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EXPLORATORY FISHING FOR SPINY LOBSTERS, SAND LOBSTERS, AND SCALLOPS IN PANAMA

By Norman L. Pease*

SUMMARY

An interagency agreement between the U. S. Bureau of Commercial Fisheries and the Agency for International Development provided for a survey of the spiny lobster potential on the coasts of the Republic of Panama. This was conducted for an 18-month period with the chartered vessel Pelican, and staffed from the Bureau's Exploratory Fishing and Gear Research Base at Pascagoula, Miss.

Lobster traps were selected for use during the exploratory phase owing to their versatility, which enabled several scattered areas to be worked simultaneously. Three types of traps were used: wire, wood, and reed.

Wood traps were the most successful, and were better able to withstand the rough handling experienced during fishing operations. Up to 200 traps a day could be hauled and reset during exploratory work. A variety of locally caught bait was used with no strong preference being indicated by the catch results. Decomposed bait and eel pieces did not prove effective.

Exploratory fishing revealed three areas with good commercial lobster fishing potential: 1 Caribbean area, Bocas del Toro; and 2 Pacific areas, Gulf of Panama and Gulf of Chiriqui coast. Commercial quantities of two species of spring lobsters and one species of sand lobster were caught in those areas. The sand lobster could be caught only by trawling.

The male Pacific spiny lobster was found to be predominant in the trap catch while the female lobster was predominant in the trawl catch. Data from the catch of the female Pacific spiny lobster revealed that gravid females were more abundant in the trawl catch than the non-gravid, whereas in the traps, the ratio of gravid females was slightly less than the non-gravid. The trawling was done offshore and probably influenced the catch ratio because the swimming females seek areas with favorable offshore flowing currents to disperse the larvae.

A bay scallop with commercial potential was found in the Gulf of Panama. Within 2 months, over 400 people afloat and ashore were employed catching and processing scallops.

*Senior Biologist (General), Exploratory Fishing and Gear Research Base, U.S. Bureau of Commercial Fisheries, Pascagoula, Miss.



Fig. 1 - R/V Pelican approaching a flag buoy which marks a lobster trap location.

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INTRODUCTION

In 1961, local fishermen were exploring with modern techniques and equipment only two of the natural marine resources of the Republic of Panama. These were shrimp and sardine like fish. Most food fish consumed within Panama was still being taken with hand lines; a small number were taken incidental to the shrimp fishery; and there was some beach seining. For many years an important pearl oyster and pearl-oyster shell fishery flourished along the Pacific coast. That fishery started declining after 1925 (Galtsoff 1948); it has now been defunct for more than 25 years. Approximately 25 percent of the 886 miles of the Pacific coastline of Panama was being used in established fisheries. The 489 miles of its Caribbean coastline were almost completely undeveloped. Only a small amount of food fish was caught (for personal consumption) along that sparsely settled coast. Several years ago a fishing cooperative was established at a small coastal community in the Gulf of Panama. That cooperative is attempting to introduce new fishing methods and fish-handling techniques.

It was with this background that the U. S. Agency for International Development (AID) requested the U. S. Bureau of Commercial Fisheries to study the feasibility of developing new fisheries in Panama. The resultant report indicated possibilities that two resources, sharks and spiny lobsters, might be developed.^{1/} One recommendation in the report was that an exploratory fishing survey be made to determine the spiny lobster resources of the Caribbean and Pacific coasts of Panama. That suggestion was approved, and the Bureau and AID negotiated an interagency agreement for the survey. The initial agreement was extended so that the entire survey was conducted for an 18-month period from July 1962 to December 1963. The responsibility for the survey was assigned to the U. S. Bureau of Commercial Fisheries Exploratory Fishing and Gear Research staff located in Pascagoula, Miss.

VESSEL AND EQUIPMENT

A 72-foot, steel-hulled shrimp trawler, Pelican, was chartered by the Bureau for use during the survey (fig. 1). Some modifications were made to the vessel, and some additional equipment was installed--a flying bridge equipped with steering and engine controls, new davits on the stern for carrying a skiff, and air conditioning units for the living quarters. A hydraulically-operated boom and power block were installed amidships at the port rail for use as a trap hauler. Additional electronic equipment was installed as follows: radar, loran, single-side band and citizen-band radio transmitter-receivers, radio direction finder, and two depth-recorders. The fuel and fresh-water capacity was for a range of 2,500 miles. Accommodations were provided for 5 staff members or cooperators and a permanent vessel crew of 5.

