplaced number of *Clypeaster* sp. The holothuroid, *Isostichopus badionotus* was frequently in

evidence. Ophiuroids of note were *Astrophyton muricatum* on *Oculina* and *Astroporpa annulata* on the solitary antipatherian. Particularly of note was a sighting of large pink-red *Ophioderma* which we suspect might be *Ophioderma pallidum*.

ICHTHYOFAUNA

The fish fauna associated with the rim of the De Soto Canyon was dominated by families characteristic of Caribbean

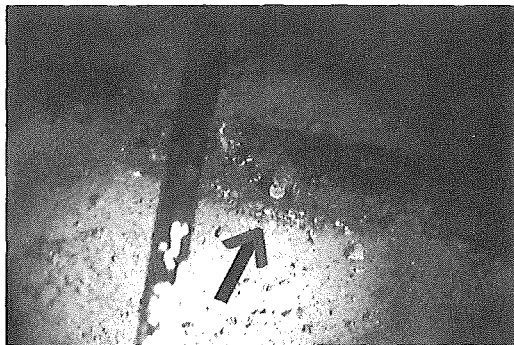


Figure 4. *Scyllarides nodifer* partially concealed between blocks of limestone, 55m.

reefs, but some species of which are poorly known. Sea basses (Serranidae) and damselfishes (Pomacentridae) comprised the most visibly abundant components, but the cardinal fishes (Apo-gonidae) butterflyfishes (Chaetodontidae), bigeyes (Priacanthidae), drums (Sciaenidae), squirrelfishes (Holocentridae), and snappers (Lutjanidae) also were present in larger numbers (Table 1). Other families, especially grunts (Pomadasyidae) and porgies (Sparidae) were represented by sporadic sightings of other less frequently observed species.

Muraenidae. The reticulate moray, *Muraena retifer*, was observed and videotaped on several occasions, with its anterior portion projecting from

Table 1. Fishes inhabiting the vicinity of the northern rim of the DeSoto Canyon, identified from the research submersible *diaphus*.

Muraenidae <i>Muraena retifer</i>	Apogonidae <i>Apogon pseudomaculatus</i>
Scorpaenidae <i>Scorpaena brasiliensis</i>	Sciaenidae <i>Equetus umbrosus</i> <i>E. sp.</i>
Antennariidae <i>Antennarius radiosus</i>	Chaetodontidae <i>Chaetodon aya</i> <i>C. sedentarius</i> <i>C. ocellatus</i> <i>Holacanthus bermudensis</i> <i>H. ciliaris</i>
Priacanthidae <i>Priacanthus arenatus</i> <i>Pristigenys alta</i>	Pomacentridae <i>Chromis scotti</i> <i>C. enchrysurus</i>
Grammistidae <i>Rypticus maculatus</i>	Labridae <i>Bodianus pulchellus</i>
Holocentridae <i>Adioryx bullisi</i> <i>Ostichthys trachypomus</i>	Tetraodontidae <i>Sphoeroides spengleri</i>
Serranidae <i>Mycteroperca sp.</i> <i>Serranus phoebe</i> <i>Centropristis ocyurus</i> <i>Liopropoma eukrines</i> <i>Paranthias furcifer</i> <i>Anthias nicholsi</i> <i>Hemanthias sp.</i>	Diodontidae <i>Chilomycterus schoepfi</i>
Rachycentridae <i>Rachycentron canadum</i>	Batrachoididae <i>Opsanus pardus</i>

under ledges. It was the only muraenid observed from the ledges proper, although the blackedge moray, *Gymnothorax nigromarginatus*, is abundant in adjacent mud/sand and rubble areas. Two large *M. retifer* (554 and 800 mm standard length) were taken in lobster traps from the ledges subsequent to the R/S DIAPHUS operation.

Batrachoididae. One or two leopard toadfish, *Opsanus pardus* were observed on each of several dives. These lay singly in partially protected crevices.

Antennariidae. *Antennarius radiosus*, the singlespot frogfish, was recorded once from the ridge areas. Like the barbfish, (see below) the singlespot frogfish exhibits extremely effective camouflage, and may have been more numerous.

Holocentridae. Two species of squirrelfishes, the deepwater squirrelfish, *Adioryx bullisi* and the bigeye soldierfish, *Ostichthys trachypomus* were observed. *A. bullisi* was noted during most dives, regardless of time of day. *O. trachypomus*, however, became active at dusk, usually by emerging from cavities

or spaces within *Oculina* clusters.

Serranidae. Serranids were the dominant fish family of the rim region. Areas of heavy *Oculina* (Fig. 5) were surrounded by dense aggregations of *Hemanthias* sp. representing all size classes from juveniles to adults. The tattler, *Serranus phoebe* was also frequently seen in these areas, but singly or in small (2 to 5 individuals) aggregates. Numerous *Anthias nicholsi* (Fig. 6) hovered singly over *Oculina* clumps as well as over larger boulders. The wrasse bass, *Liopropoma eukrines*, was frequently sighted, but also singly. This species appeared to prefer deeper crevices between large blocks, and individuals rarely ventured more than about a meter from such preferred loci; prolonged observations indicated strong territorial behavior. The bank seabass, *Centropristis ocyurus*, was abundant, and individuals appeared to prefer resting on bottom or within crevices, and rarely were observed to move more than a few centimeters. *Mycteroperca* sp. was abundant and frequently observed in small (2 to 5 individuals) schools cruising above the reef area. None was observed at rest on bottom. A single creole-fish, *Paranthias furcifer*, was noted and confirmed on subsequent examination of videotape. Numerous other species of serranids, mostly juveniles, were observed but unidentifiable, including numerous sightings of xanthochromic individuals.

