Harvesting Rock and Jonah Crabs in Rhode Island: some Technical and Economic Aspects

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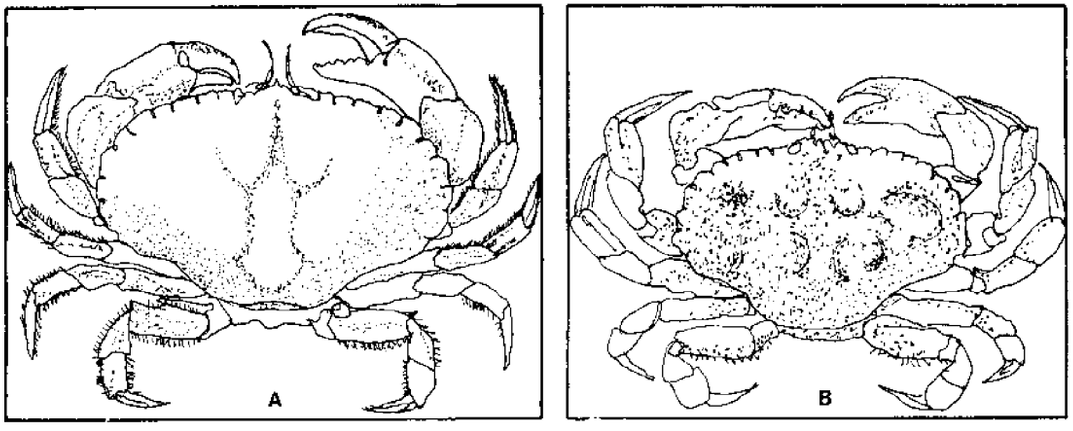

Fig. 1. Cancer borealis, the Jonah crab (A) and Cancer irroratus, the Rock crab (B), dorsal view, reduced. After: Rathbun, M.J. The Cancroid crabs of America of the families Euryalidae, Portunidae, Atelecyclidae, Cancridae and Xanthidae.

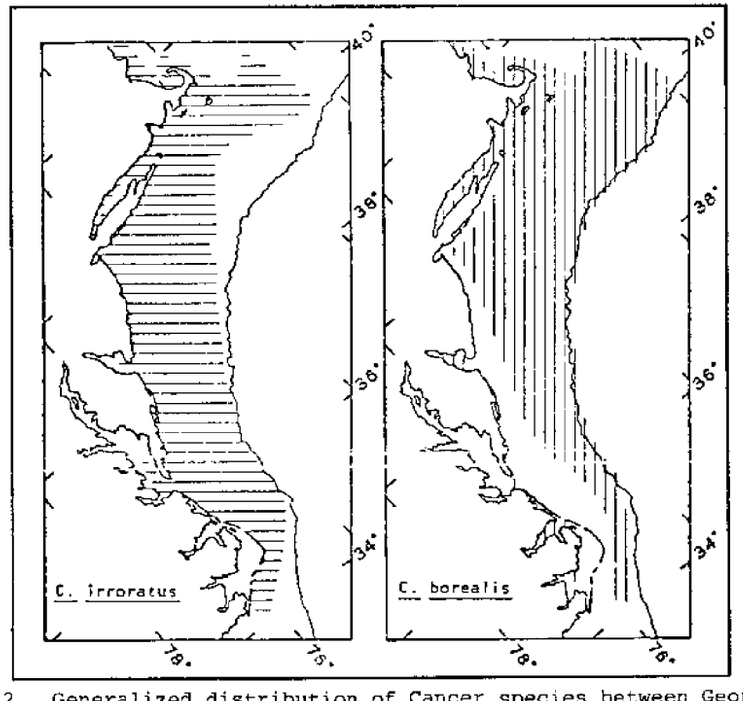

Fig. 2. Generalized distribution of Cancer species between Georges Bank, Massachusetts, and Cape Hatteras, North Carolina. After: Saila, S.B. Coastal and offshore environmental inventory: Cape Hatteras to Nantucket Shoals.

Introduction

A significant increase in fishing effort on the grounds between Nova Scotia and Cape Hatteras over the last decade has led to a major decline in the stocks of the traditional species of fish and shellfish harvested in that area. Most of the major species of food fish are now under quotas which are decreasing year by year.

