In the Northeastern Gulf of Mexico —

HARVESTING COASTAL PELAGIC FISHES WITH ARTIFICIAL LIGHT & PURSE SEINE

Donald A. Wickham

Coastal pelagic fishes in the Gulf of Mexico represent a latent resource estimated at 4 million tons, a potential 8 times the present 500,000 tons (Bullis & Carpenter, 1968). These could be harvested economically with purse seines if supplemental methods, such as light attraction, were developed to create commercial aggregations in areas with fishable bottom. Experimental night-light purse seining revealed that fish could be attracted throughout the night, but that average catches were larger during the new moon.

Three species contributed 50% or more of total catch weight in 71% of experimental sets. Their potential was estimated the greatest among latent coastal pelagics. These were Spanish sardine, Sardinella anchovia; Atlantic thread herring, Opisthonema oglinum; and scaled sardine, Harengula pensacolae.

Nightly total catches from a light source, a single 1,000-watt underwater mercury vapor lamp, ranged from 500 pounds to over 6,000 pounds. The nightly average was 2,500 pounds. It indicates that artificial light can be developed for harvesting coastal pelagics.

Present production of coastal pelagics is based primarily on purse seining for menhaden, Brevoortia spp., for reduction to industrial products. There are indications the catch of B. patronus has reached or perhaps surpassed level of sustainable yield. At best, this species is only the third, and perhaps only fifth, most abundant coastal clupeid in Gulf. Stocks of thread herring, Opisthonema oglinum, alone have been estimated at about one million tons (Bullis and Thompson, 1967).

Butler reported in 1961 that the behavior of the herringlike coastal pelagics makes them difficult to capture with standard purse seines. At times, large schools divide rapidly into smaller groups that are extremely fast and difficult to encircle with a purse seine. Fuss and his colleagues reported in 1969 that the thread-herring fishery has been confined to a small area off Ft. Myers, Florida, in less than 10 fathoms. This is because of rough bottom conditions to north and south, and depth limitations of tom-weight purse seines prevents successful fishing. The feasibility of harvesting this resource economically with present methods has yet to be demonstrated.

Facilitating Economical Exploitation

Economical exploitation of coastal pelagic resource could be facilitated in two ways: by development of new fishing gear, or by introducing to purse-seine fishery supplemental methods capable of forming commercial-sized aggregations in areas with fishable bottom. In 1960, von Brandt reviewed methods

