Mariculture Potentials in Estuarine Oil-Pipeline Canals [1]

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ABSTRACT

Rotenone samples of estuarine oil-pipeline canals in Louisiana showed that natural standing crops of harvestable fin-fishes ranged from 133 to 369 kilograms per hectare, with an average minimum wholesale value of $38.80 per hectare. Trawl samples indicated an abundance of blue crabs, and that white, pink and brown shrimp overwintered in these canals. Salinities ranged from 2.0 to 25 parts per thousand.

Potential mariculture uses of these canals are discussed, involving polyculture of naturally occurring species of fishes, mollusks and crustaceans, along with cage culture of catfish, pompano and other species. Problems associated with pipeline mariculture are discussed.

INTRODUCTION

Canals excavated in estuarine marshes for the purpose of oil exploration, drilling and transportation by the oil industry have become an important factor in determining future management practices for our coastal wetlands. These man-made channels can be classified into groups, according to their initial purpose: those used for access to oil well drilling sites, those used for pipeline right-of-way and those used for oil-logistic support vessels and the movement of petroleum barges. Canals are necessary for these operations due to the type of equipment used by the oil industry in marsh areas. In some oil fields, a network of main channels and their connecting canals may amount to as much as 30 miles of canals within a 6 square mile area (Davis, 1973).

Unplanned or poorly planned canal dredging operations have often resulted in direct destruction of valuable marsh areas (Bybee, 1972). Barrett (1970) reported that the length of dredged canals and channels in coastal Louisiana is nearly 4,600 miles, of which open water area is 42,104 acres, with a spoil area of 40,000 acres. This represents a direct alteration of over 82,000 acres, and an indirect alteration of several times that amount. Of course, not all of these canals were constructed exclusively for the oil industry, but many of them were. The

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impact of these alterations is brought to the forefront by environmentalists such as Stroud (1971), who claimed that "for each acre of estuary obliterated through filling, or otherwise destroyed, there could be a corresponding annual loss in yield (at present levels of resource development) of about 535 lb of fisheries products on the Continental Shelf." Taylor and Salomon (1969) estimated the value of an estuarine area, Boca Ciega Bay, Florida, in terms of its biological resources, to be about $400 per acre ($988 per hectare) per year.

Due to the importance of our wetland resources, and the apparent impact of environmental modifications, such as canals, upon these resources, we attempted to assess the importance of the canals as an environmental resource in their own right. Many canals have water-control structures, such as weirs, dams and dikes, that cause these canals to become semi-permanent, brackish-water pond ecosystems. Our objectives were to identify the biological resources of some of the smaller channels, known as pipeline canals, and to determine the feasibility of culturing various commercially important species in these canals. Since it has been shown that channel catfish, a commercially important fresh-water species, can be grown in brackish water (Perry and Avault, 1970), and because several environmental parameters important to the growth and management of shrimp have been documented (Barrett and Gillespie, 1973; Ford and St. Amant, 1971) we began mariculture experiments with those organisms. We felt that once we determined the natural productivity of these canals, we could attempt to formulate management practices that would enable us to use mariculture as a means of maintaining some of the food resources that might otherwise be lost from wetland environments.

METHODS AND RESULTS

Canals Used in the Study

The studies were conducted in several canals located in a salt-marsh, estuarine area in Lafourche Parish, Louisiana. The canals are damned on both ends. Spoil banks on each side of the canals were raised at least 60 cm above marsh level with spoil from inside the canals. A 76-cm culvert with a gate-valve was installed at one end of each canal, to manipulate the water level and salinity within each canal. All canals used in these studies had been constructed between 1958 and 1968. Three canals (R-1, 2.55-ha; R-2, 4.45-ha; R-3, 1.21-ha) are located within 5 km of each other, and had normal salinities of about 5 ppt. They were virtually closed off from the surrounding environment, except during periods of abnormally high water. Another canal, closer to the Gulf of Mexico, is 7.38-ha, with a normal salinity of 25 ppt.

Study of existing fish populations

The three R-canals were rotenoned in May, 1972. An attempt was made to recover all but the smallest fishes. Standing crops and species composition of the fish populations differed among canals. Canal R-1 had a standing crop of 216 kg/ha, mainly Gulf menhaden (38%), sheepshead (20%) and red drum (16%). At current wholesale prices, the value of edible species alone was $35.52/ha. The standing crop of canal R-2, 155 kg/ha, was valued at $34.79/ha, due to the larger percentages of valuable fishes (sheepshead, 35%, and red drum, 18%). Canal R-3, with the highest standing crop (369 kg/ha), was valued at $47.53/ha, even though gizzard shad, a low-value species at 15c/kg, made up 63% of the standing crop, by weight. The fourth canal, FO-2 had a standing crop of 133 kg/ha, but was valued at $36.53/ha. Overall, this amounted to an average value of $38.80/ha for edible species. We did not estimate the commercial value of other species, such as menhaden, which could be used as crab or crawfish bait, or be converted into fish meal. This study showed that as many as 28 different species may be found in these canals, many of which have commercial and recreational value. A complete list of species can be found in Kilgen, Harris, and Kraemer (1973).