Between 1960 and 1970, total fishing effort in New England waters increased threefold, yet United States effort during that period declined 30 percent. By 1970, 80 percent of the total effort in the area was foreign.[1/] The need to halt the reduction in the stocks of the traditional foodfish species led, in 1973, to the establishment of overall quotas in addition to quotas by species by the International Commission for the Northwest Atlantic Fisheries (ICNAF).

The 1973 total catch of finfish (excluding menhaden and large pelagics) and squid in ICNAF sub-areas 5 and 6 was about 1,180,000 metric tons. At the 1973 ICNAF meeting in Ottawa it was decided that the aggregate catch of all species of fish under management in sub-areas 5 and 6 should not exceed 923,900 metric tons in 1974 and 850,000 metric tons in 1975.[2/] For 1976 ICNAF will set the quota according to the advice of its scientific committees; it is expected to be a maximum of 800,000 metric tons.

Stocks that are harvested within the 12-mile limit have suffered from excessive effort too. Inshore lobster landings, for example, are expected to continue to decline; in Maine in 1974 they were expected to be nine percent or more below the 1973 level.[3/]

The uncertainty about whether or not fisheries jurisdiction will be extended for the coastal state makes looking for alternative stocks and better utilizing present catches objectives of great importance. Exploitation of under-utilized stocks of fish and shellfish would reduce the U.S. fishing pressure on stocks under quota and also could create a source of additional income for New England fishermen.

The urgency of finding solutions to these problems facing the fishing industry has led to the establishment of the New England Fisheries

Development Program, a cooperative effort between the federal government and the New England fishing industry. After several meetings, this body singled out three areas of study, including the potential utilization of the New England crab resources. This report, we hope, will expand on the limited knowledge that exists about the New England Cancer crab resources and supplement the work carried out by the New England Program.

These crabs as a commercial resource. To make decisions related to utilization of a resource, an industry must know, of course, about its distribution, the size of the stocks, the potential annual harvest, the effectiveness of fishing gear in catching the species and the potential catch rates.

To obtain information on catch rates and current harvest practices, the authors designed a questionnaire, which was mailed to all holders of commercial lobster licenses in the state of Rhode Island for 1973. The questionnaire was divided into two sections, one to be answered by those who were engaged in potting and the other, by those who were trawling. Fishermen engaged in both potting and trawling were asked to answer both sections of the questionnaire.

The universe included 403 fishermen, but the rate of response was a disappointing low 10.7 percent (43 responses). Some of the reasons for the very low rate of return proved to be the inability of many fishermen to differentiate between Jonah crabs and rock crabs, especially in the inshore areas, and a lack of interest in these crabs, the reasons for which will be explained later in this paper. To supplement these data 19 full-time pot-lobstermen and trawler captains were interviewed.

In order to determine the economic feasibility of keeping and landing incidental catches of Jonah and rock crabs, a marginal analysis (partial budgeting) was used. The use of partial budgeting involves analyzing the additional costs and benefits (or reductions in costs and benefits) that would be derived from keeping crabs. The economic feasibility of a directed fishery for Cancer crabs was also studied.

1/ U.S. Department of Commerce, NOAA, NMFS. 1972. Program synposis - Northeast Fisheries Center, September, p. 3.

2/ International Commission for the Northwest Atlantic Fisheries. 1973. Press Notice, Special Meeting of ICNAF, Ottawa, Canada, 15-19 October, p. 3.

3/ U.S. Department of Commerce, NOAA, NMFS. 1974. Shellfish--review and outlook. Current Economic Analysis S-30, Market Research and Services Division, Washington, D.C., July, p. 13.

Distribution, Size of Stocks, General Biology

Crabs of the genus Cancer are found in all oceans of the world. Fifteen species are found off the coasts of the United States, but only two off the Atlantic Coast.

Cancer borealis (Cancer meaning crab, and borealis meaning northern), commonly referred to as Jonah crab (figure 1), is found from off Campobello Island at the mouth of the Bay of Fundy, along the New England Coast both in shallow and deep water, southward through South Carolina and off St. Augustine, Florida.1/ Yet, they appear to be abundant only between Georges Bank, Massachusetts, and Cape Hatteras, North Carolina, from low tide level to depths of over 120 fathoms. (figure 2)

Pot sampling transects of the continental slope south of New England made at Block, Hudson and Baltimore Canyons during the 1971 *Delaware II* cruise indicate that this species is plentiful at depths of less than 150 fathoms, but some crabs were taken at depths down to 220 fathoms.2/

Cancer irroratus (irroratus meaning speckled), commonly known as the rock crab (figure 1), is found inshore from Labrador to South Carolina and offshore between Delaware Bay and Cape Hatteras. In the north, the rock crab is found along the coast year-round, while in the south

it is abundant near shore only during the winter and migrates in the summer to deeper waters. Figure 2 shows the distribution of these crabs in the area between Georges Bank (Massachusetts) and Cape Hatteras, North Carolina.