A 17-foot outboard-powered skiff was carried for working traps in shallow-water areas (fig. 2). Equipped with a depth-sounder, which recorded in feet, the skiff was capable of carrying 3 men and between 15-25 traps in areas not navigable by the Pelican.



Fig. 2 - The 17-foot fiberglass skiff loaded with wire and reed lobster traps.

FISHING GEAR

Lobster traps were selected as the primary fishing gear for the survey. This was because of their demonstrated proficiency in successful lobster operations throughout the world and because of their adaptability to either a large- or small-scale fishing operation. The traps used were constructed of three different materials--reed, wire, and wood.

^{1/}A program for the More Effective Use of Panama's Fishery Resources, PIO/T 525-29-060-10037, Washington, D. C., June 30, 1961 (mimeographed report from the Bureau of Commercial Fisheries to the U. S. Agency for International Development).

REED TRAPS: The woven reed traps used were acquired in Nicaragua. They were similar in design to those used in other tropical areas (fig. 3). Efforts to replenish the supply of the type trap became difficult, owing to a limited amount of reed in Nicaragua and the lack of drying facilities. The traps were 14 inches high and 32 by 36 inches wide with a single funnel opening on one side. A 15-pound cement block was wired to the bottom of the trap to keep the trap upright on the ocean floor.

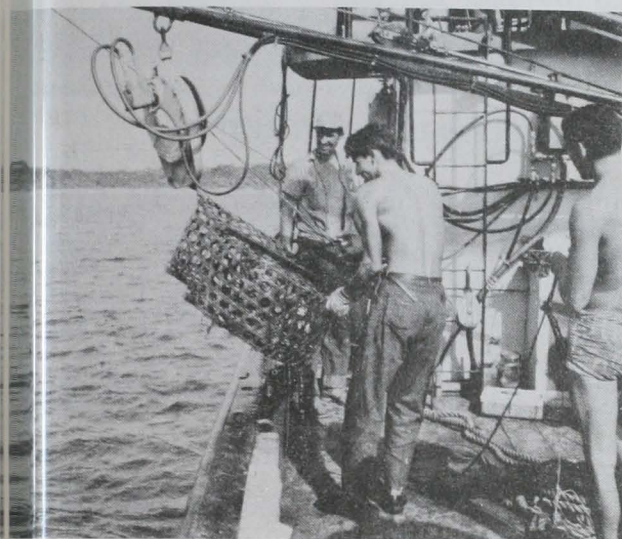


Fig. 3 - A reed trap being hauled aboard the Pelican. The side funnel shows at left.

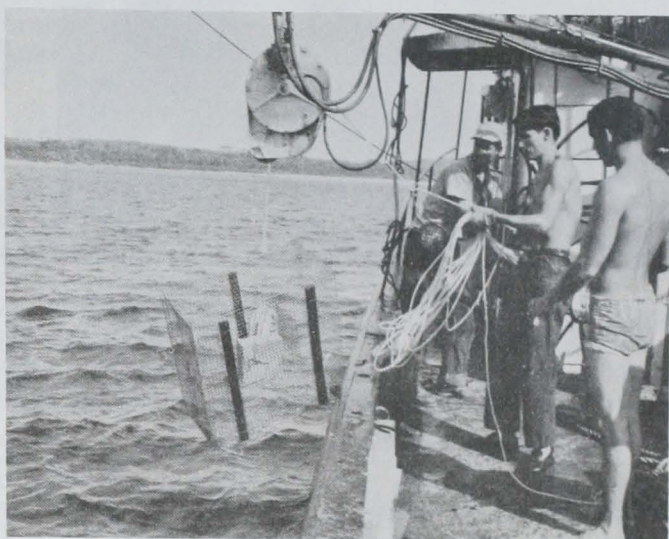


Fig. 4 - A wire lobster trap being hauled aboard the Pelican. The hydraulic block and its connections are visible.