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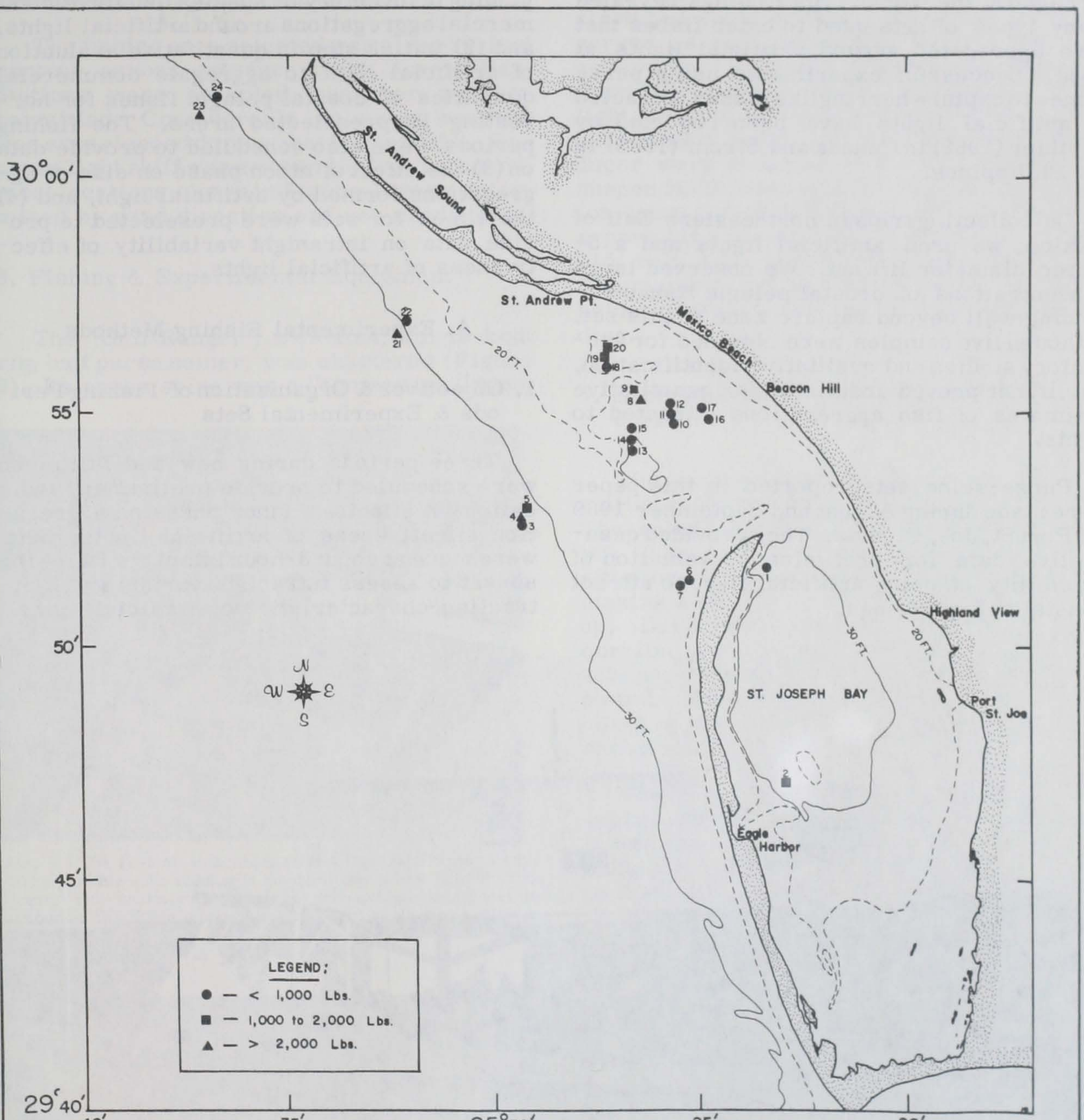

Fig. 1 - Location of night-lighting stations sampled by purse seine during Aug.-Sept. 1969. Sample numbers are beside each station. Legend is key to catch size.

of harvesting sardines and related species throughout the world. His findings revealed many types of nets used to catch fishes that have aggregated around artificial lights at night. Successful experiments using purse seines to capture herringlike fishes attracted to artificial lights have been reported by Gauthier (1969) in Canada and Ström (1969) in the Philippines.

On collecting trips in northeastern Gulf of Mexico, we used artificial lights and a 5-meter diameter lift net. We observed large concentrations of coastal pelagic fishes extending well beyond capture zone of this net. Although live samples were obtained for laboratory studies and qualitative identification, the lift net proved unsuitable for quantitative estimates of fish aggregations attracted to lights.

Purse-seine sets reported in this paper were made during August and September 1969 off Port St. Joe, Florida. They provided quantitative data for preliminary evaluation of feasibility of using artificial light to attract coastal pelagic fishes.

This preliminary study provided: (1) beginning of inventory of species that form commercial aggregations around artificial lights, and (2) initial step in quantitative evaluation of artificial light to aggregate commercial quantities of coastal pelagic fishes for harvesting in preselected areas. The fishing periods were also scheduled to provide data on (3) the effect of moon phase on size of aggregations formed by artificial light, and (4) the times for sets were preselected to provide data on intranight variability of effectiveness of artificial lights.

A. Experimental Fishing Methods

1. Objectives & Organization of Fishing Periods & Experimental Sets

Three periods during new and full moon were scheduled to provide preliminary indications of effects of lunar phase on aggregation effectiveness of artificial lights. Sets were made at about 3-hour intervals following sunset to assess intranight variability of attracting-characteristics of artificial lights.

