EXPLORATORY SHRIMP TRAPPING IN THE HAWAIIAN ISLANDS

BY

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Introduction

During 1967 and 1968 the National Marine Fisheries Service (NMFS) devoted four cruises of the RV Townsend Cromwell to demersal resource surveys in the Hawaiian Islands. The primary sampling gears utilized were shrimp trawls, although limited shrimp trapping experiments were conducted (Yoshida, 1972). These surveys demonstrated that the penaeid shrimp (Penaeus marginatus) was available in modest amounts and amenable to harvest by shrimp trawls. Two species of caridean shrimps (Heterocarpus ensifer and H. laevigatus) were also taken in small numbers with the trawls. However, the initial investigations indicated that trapping, rather than trawling, was a more effective method for harvesting these latter species.

Clarke (1972) conducted trapping surveys during 1969 and 1970 at seven locales off Oahu, Hawaiian Islands. The sampling gear consisted of several trap types, but all were uncovered traps. These surveys provided data on the depth distributions of H. lensifer and H. laevigatus and indicated that these species were present in sufficient quantities to support a commercial fishery.

Further trapping trials were conducted by the NMFS during fall, 1972 at various localities in the main group of the Hawaiian Islands. These trials were of preliminary nature, and a variety of trap types, bait containers, and baits was utilized. It was demonstrated at this time that traps covered with burlap were more effective in capturing H. ensifer than were uncovered traps. It was also determined that proper catch preservation of this species was essential to insure a quality product.

We also have data from 23 sets of our gear off Oahu by staff members of the Hawaii Institute of Marine Biology, University of Hawaii during May 1973.

Methods

The traps measure 2 by 2 by 4 ft. The frame is constructed of 3/8-inch diameter steel bar and is covered with 1/2-inch square mesh galvanized wire screen. The sides, top, and bottom are then covered with burlap. The tunnels (one at each end) are also constructed with the screen (but are uncovered) and taper to 2- to 3-inch openings about one-third the distance in from each end. Bait containers are constructed with 1/2-inch wire screen and are suspended in the trap between the two tunnel entrances. One to two pounds of chopped bait are sufficient for sets of 12-14 hours.

Each trap has a 7-ft wire bridle attached to opposite corners on the top of the trap. The bridle has a snap at the center for attachment to the ground line. The ground lines and buoy lines consist of 1/2-inch polypropylene rope. The traps are spaced at 10-fathom intervals, and the first and last traps on a string have 5-pound anchors attached to a trap corner. We usually fished six or eight traps to a string, but this would vary according to the capabilities of the vessel. We have our buoy lines made up into 100-fathom lengths, and these are stored in plastic garbage containers of approximately 40-gallon capacity. The ground line is made up with this line by forming loops for each trap at 10-fathom intervals in the distal portion of the first 100-fathom section. The proper number of 100-fathom sections are then added as the traps are set in order to give an excess amount of buoy line on the order of 50-150 fathoms greater than the depth of water being fished. Just before the entire amount of line is payed out, a buoy is attached and set as the final few fathoms are run out. A weight is smapped onto the buoy line about 10 fathoms below the buoy to assure that the polypropylene line does not float at the sea surface. The set is retrieved with a Marco* crab-pot hauler; the 100-fathom sections are stowed directly into their containers as the line comes aboard.

Because the trapping operations were interspersed with other vessel programs, the traps were set at dusk and retrieved at dawn. We do not have data on daytime catch rates.

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* Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Results

Different types of traps, bait containers, and baits were tested by various combinations of these factors on sets of four to eight traps per string. Traps measuring 1 by 2 by 4 ft were less effective than the larger traps measuring 2 by 2 by 4 ft. Traps with 1-inch mesh wire screening caught fewer H. ensifer (through escapement) than those with 1/2-inch mesh screening. Comparison between alternated covered and uncovered traps during eight sets of four to six traps resulted in the covered traps outfishing the uncovered traps by 2.5-10 times. Possibly the covering on the sides of the trap concentrates the bait scent near the entrances at the ends of the traps, resulting in greater catch rates. Quite probably traps constructed of any material that conforms to the basic design principle of the covered trap would be equally effective.