WIRE TRAPS: Wire traps were made locally from either $\frac{3}{4}$ - or 1-inch hardware cloth and measured 36 x 36 x 14 inches (fig. 4). Various funnel arrangements were tried; both side and top funnels were used as were multiple funnels. Each trap had a cement block wired to its bottom.

WOOD-SLAT TRAPS: Wood traps were constructed of 1- by 2-inch slats and measured 2 $\frac{1}{2}$ x 3 feet at the base (fig. 5). The sides sloped-in approximately 2 inches from bottom to top. Each trap was 18 inches deep and had an 18-inch square funnel on the top that extended 6 inches into the trap. For weight, 1 inch of cement was poured into partitions on each end of the trap.

FLAG BUOYS AND LINES: Flag buoys were used to mark the location of one trap or a multiple set of traps (fig. 6). They were made using a 40-inch wood pole which had 3 square inches of cement at the base. Two to three 6-inch squares of 2-inch styrofoam were secured slightly below the middle of the pole, and a flag was attached to the top. The use of fluorescent orange paint on either the pole or the flag assisted in locating it. A 2-fathom length of line, with an additional styrofoam float at its end, was secured to the buoy; this provided a target area for the retrieving personnel. A $\frac{5}{16}$ -inch manila or sisal buoy line was secured from the 2-fathom float line to the trap. The lengths of the buoy lines were adjusted according to the depth of the water; however, 15-fathom lengths were most frequently used.

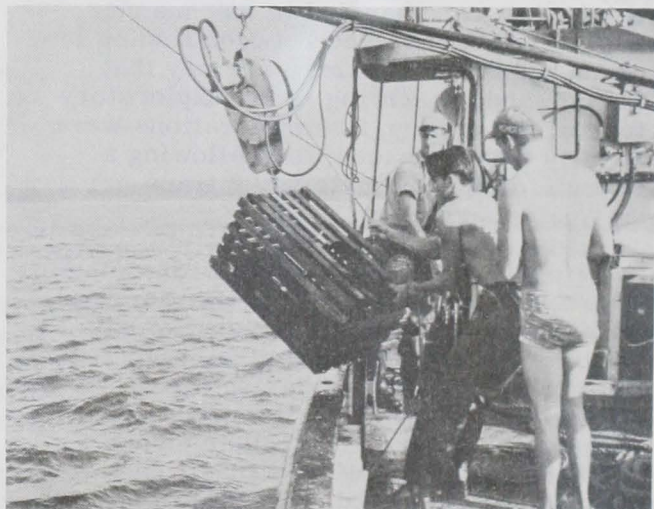


Fig. 5 - A wood-slat lobster trap being hauled aboard the Pelican, with the top funnel showing.

with the top funnel showing. 15-fathom lengths were most frequently used.



Fig. 6 - A basket of Pacific spiny lobsters, *Panulirus gracilis*. Flag buoys and wood-slat lobster traps are in the background.

ography, currents, and other environmental conditions determined after on-the-scene observations. Another factor considered was the proximity to coastal towns and fishing communities.

When the fishing location had been determined, buoy lines were tied to the traps, which had been baited and stacked in units of two on deck. The vessel then traveled a predetermined course at a reduced speed, and the traps were set. A flag was first thrown into the water. When all the buoy line had been payed out, the trap was dropped. This was followed immediately by the next buoy, and the process was repeated until all the traps had been set. Sometimes, multiple sets were made. Main buoy lines from 2 or 3 traps were connected in sequence, and a flag buoy was used only on the first trap. This technique reduced hauling time, but occasionally many traps were lost when buoy lines parted.

Traps were retrieved by using a grapnel to hook the 2-fathom float line and pulling in enough buoy line slack to reach the block of the hydraulic trap hauler. The trap was then hauled aboard over the hauler, the lobsters were removed, and traps were rebaited and stacked for resetting (fig. 7). About 50 traps at a location were handled in that manner. The greater the distance between fishing locations, the fewer the traps per day that could be handled. Owing to the exploratory nature of the survey, fishing locations were generally widely spaced, thus allowing a maximum of approximately 200 traps per day to be hauled and reset.