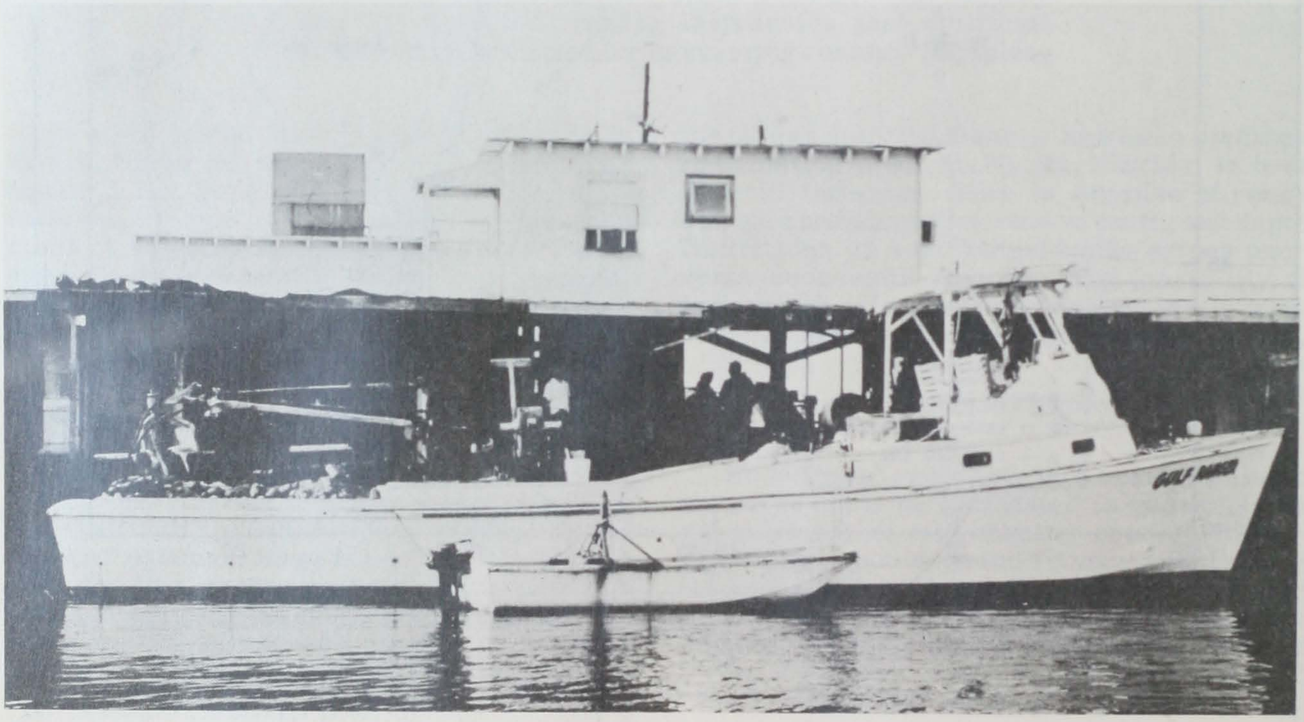

Fig. 2 - The chartered 49-foot, single-boat rig, bait purse seiner, 'Gulf Ranger'. The net skiff is tied alongside seiner.

2. Selection of Fishing Stations

The fishing area selected was along 30-foot contour across entrance to St. Joseph Bay. Stations were occupied whenever weather permitted. Considerable inclement weather was experienced during charter periods. Because light skiff was an open 16-foot outboard, most locations shown in Figure 1 were determined by wind direction and sea conditions.

3. Fishing & Experimental Equipment

The 'Gulf Ranger', a 49-foot, single-boat rig, bait purse seiner, was chartered (Figure 2). Its purse seine was a "tom-weight" type, 1,545 feet long and 71 feet deep, with $1\frac{1}{4}$-inch stretched mesh webbing. A 16-foot outboard served as skiff; attracting lamp (1,000-watt underwater mercury vapor) was deployed from it (Figure 3). Fish aggregations below light were monitored by echo sounder. The underwater lamp and echo-sounder transducer were mounted on a wooden depressor suspended beneath skiff during fishing. Power for lamp and echo sounder were supplied by a portable, gasoline-powered, 2.5 kilowatt, 115 volt A.C., generator mounted in skiff. Communications between skiff and purse seiner were maintained by portable FM radios.

