MODIFICATIONS OF CHESAPEAKE BAY COMMERCIAL CRAB POT[1/]

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ABSTRACT

The purpose of this study was to build a more efficient crab pot or one that would be cheaper to construct. Either one would be economically advantageous to commercial fishermen.

The placement of the entrance funnels in the lowest rows of meshes in the pot allowed the crab to enter with the minimum amount of random searching, and the wire partition in the standard commercial crab pot was found to be an effective means of crab retention. A one-way gate as a means of crab retention was found to be as effective as the wire partition but was cheaper and faster to construct.

For each pot initially set out in the fishing season one or more replacements will be required, therefore the one-way gate method of crab retention should receive more consideration.

INTRODUCTION

The purpose of this study was to build a more efficient crab pot or one that would be cheaper to construct. Either one would be economically advantageous to commercial fishermen.

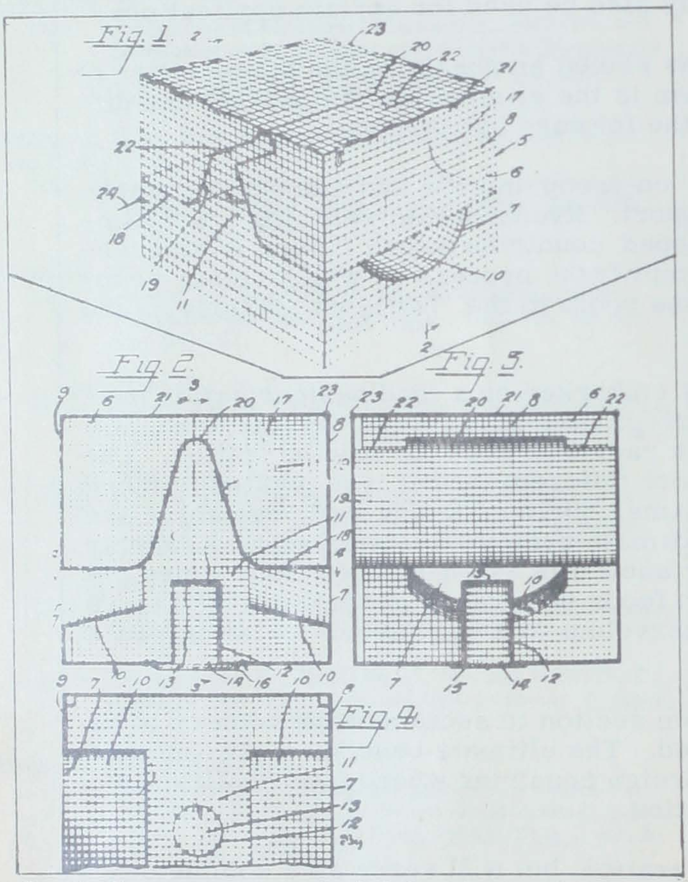

Fig. 1 - Drawings accompanying B.F. Lewis' crab pot (trap) patent, filed September 2, 1937. Fig. 1, External view; Fig. 2, Vertical section through entrance funnels, bait box and partition; Fig. 3, Vertical section, at right angle to Fig. 2, through bait box and partition; Fig. 4, Part of horizontal section top of funnels.

In 1927 B. F. Lewis began experiments with a behavior-adapted trap for use in the Chesapeake Bay commercial fishery for blue crabs (Wharton 1956). The crab pot patented by Lewis (Lewis 1938) consisted of a rectangular wire cage, separated by a U-shaped wire partition into an upper trap chamber and a lower bait chamber. Entrance funnels in the side of the bait chamber allowed the crabs access to the bait which was contained in a wire cup in the center of the floor (fig. 1).

Lewis observed that the crab entered the pot through a funnel, then seized the food and tried to run with it, and after eating swam upward away from the food.

Lewis' trap did not insure capture, but the U-shaped partition tended to delay the crab's escape.

Until Lewis' pot was perfected in 1938, the trotline method of fishing accounted for more than two-thirds of the Virginia and Maryland commercial hard crab catch. By 1959 the crab pot accounted for two-thirds of the catch (U. S. Fish and Wildlife Service 1961). It was the intent of this study to re-examine the role of the partition and to develop a device that would either delay escape longer or would physically restrain any crab that would enter the pot.