The most quoted figure on the size of the Jonah crab resource between Georges Bank and Cape Hatteras is 500 million pounds.[3] No estimate on the size of the rock crab resource exists in the literature, but Fullenbaum speculates that a maximum sustainable yield of 20,000 metric tons (44.1 million pounds) can be expected in the Northwest Atlantic.[4]

Both Jonah and rock crabs are caught by New England fishermen along with lobsters in lobster pots and with finfish in other trawls. Only Jonah crabs are reported present in offshore grounds (beyond 100 fathoms), but both crabs live inshore. Jonah crabs are most common where the water temperature is 46° to 48°F, while rock crabs prefer water temperatures in the 57° to 70°F range.[5]

Jonah and rock crabs are morphologically similar and may sometimes be mistaken for one another. Both have a broad carapace, a characteristic of the genus Cancer, and moderately large claws. The Jonah crab is more heavily built than the rock crab, has a much rougher surface, and is brick red above and yellowish beneath. The rock crab has smaller claws then the Jonah and a yellow ground color. In size, both rock and Jonah crabs found inshore average about one-third to one-half pound each. Jonah crabs found in the offshore grounds are larger than the inshore ones, and on the average they weigh about one pound each, with some weighing up to two pounds.

For habitats, the Jonah crab prefers exposed locations on the outer coasts and leads a reclusive life, hiding in crevices and relying upon its heavy claws for protection. Rock crabs, on the other hand, are adapted for life on flat, sandy bottoms where survival depends on the ability to run, catch food and escape from predators.[6]

It appears that both species molt annually after reaching maturity, and reports from New England fishermen indicate that newly molted crabs are abundant between the months of December and March. These crabs are considered undesirable by crab processors due to their low yield.

1/ Mary J. Rathbun. 1930. The Cancroid crabs of America of the families Euryalidae, Atelecylidae, Cancridae and Xanthidae. U.S. National Museum Bulletin No. 152, p. 176-192.

2/ U.S. Department of Commerce, NOAA, NMFS. 1971. Shellfish resource assessment cruise report - Delaware II. Unpublished Report, Exploratory Fishing and Gear Research Base, Woods Hole, Mass., p. 7-8.

3/ For example see Department of Commerce, NOAA, NMFS. 1973. The Jonah crab, Food Fish Facts No. 47, p. 1.

4/ Fullenbaum. 1970. A survey of maximum sustainable yield estimates on a world basis for selected fisheries, Working Paper 43, NMFS Division of Economic Research, February.

5/ Rathbun, op. cit.

6/ H. Perry Jeffries. 1966. Partitioning of the estuarine environment by two species of Cancer. Ecology, 47:3, 477-481.

Harvesting Technology

Gear. Crabs are caught around the world by a wide variety of gear. The most widely used methods in the United States include crab pots, dredges, otter trawls and trotlines. Experience in harvesting Cancer crabs shows that these crabs pot very well and, thus, there is widespread use of pots or traps in this fishery. Pot design differs markedly from port to port and from fisherman to fisherman and is highly influenced by tradition and personal preference.

Due in part to competition from lobster, there is no significant commercial fishery in New England for Jonah and rock crabs at the present time. Except for a few fishermen who fish for these crabs in Maine, all of the rock and Jonah crabs landed are incidental catches.

In Maine, fishing for rock crabs involves the same gear used to catch lobsters, the semi-cylindrical, or half-round, pot. The dimensions and construction of these pots vary significantly from port to port, but they are generally made of wood and vary in length from between 28 to 48 inches.

Pots used in the inshore and offshore Rhode Island lobster fisheries are usually rectangular, but differ in terms of dimensions and building materials. Some are wooden, some are partly wooden and partly vinyl-coated steel, and some are mostly wire or vinyl-coated steel. Other differences are the number of parlors, the location of the side entrances, latch spacing, or just the general dimensions of the pot (trap). The pot most widely used by Rhode Island inshore fishermen is wooden, rectangular and approximately one foot high, two feet wide and three feet long.