Bait was taken by trawling with a standard 40-foot semiballoon trawl (Bullis 1951), by trolling, by long-lining for sharks with 10-hook units of Japanese long-line gear (Captiva 1955), and by hand-lining during the day or by night with lights for attraction. Experiments were made to determine whether or not lobsters showed any significant preference for any of a variety of locally-caught bait. Among the species of fish used were black skipjack, several species of sharks, jacks, anchovetas, and species of bottomfish such as snapper, croaker, majarra, goatfish, threadfin, and others. Large fish were cut into 6-inch strips, and small fish were used whole. Several fish, or pieces of fish, were strung on soft baling wire and secured to the bottom of the trap where it would be impossible for a lobster to reach them from the outside. All the species used were

LOBSTER TRAWL: A 40-foot, 4-seam shrimp trawl made from 2-inch synthetic webbing, which had been used for catching bait, was slightly modified for lobster fishing. Twenty-two 9-inch rollers were strung on a $\frac{1}{4}$ -inch nylon line, which was seized to the foot-rope between each roller. A $\frac{1}{4}$ -inch tickler chain, connected to the lower rear bracket of each door, was adjusted to scrape the bottom just ahead of the trawl.

FISHING METHODS

Several factors determined which areas were to be explored. Initially, the coastal and island areas were separated into geographic zones that could be conveniently covered during a single cruise. Locations within those zones were further delineated by bottom top-



Fig. 7 - Removing a spiny lobster from a reed lobster trap.

found to work with equal efficiency as long as they were fresh. Putrefied bait appeared to be less attractive. Fish with spines or other sharp protuberances were not used for personal safety reasons.

Only one species of fish, a puffer (*Spaeroides annulatus*) was found to be unsuccessful as lobster bait. When that fish was used as bait, it would not attract lobsters; when it was mixed with other species, it would be ignored, but the other fish would readily be consumed. Halstead and Russell (1956) report two toxic substances isolated from a puffer found in Japanese waters, which when ingested by humans can cause illness within 30 minutes and coma and possible death within 1-24 hours.

FISHING RESULTS

LOBSTER AREAS: During exploratory fishing, three areas of potential lobster production were located, 1 on the Caribbean coast and 2 on the Pacific. Each area, in addition to having extensive reef or rocky bottom conditions, which could sustain large lobster populations, was also close to population centers with established transportation systems. The Bocas del Toro area was explored on the Caribbean coast; Chiriqui Gulf and the northwestern section of the Gulf of Panama (fig. 8) were explored on the Pacific coast. Although lobsters were found in other explored areas, a reduced amount of favorable bottom or the remoteness of the other areas from any community forestalled further immediate interest.