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THE APPROACH AND ENTRANCE TO A POT

In the light of observations on crab behavior, the feeding pattern of the crab can be expressed as a sequence of complex events: (1) directed searching--the phase of searching where the animal is responding to stimuli localized in the habitat; (2) food seizure--the action of the crab grasping the food with its chelae; (3) running with the food--the movement of the crab away from the point of first contact with food; (4) eating on bottom--the act of ingestion of food; (5) swimming away--the rapid swimming of the crab away from the food item, which it leaves on the bottom.

To be most effective the crab pot should be built in a manner that would offer the least hindrance to the crab's feeding behavior. The placement of the opening funnels would be a key factor in determining the length of time the crab spends in entering the pot. If an entrance funnel were located close to the point where the crab first encountered the pot, time spent in locating the funnel would be minimized.

MATERIALS AND METHODS: Sixteen crab pots of standard commercial dimensions were constructed. The standard pot is 24 inches long, 24 inches wide, and 20 inches high, and is made of 18-gauge, galvanized $1\frac{1}{2}$-inch mesh, hexagon netting (fig. 2). An iron rim is tied on the bottom of the pot to weight it.

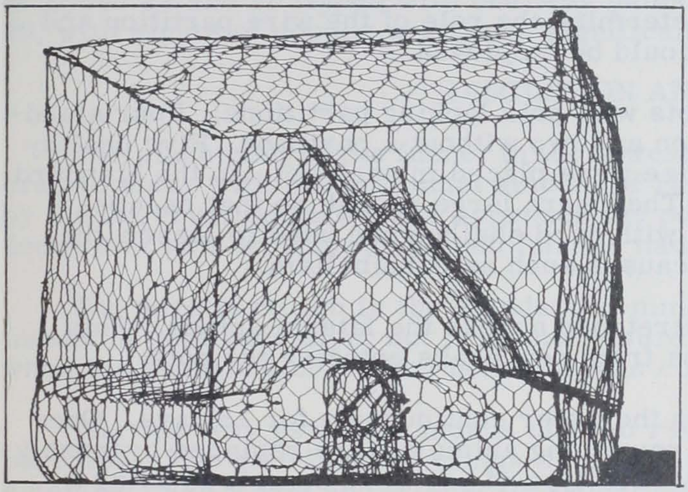

Fig. 2 - Chesapeake Bay crab pot is 24 x 24 x 20 inches, made of double-galvanized, 18-gauge, hexagonal-mesh wire.

The pots were made up in sets of four, each set differing only as to the height from the lower edge of the entrance funnels on the side of the pot.

To eliminate bias due to the depth of the water, bottom type, influence of tides, and diurnal variation in activity of the crab, the pots were placed in a Latin square design (Snedecor 1959). Catch was checked once a day and at that time the pots were rebaited.

The pots were fished for four 2-week periods in the months of May, June, July, and August of 1961. Non-fishing periods were used to repair the pots and to clean them of fouling organisms. All the fishing was done on the north shore of the York River at Gloucester Point, in front of the Virginia Institute of Marine Science.

OBSERVATIONS: The crab approaches the pot in a crawling, sideways motion, usually pushing all but the swimming legs (which are used in maintaining balance) through the mesh of the pot in an attempt to reach the bait. Some crabs move away from the pots after "investigations" for various lengths of time. Continued search for the opening is a random process, in which the crab works its way around the base of the pot until the opening is found. The crab then crawls through the funnel into the bait chamber of the pot.

A multiple range test (Duncan 1955) for differences in mean catch for the second, third, and fourth fishing periods showed catches by the types of pots with funnels in the lower meshes were significantly larger than those with funnels in the upper meshes. Statistical analysis of data for the first period of fishing was omitted because of the preponderance of zero catches. It is believed that the zero catches were the result of a scarcity of crabs in the fishing area at the time of fishing and not due to malfunctioning fishing gear.

The smaller catches made by the pots with funnels placed at the top are considered to be evidence in support of the observation that the crab most often approaches the pot by crawling, and because of this the pots with the lower-placed funnels proved to be the most effective.