Trawling could be an effective method of harvesting crabs, except that crabs lose legs or get crushed in the cod end of the trawl. Most dealers will not accept a crab unless it is perfect, especially when the catch is bought to supply the whole fresh or frozen crab markets. Another problem with crab trawling is that the vessels used generally lack circulating seawater tanks on board. Trawlermen who catch Jonah or rock crabs usually discard them, but the few who bring some in store them on ice. They have found that if crabs are stored upside down and covered with ice, they will live longer.

Bait. The kind of bait used in the pots is influenced mostly by price and availability. The most commonly used bait to catch lobsters includes industrial fish (herring, mackerel, skates, etc.) and waste from processing, such as fish racks.

Due to preservation problems, it is common among lobster fishermen to use salted bait. However, if fresh bait is used, it might have to be kept on ice.

When asked what kind of bait they used in their lobster pots, 52 percent of the fishermen answered "salted" and 48 percent answered "fresh." The species of fish used by the respondents were numerous, but sea robbins, flatfish, menhaden and skate were the most common. Herring, redfish and sculpin were also mentioned. The experience in the different fisheries for Cancer crabs shows that the freshness of the bait has a significant effect on catches. This fact is not unknown to Rhode Island lobster fishermen. When asked if Jonah crabs and rock crabs pot better when a specific type of bait is used, only 20 percent answered that freshness did not influence crab catches. Among fresh bait suitable for crabs, there was no special preference, yet mackerel, menhaden, herring, cod, redfish and yellowtail frames were mentioned.

It seems obvious that lobster fishermen are not going to bait their traps with fresh bait just because it catches more crabs; the majority of fishermen try to use a bait that is easily available, inexpensive, good for catching lobsters and, if possible, poor for catching crabs. When asked if crabs hamper their ability to catch lobsters, 67 percent of the fishermen answered "yes" and 33 percent, "no." Questioned as to whether or not they tried to avoid areas where crabs were in large concentrations, 60 percent of the fishermen answered "yes" and 40 percent, "no."

The most popular method of baiting pots among Rhode Island lobstermen is to place the bait in bags which are hung from the front of the center frame. These purses, which are normally made of netting with one-half to one-inch mesh, help protect the bait from attacks by sand fleas and small fish. The amount of bait used per pot varies depending upon the kind of fish used and the price of the bait, but is is common in the inshore areas to use one bag of bait per pot. Each bag contains about two to four pounds of small fish (or pieces of fish) such as skate or small flounder. In the offshore areas similar bait is used but in amounts from about four to six pounds.

The cost of bait varies considerably, according to the species of fish used, and the available supply. Most fishermen buy the bait and string it themselves, but some pay to have it strung, salted and placed in barrels. Fresh bait is less expensive than frozen or salted bait. A pound of fresh bait, such as skate or other industrial fish, costs about three to five cents

compared to approximately ten to fifteen cents per pound for frozen redfish racks.

In Point Judith, Rhode Island, a barrel of salted and stringed bait, containing 60 strings (of two and one-half pounds of fish each), sells for $15 to $16. The cost breakdown for such a barrel of bait is: $8 for fish; $1.50 for salt and $6 for labor (stringing).

Catches. Due to the incidental nature of the crab catches in Rhode Island and to the fisherman's widespread practice of culling or discarding them, it is very difficult to estimate the volume of crabs caught by inshore lobster vessels. What is important to the fishermen is not the total number of crabs caught, but the total number of commercial-sized crabs in the catch.

Most fishermen and dealers in New England seem unable to differentiate inshore Jonah crabs from rock crabs; thus, it was necessary to aggregate data on catch rates.

It is common knowledge among fishermen that crab catches vary considerably from area to area, and they are often reluctant to advance an estimate of an average catch per pot. Answers to our mail survey ranged from one to twenty-four and averaged nine, while full-time inshore lobstermen reported average incidental landings of crabs ranging from one to five commercial crabs per pot.