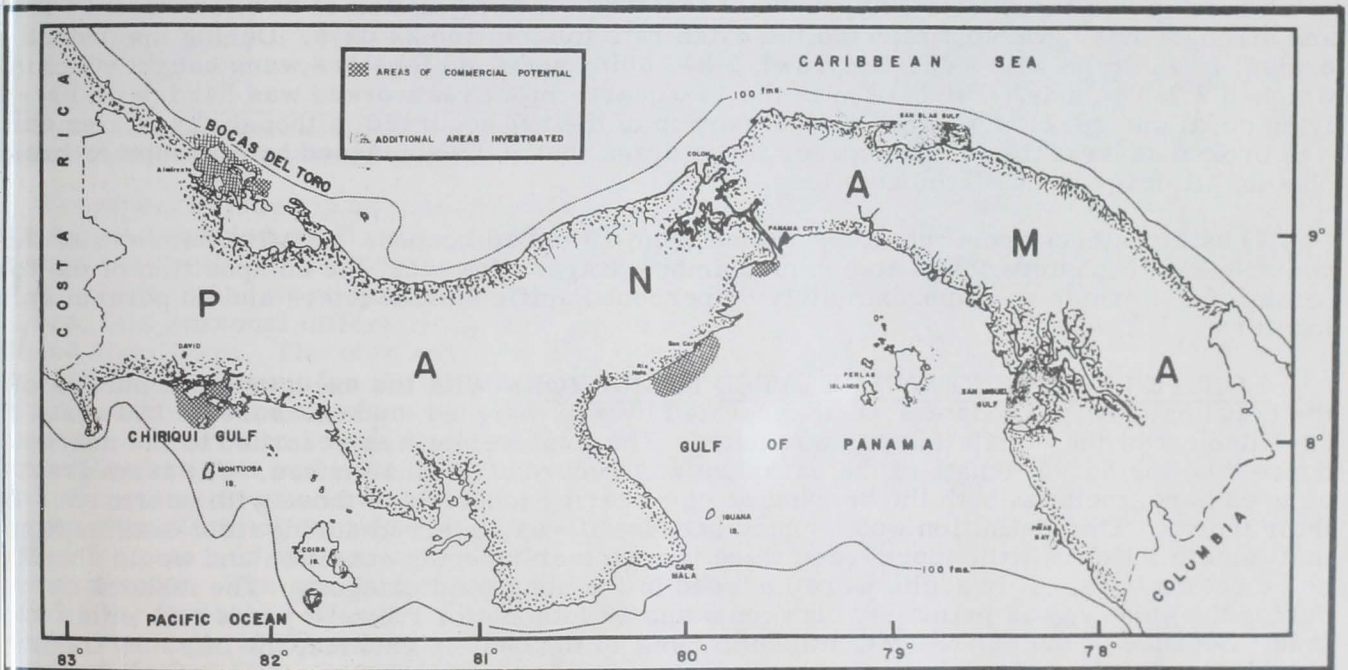


Fig. 8 - Chart of Panamanian waters with areas of commercial lobstering potential and all other areas investigated indicated.

EFFECTIVENESS OF TRAPS: A comparison of the catch per unit of effort indicated that the order of effectiveness of the three types of traps used, wood was most successful, followed by reed, then wire. The wood traps had a 48-percent catch per unit of effort, the reed 37 percent, and the wire 25 percent. The reed traps, and the wire to a slightly less degree, were also found to be susceptible to shark damage.

Experiments to determine the optimum number of days between hauling traps indicated that maximum catches were made from those traps which were fished for 2 to 3 days. It was found that after 3 days, the bait had generally been consumed or else it had become badly decomposed and was less effective. From 4 days on, after the bait had been entirely consumed, it was not uncommon to find that 1 or 2 of the lobsters had been devoured by the rest of the lobsters still in the trap.

LOBSTER SPECIES: Three species of lobsters were found in commercial quantities during the survey. In the Bocas del Toro area, the Caribbean spiny lobster, *Panulirus argus*, was caught by traps in depths up to 10 fathoms. On the Pacific side, in the Chiriqui Gulf, a Pacific spiny lobster, *P. gracilis*, was caught by traps within the same depth range. In the Gulf of Panama, *P. gracilis* was caught by both traps and by trawls, and a Pacific sand lobster, *Evibacus princeps*, was caught with trawls (fig. 9). Trapping of lobsters was generally carried out between 50 yards and 1 mile from land or exposed rock formations, whereas the trawling was conducted between 2 and 5 miles from shore.

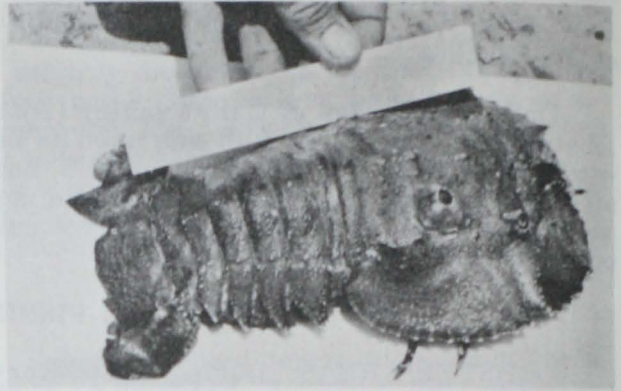


Fig. 9 - A Pacific sand lobster, *Evibacus princeps*. This specimen can be identified as a female by the divided tip of the 5th leg visible in photograph.