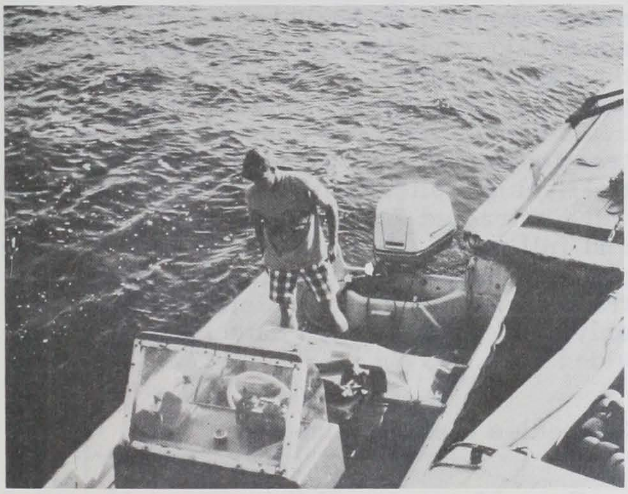

Fig. 3 - The 16-foot outboard used as a light skiff during study. The portable echo sounder is mounted across boat behind bench seat. The underwater light and echo-sounder transducer are mounted on wooden depressor lying in right hand corner of stern. The portable generator, not shown, was positioned in bow ahead of steering console.

4. Experimental Fishing & Sampling Procedure

The manned light skiff was anchored on station at night with light turned on (Figure 4). The seiner anchored nearby with its lights off. The seiner turned its lights on only after the net was pursed. When seiner began making a set, the light skiff anchor was pulled up. During pursing, the skiff would drift to corkline opposite net opening and remain inside net with light on until pursing was completed. The skiff would then move across corkline and resume fishing with light after anchoring clear of seiner and net.

The total catch weight was estimated by vessel captain after net bunt was dried up. A sample was brailed into a large plastic container to be weighed, sorted, and identified while fishermen handled catch and restacked the net. This general procedure was followed during each set.

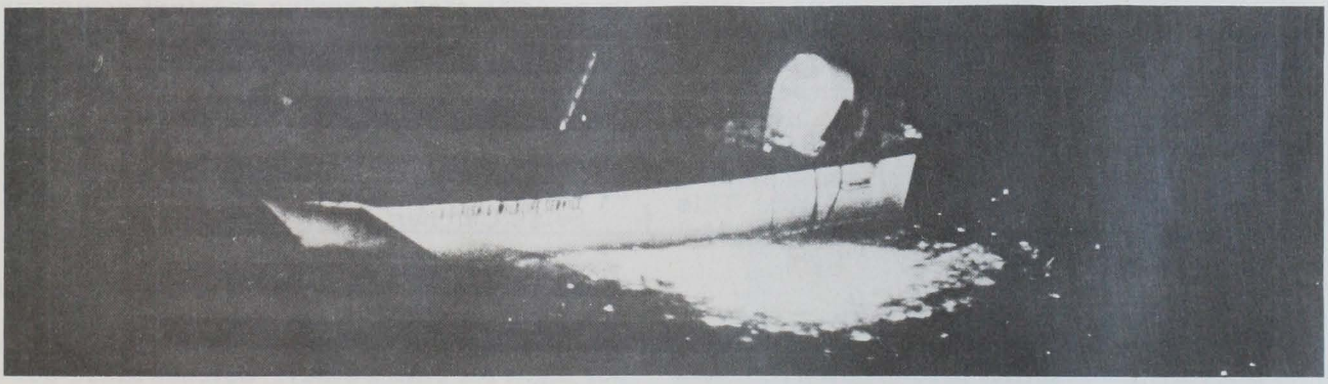

Fig. 4 - The light skiff anchored on station with 1,000-watt mercury-vapor underwater attracting-light turned on. A large school of fish has accumulated around light, considerably reducing size of light field.

B. Catch Results

1. Attraction of Fish by Artificial Light

The operation of passive fishing gear (traps, bait, and artificial light) requires that fish pass within its effective zone of attraction before they can be subject to capture. So the catch of a passive gear depends on size of its zone of attraction and fish density therein. The characteristics of capture zone is not consistent because variables--turbidity, ambient light, biological rhythms, and many others--influence effectiveness of gear and/or susceptibility of animal to capture; this variability is reflected in catches.