The influence of length of soak of the pots on the catches of Jonah and rock crabs has never been tested. When Rhode Island lobster fishermen were asked if crab catches vary with the length of soak, 54 percent answered "no" and 46 percent, "yes." The reasons given by some of the fishermen who claim that length of soak does not influence catches of crabs significantly is that Jonah crabs are slow-moving animals, and after eating the bait, they will stay in the pots for some time. However, experience in other fisheries for crabs of the genus Cancer show that these will tend to escape after the bait is gone.

Offshore lobster fishermen catch Jonah crabs but not rock crabs. These offshore crabs are bigger in size than the inshore ones and command a higher ex-vessel price. A catch of one to four commercial-sized Jonah crabs per pot seems to be average for these vessels.

Vessels. Most of the inshore boats used in the Rhode Island trap lobster fishery are open, wooden boats. Size of the inshore boats varied from 12 to 43 feet in length with a median of 28.5 feet. Horsepower of their engines ranged from 18 to 160, with a median of 105.

The offshore lobster boats were significantly bigger and more seaworthy than the inshore ones. The average size of the offshore boats was 60 to 65 feet with a median of 60 feet. Horsepower ranged from 224 to 400, with a median of 350.

If a lobster fisherman stays at sea more than a few hours, he must have a method of keeping his catch alive. The most common holding method in the Rhode Island lobster fishery is circulating seawater. In the offshore grounds, it is common to use refrigeration. Lobsters and crabs are very sensitive to changes in water temperature, salinity and oxygen. The warmer the water and the higher the salt content, the less is its oxygen-holding capacity. A holding temperature of 45°F is considered optimal and can be maintained with a relatively small refrigeration unit.[1/]

A few of the respondents to the questionnaire stated that one of the reasons for discarding crabs is the lack of space in the holding tanks. Many times this is not a lack of physical space, but a lack of oxygen: holding a sizeable catch of crabs in addition to lobsters can result in a sharp decrease in the oxygen content of the water, which could endanger the lives of the animals.

Lobster tanks in both inshore and offshore boats are in most cases divided into two or three compartments, depending upon the size of the boat and the number of pots being handled. Tanks vary in design and capacity, but on the average inshore boat they can hold up to 250 pounds of lobster in each compartment of the tank. Most fishermen said they are not filling their tanks to capacity and that they could allocate at least one compartment to crabs. How many crabs can fit in one of these compartments is not known, but five fishermen estimated that 300 is a realistic figure. The greater the catch is in a holding tank, the larger

is the supply of recirculated seawater needed to provide an adequate supply of oxygen.

Production. The number of pots lifted per trip varies significantly from fisherman to fisherman.

Information from the mail survey indicates that the average full-time inshore lobster fisherman in Rhode Island lifted about 100 pots per trip and made about 100 trips during the season (seven months) in 1973. These fishermen could catch incidentally from 100 to 500 crabs per trip or from 10,000 to 50,000 crabs per season when lobstering or about 900 crabs per trip or 90,000 crabs during the season if he were fishing for crabs.

The average full-time offshore lobster fisherman averaged 40 trips during the year, lifted 400 pots per trip and averaged between one and four Jonah crabs per pot. These fishermen could obtain an incidental catch of 400 to 1,600 crabs per trip or 16,000 to 64,000 crabs per season.

1/ Thomas L. Meade, Factors Involved in the Storage and Transport of the American Lobster, New England Marine Resources Information Program, University of Rhode Island, Kingston, 1973.

Economics of Harvesting

One of the sources of decreased revenues or increased costs could be that keeping Jonah and rock crabs could mean decreased efficiency of the lobster or finfish operation. However, interviews with fishermen indicate that this is not the case as long as the time involved in sorting and storing these crabs is not subtracted from the time spent working on the main species of fish or shellfish handled. The time required would normally be taken off the leisure time that fishermen enjoy between trawls or during steaming times. But are fishermen willing to allocate some of their leisure time to handle crabs? Some fishermen said they are currently bringing in crabs, and that doing so means a significant additional income, others said that keeping crabs is not "worth the bother," given their present ex-vessel prices.

Other expenditures such as fuel, insurance, food, docking, rope, etc., are incurred whether or not fishermen keep crabs and should therefore be considered sunk, irrecoverable, and irrelevant to the question of whether or not to keep crabs.