Several bait container types were tested. Containers constructed of 1/2-inch mesh screening (measuring 6 by 6 by 6 inches) were generally superior to plastic containers of the same size perforated with 1/4-inch holes or bait wrapped in cheesecloth.

Five types of bait were tested: finely ground fish, squid, shrimp (H. ensifer) and coarsely chopped fish and shrimp. Chopped fish species that are lily or bloody were found to be the best baits. Possibly the fine-ground baits dispersed to rapidly. Fish and shrimp were superior to squid.

Catch rates of H. ensifer obtained during 1972 were highly variable due to the variety of traps, bait containers, baits utilized and depths sampled. At this time the best catches ranged between 15 and 63 pounds per trap for an overnight set.

More reliable data on catch variability was provided by 21 sets of covered traps (four per set) off the sough coast of Oahu in depths of 200-220 fathoms during spring, 1973. Only one bait type (fish) was utilized. During this series of sets catches of H. ensifer ranged from 2 to 34 pounds per trap and averaged 15.2 pounds per overnight set. Considerable variation in catch rates between localities was noted.

These catches of H. ensifer with covered traps generally exceeded those experienced by Clarke (1972) off the northeast coast of Oahu with uncovered traps. Catches there for nine sets in the 150-250 fathom depth range varied from 0.6 to 11.9 pounds per trap and averaged 4.5 pounds.

The larger H. laevigatus is apparently much less abundant than H. ensifer. Our usual catches of H. laevigatus were 1-3 pounds, but occasionally ranged up to 9 pounds per trap. Clarke (1972) experienced similar catch rates.

The model size group of H. ensifer retained by the 1/2-inch mesh traps range from 35 to 45 individuals per pound (heads on). The largest individuals of H. laevigatus range from 8 to 12 per pound. For both species the tail (with shell) comprises about 45% of the total body weight.

Clarke (1972) found that H. ensifer occurs in depths of 80-400 fathoms in the Hawaiian Islands, but is most abundant between 150 and 250 fathoms. Shrimps taken in this latter depth range were found to be significantly larger than those taken at the upper and lower limits of the total depth range. H. laevigatus occurred in depths of 200-400 fathoms; there was no obvious trend in abundance between 250 and 400 fathoms. Our fingings during all surveys are in accord with these results. The optimal depth range for H. ensifer corresponds to bottom temperatures of 7 -13 C.

The traps have been fished on a variety of bottom types. The only constraints are that the slope must be gentle enough to permit the traps to fish without drifting off and the bottom must be smooth enough to abviate trap loss.

Attempts to market the two species of Heterocarpus in Hawaii have been generally unsuccessful in the past. This is due to enzymatic breakdown of the chilled tail meat within 12-24 hours which results in a soft and unacceptable product when cooked. We found that cooking the shrimp immediately after catching resulted in a chilled shelf life of 3-4 days. One test of immediate freezing of raw shri;p in a brine solution at about -20 C. resulted in a superior product. After brine freezing, the shrimp were placed in a conventional freezer and tested at intervals over a 2-week period and found to be very acceptable. Very lettle salt was taken up by the shrimps during brine freezing.

Care must be taken not to overcook these species. Boiling times of 2-4 minutes are adequate for the frozen shrimp. The tail meat can be shelled easily for other methods of preparation by briefly thawing with running water.

H. ensifer is known to occur in tropical waters from the western Atlantic to Hawaii. This species, and/or a congener undoubtedly occurs in areas of the South Pacific. The standing biomass of H. ensifer has been greatly underestimated in the past because shrimp trawls appear to be inadequate sampling devices for this purpose. If members of this genus are as abundant in other regions of the tropics as in Hawaii, together they probably represent a biomass exceeding that of any commercially exploitable tropical crustacean.