Catches from individual sets around the light showed considerable intranight and internight variability.

a. Intranight variability

Catch data averaged by set time for new and full moon periods, disregarding location and other variables, indicates that artificial light was effective in attracting fish throughout the night (Figure 5). There was consistency in average catches for the three nightly sets, during both new and full-moon periods (Figure 5). This suggests that intranight catch variability for individual sets probably resulted from different fish densities in envelope of water within which light was effective. This conjecture was supported by visual observations and echo-sounder tapes made from the light skiff. These indicated that schooling species, the bulk of larger catches, usually arrived in the light field in large numbers at infrequent intervals; the remaining species appeared to accumulate gradually. These results contrasted with lift-net sampling that indicated early evening and predawn peaks for light-attraction effectiveness. In view of purse-seine catch, peak periods for lift-net catches may be indicative of changes in dispersion distance around artificial light. This arises, possibly, from rhythmic physiological changes in fishes' sensitivity to light.

b. Internight variability

Internight variability in total catch resulted primarily from environmental factors--location, water turbidity, thunderstorms, and others--which could affect catch and light's attraction characteristics. Some effects of location on catch are shown in Figure 1. However, the present data are not sufficient to permit analysis of effects of environmental factors on light-attracted catches.

c. Lunar pattern

The effects of moon phase on attraction by artificial light are noticeable in comparison of average catches per set by moon phase. Figure 5 shows average catch per set was considerably larger during new moon than during full moon. Present data only permit speculation on causes of different catch rates for these two lunar periods. However, it is probably that bright ambient light during full moon reduces contrast between artificial light and background, thereby reducing appreciably the extent of effective attraction zone. Also, physiological changes related to lunar cycle could render fish less susceptible to attractraction by artificial light. In terms of potential fishing applications of artificial light, fish were attracted successfully during both new and full moon. The full importance of moon phase to commercial application of light attraction requires accumulation of considerably more comparative catch data than provided here.

2. Species Composition

Over 50 species of fishes were identified in catches from purse-seine sets made around artificial light. Menhaden are not commonly fished in the study area; none was caught. Spanish sardine, Atlantic thread herring, and scaled sardine, usually bulk of larger catches, were estimated as having greatest commercial potential among latent coastal pelagic resources in the Gulf. Their combined contribution was 50% or more by weight in 71% of catches (Figure 6).

3. Comparison With Conventional Purse-Seine Catches

Nightly catch totals are not all based on full night's fishing of 3 sets. Nevertheless, they still average slightly better than 2,500 pounds per night for entire study. Catches made during new moon periods alone averaged better than 3,000 pounds per night, although only 2 of the 7 nights fished consisted of a full 3 sets.