SIMULATED COMMERCIAL FISHING: Two simulated commercial fishing cruises were conducted in the Gulf of Panama. During the first of those cruises, wood traps were used for 22 days of fishing, and 1,066 spiny lobsters weighing 1,458 pounds were caught. A total of 200 traps had been set. Each day 100 of those were hauled, rebaited, and reset. The daily catch rate varied from 20 to 109 pounds of lobsters. A combination of new, unseasoned traps and strong winds adversely affected the catch rate for 9 of the 22 days. During the second cruise, in 45 drags with a lobster trawl, 2,847 spiny and sand lobsters were caught which weighed 2,758 pounds. The bottom in the 14-square-mile area worked was hard, with low-lying coral and rocks. Only one major tear-up of the net occurred, although the tickler chain was broken several times. Except for those drags that were shortened by tear-ups or broken chains, all drags were 90 minutes long.

Lobster catches from the drags varied from 10 to 210 pounds. Relative numbers of the two species of lobsters taken also varied among drags. However, the composition of the total catch for the cruise was approximately 60 percent Pacific sand lobsters and 40 percent spiny lobsters.

LOBSTER SPAWNING AND RELATED MIGRATION: With the exception of a portion of the trawl catches, all lobsters were separated by sex, weighed, and measured. The sexual development of the female lobster was noted. The total weight was recorded to the nearest ounce, and the dorsal length of the carapace was recorded in millimeters. The term gravid, as used here, includes both the berried or egg-bearing lobster and those with sperm sacs on their thorax. This definition was adopted because it was observed during field examinations that female lobsters with sperm sacs were in a ripe or ripening condition and would shortly be releasing eggs. Only adults were included in the nongravid category. The inshore fishing during the survey, was primarily between 5 and 10 fathoms or from 50 yards to 1 mile from land. Because of the extensive Continental Shelf in the Gulf of Panama, the offshore fishing was also in the 5- to 10-fathom depth range, but the distance from the nearest land varied between 2 and 5 miles.

To derive useful information on spawning required collections for a full 12-month period. This was accomplished for the Pacific spiny lobster, *P. gracilis*. Owing to adverse weather conditions and the geographical distances involved, an insufficient amount of spawning data was collected for the Caribbean species of spiny lobster, *P. argus*. The Pacific sand lobster was not located in commercial quantities until just prior to the end of the project; this precluded any opportunity to collect the necessary seasonal information. An indication that additional species of lobsters might be available was revealed by the capture of one specimen of the Caribbean sand lobster, *Scyllarides aequinoctialis*, in 8 fathoms off the northwest coast of Panama.

A total of 877 Pacific spiny lobsters, *P. gracilis*, were examined from the catches of simulated commercial trap fishing in the Gulf of Panama. The sex ratio of this catch was 542

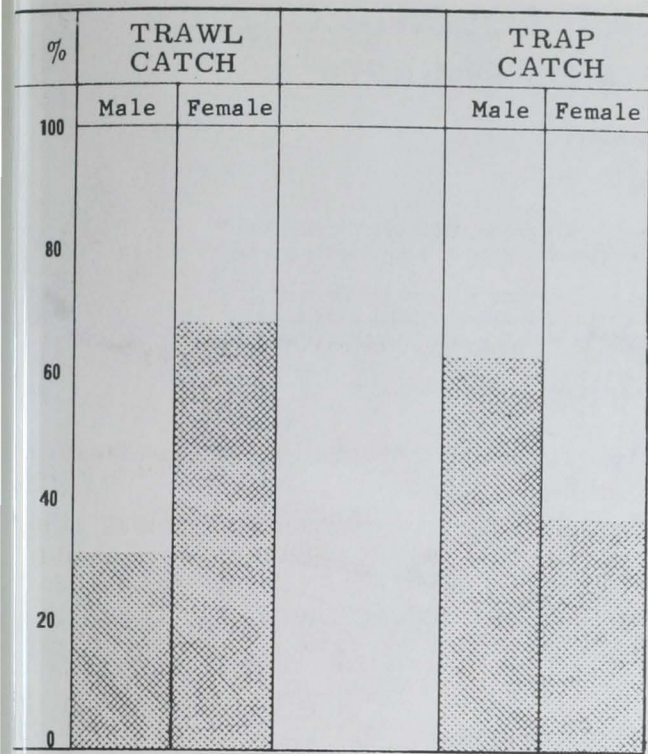


Fig. 10 - Graph showing the inverse sex ratio between the trawl and trap-caught Pacific spiny lobster, *P. gracilis*.