THE FUNCTION OF THE PARTITION

In field trials of the prototype of the modern crab pot, B. F. Lewis observed that the crabs have a tendency to collect in the bait chamber and that after feeding they will attempt to escape by swimming upward through the openings in the inverted U-shaped partition and into the trap chamber. Since then, it has been standard practice to include a wire partition in the pot for the presumed function of making escape from the pot more difficult. The partition is used to capitalize on the crab's response to move upward to the water's surface after feeding.

Observations on the method by which a crab leaves the bait chamber and enters the trap chamber of the pot reveal that there are two ways by which this movement may occur, depending upon the relative position of the crab to the partition at the moment of first contact. If the crab's ventral side makes first contact, the crab will grasp the partition and continue to move at random until an opening is found. However, the dorsal side of the crab may contact the partition first. The crab may then bump the partition repeatedly until an opening is found, but after unsuccessful attempts at passing the barrier it may return to the floor of the pot. Once the crab returns to the floor of the pot, its behavior is not predictable.

This phase of the study was undertaken to determine the role of the wire partition and to see whether other methods of crab retention could be employed.

TESTS: 1. Comparison of standard crab pots with pots lacking partitions: Four standard-size crab pots were used, two with a partition and two without a partition. Five healthy hard-shelled crabs of approximately the same size were placed in each pot. In the standard pot the crabs were placed in the trap chamber. They were large enough so that escape through the mesh was impossible. Active crabs with hard shells were used to lessen the chances of mortality by handling and by natural causes such as cannibalism.

Each crab was marked with a rubber band stretched across the lateral spines. This precaution was taken to distinguish the test crabs from new crabs entering the pots.

The pots remained unbaited and were kept in the water continuously for 13 days. Once each day pots were checked and at that time the remaining animals were replaced by freshly-caught crabs. The numbers of crabs retained by each type of pot were compared using a Chi-square test of independence (Snedecor 1959). The results of the test showed the wire partition to be an important factor in crab retention.

2. Comparison of standard crab pots with pots having markedly inclined funnels and lacking partitions: An attempt was made to make escape more difficult by inclining the entrance funnels more steeply.

Four standard-size crab pots were used, two with a partition and two without a partition but entrance funnels inclined at a 60-degree angle. The pot without a partition did not retain as many crabs as did the standard pot with a partition.

A FUNCTIONAL ESCAPE-PREVENTION DEVICE

Escape might be made impossible if one-way gates were placed over the entrance funnels. Regardless of the behavior patterns of the animal, it would be trapped after it had passed the gate.

Sixteen standard-size crab pots were used. All the pots had funnels placed in the first to third row of meshes from the lower edge of the side of the pot. The pots were made up in sets of four, each differing in the device used for crab retention: Type C had the wire partition which is normally included in the standard commercial pot; Type 20 lacked the wire partition but had a one-way gate of 20-gauge copper wire suspended from the top of the interior edge of each funnel; Type 22 was designed on the same principle as Type 20, but the wire used was 22-gauge Nichrome IV wire; Type 28 was also built like Type 20, but 28-gauge

Chromel A wire with a 0.33 gram weight at the free end was used. Both Nichrome IV and Chromel A contain 80 percent nickel and 20 percent chromium.

The weight of the gate in Types 20 and 28 was the same, but heavier than in Type 22. Different gauges of wire were used to determine if the thickness of the wire or the weight of the gate could have any effect on the efficiency of a pot.

Types 20, 22, and 28 pots with one-way gates are faster and cheaper to construct than Type C, the "standard" pot type.

The sixteen pots were placed in a Latin square design to eliminate bias due to depth of water, bottom type, influence of tides, and diurnal variation in activity of the crabs. The pots were fished continuously for three days. The catch was checked once a day and it was then that the pots were rebaited.

OBSERVATIONS: The analysis of the Latin square design showed that differences in retention are probably due to differences in pot types. By using a multiple-range test for differences in pot means, it was shown that there was no significant difference in the catches of Types 22 and 28 (types with one-way gates) and C (the "standard" pot). The catch of Type 20, with a gate of copper wire, was significantly lower than that of the other three types.