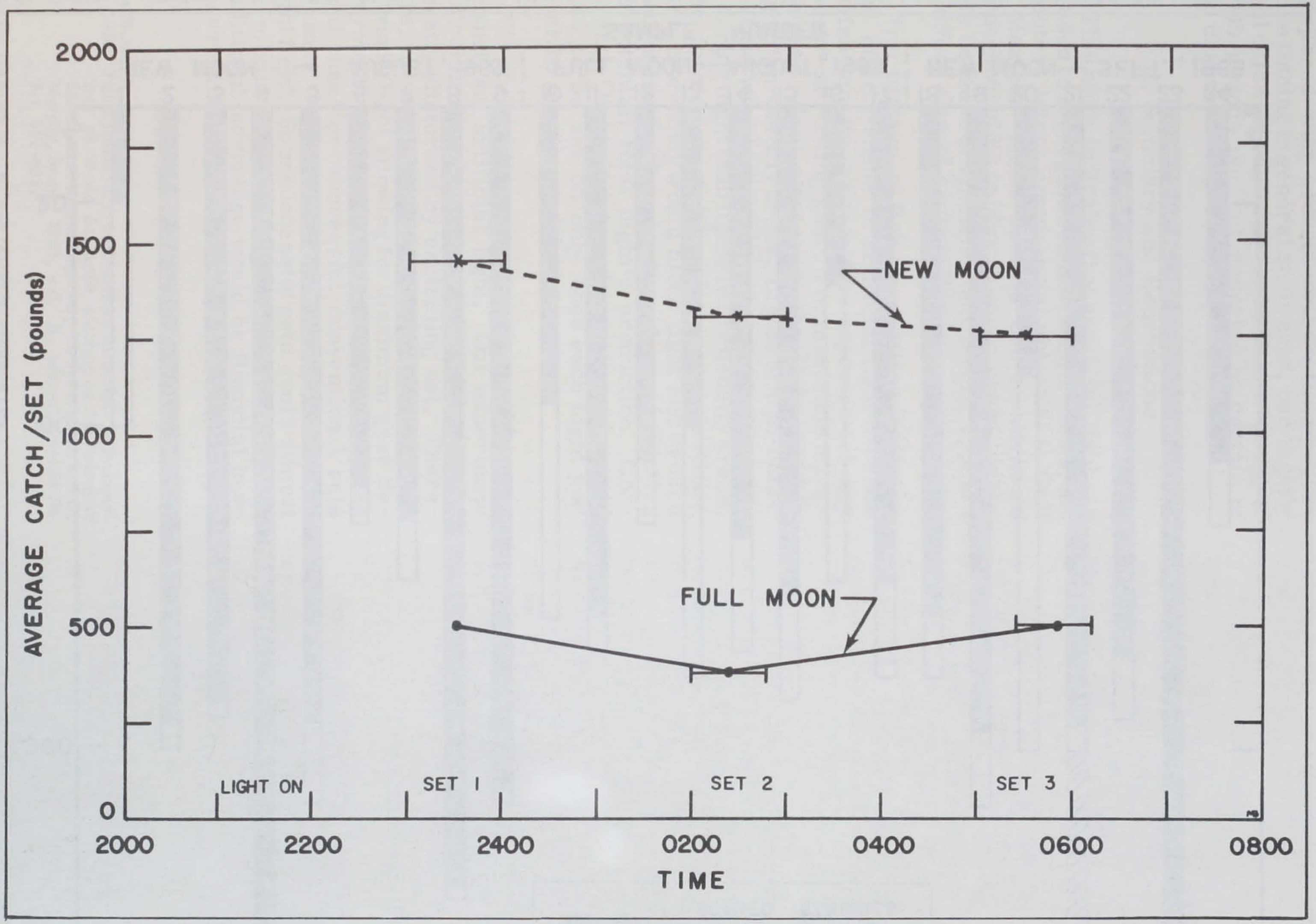

Fig. 5 - Catch data averaged by set time for new and full moon charter periods. Locations and other variables were disregarded.