Traps were fished in September, and the trawling was carried out during December. Because the depth, temperature, and salinity of the waters fished were similar in both instances, this seasonal difference is not considered significant. The only apparent variable that might account for the differences in sex ratio was that the trawls were operated from 2 to 5 miles offshore whereas trapping was done from 50 yards to 1 mile from either land or exposed rock formation.

A total of 861 female lobsters that had been caught in inshore waters were examined (fig. 11). Of those, 405 or 47 percent were gravid and 456 or 53 percent were nongravid. Also, 204 female lobsters caught by trawls in offshore waters were examined. Six of those were juveniles and were not used in the data. Of the remaining 198, 183 or 92 percent were gravid and 15 or 8 percent were nongravid. The gravid females, which were found offshore, were probably attracted there by the favorable offshore-flowing currents which provide maximum dispersal of their larvae. Fleming (1938) states that there is a counter-clockwise circular movement of water within the Gulf of Panama which has a velocity of approximately 0.5 knot. The spiny lobster larvae are reported by Thorson (1961) to have a pelagic life of 150 to 180 days.

(62 percent) males to 335 (38 percent) females. From the catches of trawls in the Gulf of Panama, 302 lobsters were examined. Their sex ratio was 98 (32 percent) males and 204 (68 percent) females (fig. 10).

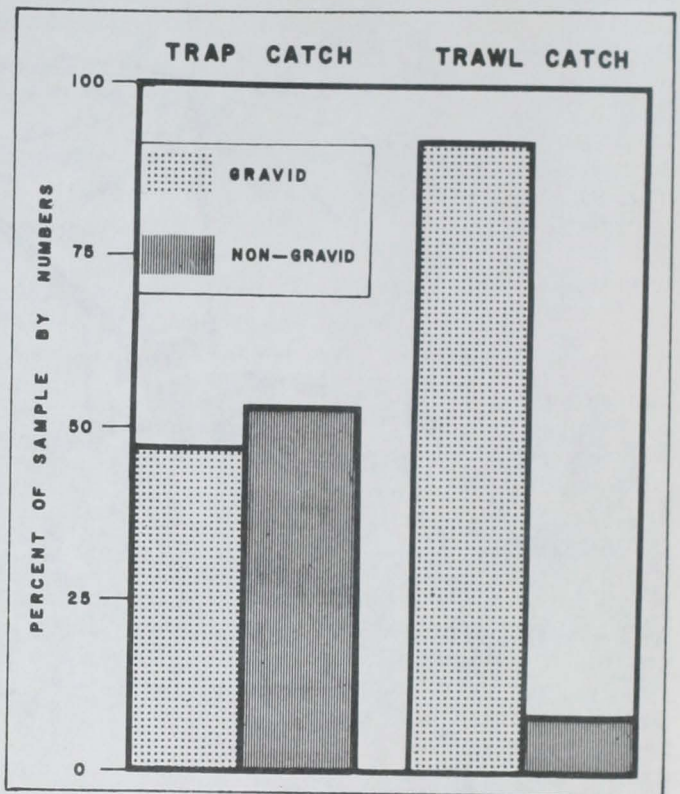


Fig. 11 - Ratio of gravid and non-gravid female Pacific spiny lobsters, *P. gracilis*, caught by traps and trawls.

PANAMA BAY SCALLOPS, A NEW MARINE RESOURCE: During routine bait trawling in the Gulf of Panama, 4 bushels of scallops, *Aequipecten circularis*, were captured. Their meat yield and quality were checked and found to be excellent. This information was passed on to the local shrimp trawling fleet, which dispatched four vessels to the area. Using only bottom trawls, they soon caught 23,000 pounds (whole scallops). One of the local shrimp trawlers made some rapid renovations that made a 24-hour continuous operation possible. More than 300 people were employed to process, pack, and freeze scallop meats. Within a short time, there were 15 trawlers, with crews averaging 6 men, working the beds. A change of gear from trawls to 6-foot reinforced expanded metal dredges enabled the vessels to double their production rate (fig. 12). During the first 2 months of operation, 658,161 pounds^{2/} of shell stock (whole scallops) were produced.

^{2/} Personal communication from Juan L. Obarrio, Director, Department of Fishes, Panama.