Grammistidae. The whitespotted soapfish, *Rypticus maculatus*, was frequently observed cowering in sheltered areas. No specimens of the freckled soapfish, *R. bistrispinus* were seen, although this species was captured frequently in adjacent areas of less relief.

Priacanthidae. The bigeye, *Priacanthus arenatus* and short bigeye *Pristigenys*



Figure 5. Cluster of *Oculina* characteristic of much of the reef habitat. Several fish species are in evidence including aggregations of *Hemanthias* sp.

alta, were recorded on every dive. They were positioned just above the bottom, and hovered in one location. None was observed to congregate or school, and their spacing over the reef area indicated possible territorial behavior.

Apogonidae. The two spot cardinalfish, *Apogon pseudomaculatus*, was the only apogonid observed during the dives, and these sightings were most frequent around *Oculina* during crepuscular and nocturnal periods.

Rachycentridae. A single large (> 1m) cobia, *Rachycentron canadum*, was observed about 2 m above the reef area moving rapidly above the rim. Such movements are rarely seen for this species, which is usually observed near the surface, in the vicinity of sharks or large floating objects.

Lutjanidae. *Lutjanus campechanus* was the only snapper observed on the reef areas; however many small groups of large individuals, some estimated in excess of 10 kg were noted. Despite the heavy fishing pressure on this region indicated by numerous sightings of lost angling gear and anchors, red snapper and grouper still are present in abundance.

Sciaenidae. *Equetus umbrosus*, the

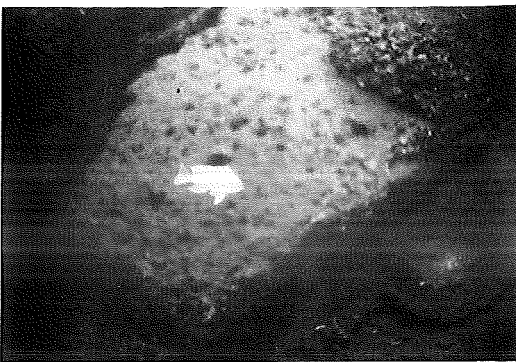


Figure 6. *Anthias nicholsi* hovering over a large granular limestone block, estimated to be approximately 1.5 m across.

cubbyu, and an undescribed species of *Equetus* were seen several times on most dives, occurring in small isolated schools of 4 or less. Only adults were observed. Although *E. lanceolatus*, the jackknife fish, is one of the most frequently captured sciaenid species in trawl samples from the region, it was not observed from the submersible.

Chaetodontidae. Three butterfly fishes (the bank butterflyfish, *Chaetodon aya*, the reef butterflyfish *C. sedentarius*, and the spotfin butterflyfish *C. ocellatus*) and two angelfishes, the blue angelfish, *Holacanthus bermudensis* and the queen angelfish *H. eiliaris* represented this family. *C. aya* was the most abundant species of the genus with numerous sightings on every dive. Occurrences were most frequently as adult pairs, with individuals often exhibiting display behavior toward each other (Fig. 7). The other two *Chaetodon* spp. were also usually in pairs, with *C. sedentarius* the more abundant. *H. bermudensis* appeared near equal in abundance to *C. aya*, and was the only species of the family where both juveniles and adults were observed. Only a single *H. ciliaris* was positively identified, but many specimens of the genus were not able to be diagnosed to species.

Pomacentridae. The purple reef fish, *Chromis scotti* and the yellowtail reef fish, *C. enchrysurus* were both abundant species, represented by all size classes. *C. scotti* remained closely positioned to the rocky substrate, and was less evident due to its uniform pigmentation. *C. enchrysurus* was evident in large schools (20-40 individuals), usually about one-half to one meter above the substrate, and clearly visible from the submersible due to the strong countershading of this species.

Labridae. The spotfin hogfish, *Bod-*



Figure 7. *Chaetodon aya*, demonstrating the interaction frequently observed by individuals of this species.

ianus pulchellus, was the only labrid positively identified from the submersible in the immediate reef area. Aggregates of 3 to 5 individuals were observed nearly continually from the submersible. This species has not been taken during the aforementioned trawling operation; however, its unique pigmentation pattern (documented by numerous color photos) leaves no doubt as to its identity.

Scorpaenidae. Although well camouflaged against encrusted materials, at least two large (>250 mm) barbfish, *Scorpaena brasiliensis* were noted.

Tetraodontidae. The bandtailed puffer, *Sphoeroides spengleri* was observed resting on the substrate during several

dives.

Diodontidae. The striped burrfish, *Chilomycterus schoepfi* went unnoticed during diving operations. However, when 35 mm slides were studied subsequently, 2 specimens were distinguishable, resting well camouflaged on the substrate adjacent to *Oculina* growths.

DISCUSSION OF ICHTHYOFAUNA

Prolonged observations of deepwater reef fishes have been few and of short duration. Observations of significant duration have been accomplished by means of habitat associated saturation SCUBA operations, but these have