DISCUSSION AND CONCLUSIONS

The placement of the funnel in the lowest rows of meshes in the pot appears to allow the crab to enter with the minimum amount of random searching. This contention is supported by the observation that crabs approach the pot by crawling, and also by the statistical evidence that pots with lower placed funnels had larger catches.

The wire partition in the standard commercial crab pot was found to be an effective means of crab retention, but it did not insure capture and its effectiveness was reached only when the sequence of feeding behavior was completed.

The one-way gate as a means of crab retention was found to be as effective as the wire partition. The gate blocked escape from the pot, but it may have prevented some crabs from entering. Van Engle and Wojcik (personal communication) have tried various types of one-way gates as a means of crab retention but their results have been inconclusive.

Cohen and Dijkgraaf (1960) have demonstrated the presence of three types of sensory receptors in crustaceans: (1) light receptors, (2) chemo-receptors, (3) tactile receptors. Any of these three types of sensory receptors might be used to detect the presence of the gate.

If only chemo-receptors are involved, then Type 28 should not have consistently caught more crabs than Type 22 for their gates were made of the same alloy.

Since the gate with the wire of the finest diameter (in pot Type 28) caught the most crabs, it may be that either light receptors or tactile receptors, or both, are used in the detection of the gate. If tactile receptors are used, then the key factor may be the diameter of the wire and not its weight, for the gates in Types 20 and 28 weighed the same and differed only in the diameter of the wire. At our present state of knowledge the reception of the "gate" stimuli can not be attributed to any single sensory modality. Thus the actual method of reception is open to future investigation.

A one-way gate is as effective as the partition as a means of crab retention and is less costly in labor and material. "The loss of pots from all sources is so great as to require one or more replacements for each pot initially set out" (Van Engle 1962). For these reasons, the use of one-way gates in pots for crab retention should receive more consideration.

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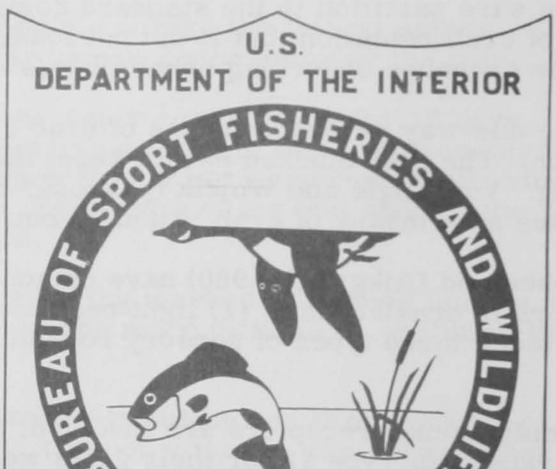
U. S. BUREAU OF SPORT FISHERIES AND WILDLIFE ADOPTS NEW EMBLEM

A new eye-catching emblem (in the form of a shield) has been adopted by the Government agency responsible for Federal wildlife and sport fish activities, the U. S. Department of the Interior announced on November 27, 1962. Motor vehicles, boats, fish hatcheries, wildlife refuges, and other equipment and installations of the Bureau of Sport Fisheries and Wildlife in the Department's Fish and Wildlife Service will be identified by the new emblem.



The shield depicts a marsh scene. Leaping from the water is a fish symbolizing the Bureau's sport fisheries activities. Overhead is the familiar flying goose symbolizing the wildlife work of the Bureau.

Fish and Wildlife Service emblems were first used in Alaska before statehood. At that time, the fish and wildlife resources of the territory were administered by the Fish and Wildlife Service through its Alaska Game Commission. Alaska Game Commission employees were the only service employees then authorized to wear uniforms. The shoulder patch for those uniforms has a typical Alaskan mountain wilderness background with a salmon leaping a falls. Overhead is a flying goose. The new stylized Bureau emblem has evolved from the Alaska Game Commission shoulder patch, which remains standard for all Bureau of Sport Fisheries and Wildlife uniformed employees throughout the United States.

The new Bureau emblem will appear on entrance signs to field stations, on signs marking the boundary of refuges and other landholdings, on bird-banding cards, and on cards notifying pond owners of fish hatchery deliveries.