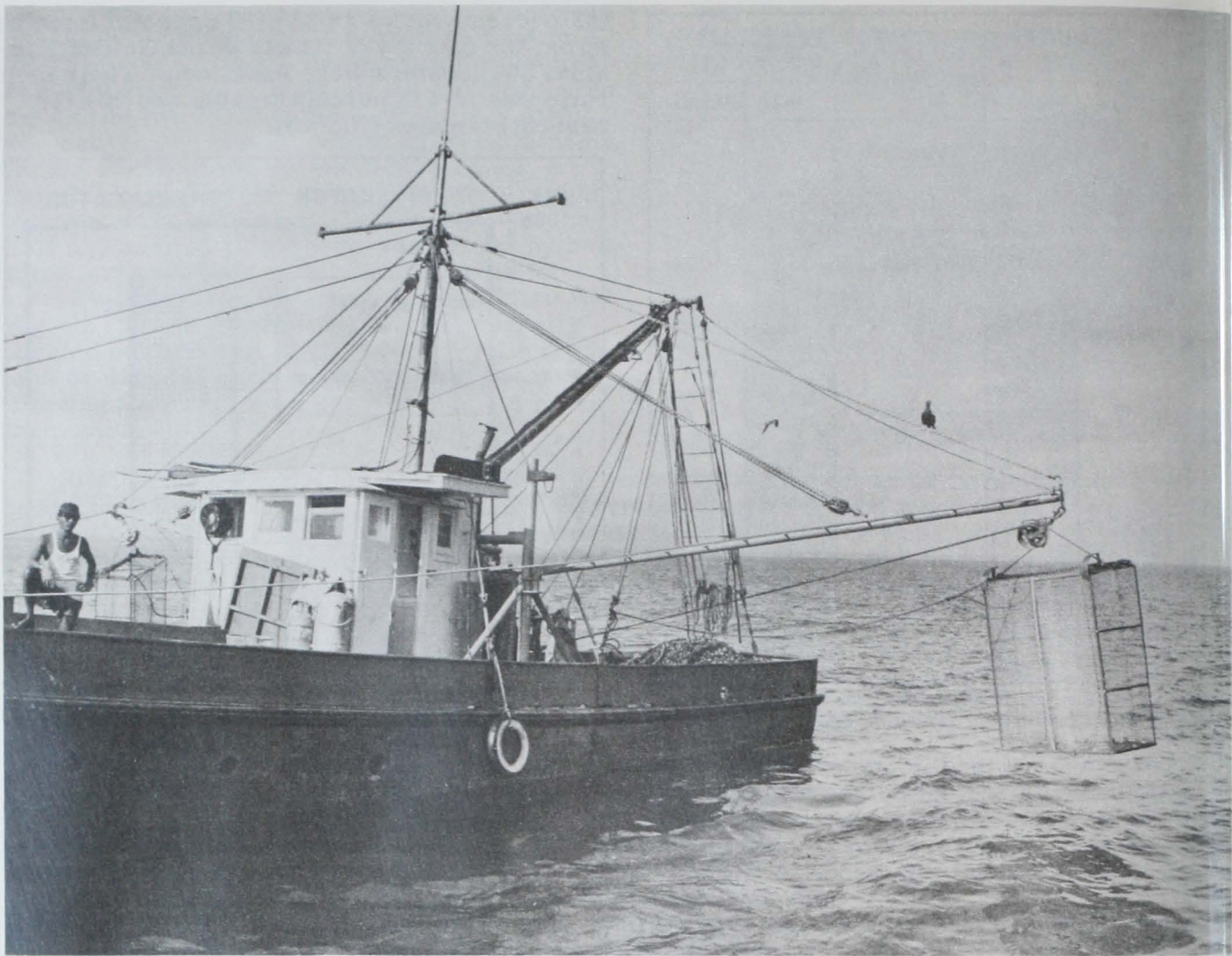


Fig. 12 - A Panamanian dragger double-rigged with a locally constructed scallop dredge. A deck load of Panama Bay scallops, *Aequipecten circularis*, can be seen.

Three private lobster trapping operations were in various stages of development at the end of the project. Two had boats in the 30- to 40-foot length range being modified and the third, using small craft to handle his traps, had constructed a lobster-holding pound.

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