After analyzing the potential changes in costs that would result from keeping incidental catches of rock and Jonah crabs, it is necessary to determine what changes in revenues could be derived from keeping these crabs. Ex-vessel prices in the spring and summer of 1974 were eight cents per crab or sixteen cents per pound for inshore crabs and twenty-five cents per pound for offshore crabs. Full-time offshore fishermen who lift 100 pots per trip and take 100 trips during the season, keeping the incidental catch of one to five commercial crabs per pot, would have an additional revenue of $8 to $40 per trip or $800 to $4,000 per season. Full-time offshore pot-lobster fishermen who average 40 trips during the season, lift an average 400 pots per trip and catch one to four commercial crabs per pot, would have an additional income of $100 to $400 per trip or $4,000 to $16,000 for the season (table 1).

The economics of establishing a directed fishery for rock and Jonah crabs requires a different analysis. To induce an inshore lobster fisherman to go into a directed fishery for Cancer crabs, he has to be assured that the gross return he would get from crabbing would be at least equal to the one he would get from lobstering. The reason why gross returns can be used as a basis for comparison between the two alternatives--potting for lobsters versus potting for crabs--is that the cost structure would be similar in both cases. The inshore grounds where crabs are concentrated are not farther away then the inshore lobster grounds, and the conventional lobster pot used inshore seems to be efficient in catching crabs.

Personal observations combined with a series of interviews with lobstermen lead to the conclusion that one and one-half pounds of lobsters per pot is a realistic average catch in good inshore lobster grounds in southern New England. This means that the average full-time inshore lobsterman who lifts 100 pots per trip and takes 100 trips during the season will make a gross income of $185 to $278 per trip or $18,500 to $27,000 during the season.[1] If a fisherman, like the one just described, decided to enter a directed fishery for rock and Jonah crabs and averaged nine crabs per pot, he would make a gross income of $72 per trip or $7,200 for the season--only 26 to 39 percent of the income he would make lobstering (table 2).[2] At current prices for crabs and lobsters an inshore lobster fisherman would have to catch 11 to 12 pounds of crabs for each pound of lobster sacrificed. In other words, a fisherman entering a directed inshore fishery for crabs would have to obtain an incidental catch of lobsters which would far exceed the value of his crab catch to make it economically feasible.

There is no doubt that larger quantities of rock and Jonah crabs can be landed and sold in the live crab market. It is surprising to hear several dealers state that they cannot obtain a sufficient supply of Cancer crabs, while fishermen state that they cannot find a market. However, if large quantities of crabs are landed, processing facilities will be needed. The current large inventories of crabmeat combined with decreasing per-capita real incomes is not promising for producers of crabmeat. However, the market for specialty products, such as whole, cooked, frozen, glazed crabs, crab claws, etc. seems to remain strong. The reason for this is that the crabmeat market is basically supplied from king and snow crabs of which there is a significant supply, while whole cooked crabs generally have been Dungeness crabs for which the fishery is declining. Further, to efficiently produce crabmeat requires a significantly larger investment than producing certain specialty products.

The authors conclude that a directed fishery for Jonah and rock crabs is not economical at present catch rates and prices for crabs and lobsters, but that increased landings of incidental catches of these Cancer crabs would give a significant additional income to lobster fishermen. Since the marketing system for Cancer crabs is not well developed in southern New England it would be advisable for lobstermen to set up a marketing agreement with specific dealers. Presently, a large processing plant for red crabs is under construction in New Bedford, Massachusetts, and it could process the amount of Cancer crabs over and above those what can be sold on the live market.

Table 1. Incidental catches of Cancer crabs by inshore and offshore pot-lobstermen and additional revenues that could be derived from keeping these crabs.

	Inshore	Offshore
Length of trip (hrs.)	7	48
Pots lifted per trip	100	400
Catch per pot	1-5	1-4
Catch per trip	100-500	400-1,600
Return per trip ($)	8-40	100-400
Length of season (mos.)	7	12
Trips per season	100	40
Catch per season (000's)	10-50	16-64
Value of crabs per season ($)	800-4,000	4,000-16,000

Table 2. Catches and gross revenues of inshore fishermen when potting for crabs full-time and when lobstering full-time.

	Crab	Lobster
Length of trip (hrs.)	7	7
Pots lifted per trip	100	100
Catch per pot	9	1-1.5
Catch per trip	900	100-150
Gross returns per trip ($)	72	185-278
Length of season (mos.)	7	7
Trips per season	100	100
Catch per season (000's)	90	10-15
Gross returns per season ($)	7,200	18,500-27,800