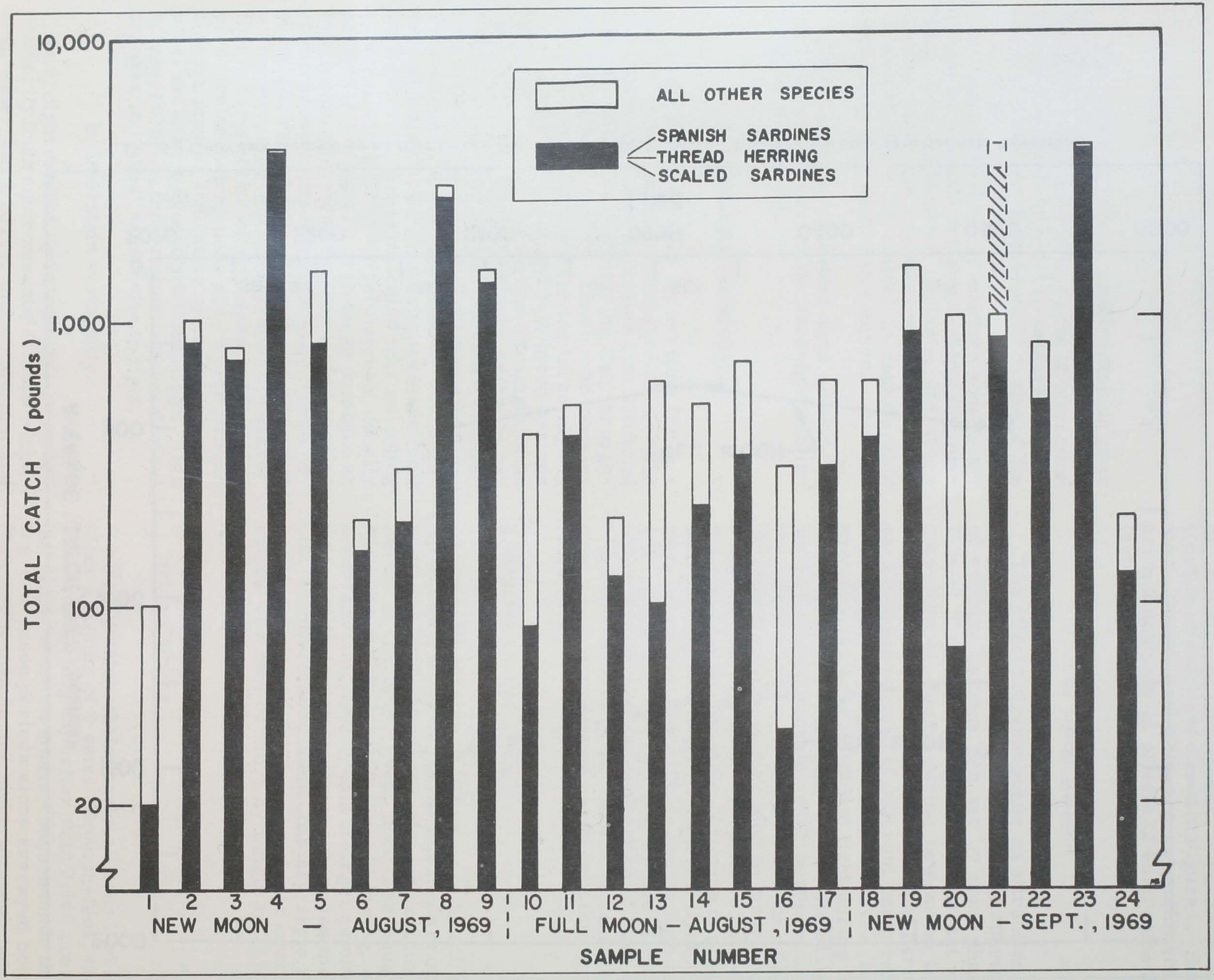

Fig. 6 - Combined contribution, by weight, of Spanish sardine, Atlantic thread herring, and scaled sardine to total catch for each nightlighting purse-seine sample. Sample 21 has been extended to account for estimated 3,000 to 4,000 pounds lost because of gear trouble.

Compared with conventional daytime purse-seine fishing in general study area, our nightly total catch average was lower than average of 4,000 pounds per set reported by captain of our chartered bait seiner.

C. Summary and Conclusions

This study indicates that artificial light can be used to aggregate coastal pelagic fishes, the greatest latent commercial potential in Gulf of Mexico. These species can be attracted throughout night, although moon phase, probably because of ambient light levels, appears to affect size of aggregations.

The pattern of fish aggregation indicates that effectiveness of artificial light depends on fish density, as would be expected for any passive attracting gear. For maximum effectiveness, light attraction should be used in high-fish-density areas. Lights in high-density areas would need to be set on more frequently during night than lights in low-density areas. The formation of large fish concentrations early in evening would block light and reduce its continued efficiency, therefore restricting its potential total night's production. Conversely, lights in low-density areas would need to be set on only once each night just prior to morning twilight.

We showed that a purse seine could be set around an artificial light. Our experience indicates that fish attracted to light are not greatly disturbed by encircling net. Therefore, purse-seine sets can be made slowly around a light allowing for maximum gear deployment. These sets also would require less skill than for successful conventional sets because fish remained undisturbed within light field. So unsuccessful sets could almost be eliminated by using artificial light. An additional advantage would be financial savings realized by locating light-fishing sites in known areas. This would reduce search time, a high cost in purse seining.

Nightly total catches from our single light source ranged from 500 to 6,300 pounds, and averaged about 2,500 pounds throughout 3 fishing periods. Despite advantages, use of light as accessory technique to purse seining is not likely to be accepted by fishing industry until catches can be increased.

Preliminary observations indicate that fish follow a slow-moving light for short distances. This suggests that fish aggregations from several lights possibly could be led to single area for more efficient harvesting. Considerably more study is required before feasibility of leading fish can be determined and useful techniques developed for incorporation into a fishery.

This study strengthened our contention that artificial light can be developed as a supplement to conventional purse seining for more efficient harvesting of latent coastal pelagic resource of Gulf of Mexico. It provides encouraging indications that artificial light can be incorporated into proposed National Marine Fisheries Service netless harvesting system (Klima, 1970). The studies required for both immediate and long-term applications of light attraction are now in progress at the National Marine Fisheries Service, Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi.

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