Subsequent analysis of these canals for water quality, plankton and benthos have indicated that some of these brackish-water canals can probably be used to produce valuable fish crops, by applying many of the techniques from fresh-water pond management. Several species could be stocked into a blocked-off canal, using various stocking ratios that would enable different species to fill the many ecological niches within the water column. Annual crops could be harvested, or the canals could be opened to sport fishing.

Commercial Production of Finfish

Our initial experiments with fish culture in these canals involved channel catfish, *Ictalurus punctatus,* and fresh-water fish-production techniques. In June 1972 approximately 1 month after rotenoning, two canals (R-1, R-3) were stocked with catfish at the rate of 2,471 fingerlings per ha, and were provided a floating supplemental feed on a daily basis, for 6 months, at 3% of their body weight. Another canal (R-2) was stocked with 618 fingerlings per ha, with no supplemental feeding. The fish averaged 53 g.

Salinities in canals R-1 and R-2 remained between 4.4 to 8.9 ppt, while the salinity in R-3 increased to 15.5 ppt within 2 weeks after stocking, and rose even higher in August. The reasons for the increase in salinity are unknown, although the salinity of the surrounding area reached 24.4 ppt. Waters of higher salinity may have entered the canal through subsurface seepage.

Catfish in R-1 were harvested on December 1, 1972, and weighed 323 g. The survival rate, based upon harvest by rotenone application, was only 25%. Heavy losses were attributed to predation by alligator gar, *Lepisosteus spatula,* which had not been eliminated by rotenone. Losses could also have occurred during an abnormally high tide which caused overbank flooding. Seining, trapping, trammel nets and even hook-and-line proved to be inefficient in harvesting. The fish were allowed to remain in R-2, due to harvesting difficulties. No fish were ever recovered from R-3 by sampling methods (seines, hook-and-line) or by rotenone application.

The recovered fishes were in excellent condition, and the water quality remained adequate during the study. We felt that if we could overcome problems caused by predators, flooding and harvesting, the canals might yet be utilized for commercial fish production. We believed that cage culture was the answer, as predation would be stopped, fish would not be lost to flooding and harvesting from cages would be more efficient. For these reasons, we placed 10 floating cylindrical cages 1-m^3 in volume, into R-1 and R-2. They were constructed from 13 x 38 mm mesh, 16-gauge vinyl-coated galvanized steel wire, with styrofoam floats. Into these we stocked 500 fingerling channel catfish, averaging 61 g. The overall stocking rates were 392 per ha in R-1 and 225 per ha in R-2. They were stocked between March 1 and March 17, 1972. A floating-type commercial feed, Purina Cage Catfish Chow, was fed daily based upon 5% to 2% of their body weight.

Cage culture eliminated the problems of flooding, predation and harvesting, but new problems were encountered which caused a premature termination of this experiment. The most serious was the difficulty in obtaining an adequate supplemental feed. It has to be a complete ration, and must float for several hours. The Purina Chow did not float at all in some cases, and much of the feed was wasted. Even so, it is projected that a feed conversion of 2.5 to 1, or better, might be expected. Fouling organisms, such as barnacles, obstructed water flow through the cages. The use of marine copper paint seemed to reduce this problem to a tolerable level. A bacterial infection caused by *Aeromonas liquefaciens* was controlled by immersing the cages in a tarpaulin container of 15 ppm formalin, and by incorporating oxytetracycline into the feed, but a 30% mortality was sustained.

Although our objective of raising the catfish to 0.5 kg was not achieved, due to feeding and disease problems, we did answer several questions. We estimate that as much as 2,000 kg/ha can be produced in brackish-water canals using cage culture techniques, if a suitable feed can be found. There were no apparent differences in water quality between the two canals, which leads us to believe that they were stocked much below their potential carrying capacity. If a suitable feed can be found, cage culture of catfish in these canals could probably be conducted on a profitable commercial basis. This also suggests opportunities for culture of other valuable species such as pompano, speckled trout, red and black drum, croaker, rainbow trout, and others.

Commercial Production of Shellfish and Crustaceans

Results of experiments conducted in other brackish-water areas (Broom, 1968; Neal and Latapie, 1973), tend to indicate that shrimp could be cultured in these canals. We found adults of both brown and white shrimp in several canals, which led us to believe that these organisms might overwinter there. In an experiment designed to prove this, white shrimp (*Penaeus setiferus*) averaging 4 g were stocked into canal FO-2 in September, 1972. Salinities averaged 23.0 ppt. By May, 1973, white shrimp averaging 26 g were recovered. The lowest temperature recorded was 9° C in February, 1973. Although they were not stocked as part of the experiment, pink shrimp (*P. duorarum*) averaging 16g were discovered in April, 1973. Since they can overwinter in these canals, it should be possible, using proper management techniques, to produce and harvest several hundred kg/ha/year. This could also be accomplished while raising fish in cages.

We observed that shrimp congregated around areas where supplemental feed was offered. It is assumed that they also eat fecal material which accumulates under the cages.

We estimated that the natural production of blue crabs, *Callinectes sapidus*, in these canals might be at least 4 bushels per ha (5 dozen/bushel). In Louisiana, these crabs have an average wholesale value of $6.00 per bushel, or $24 per ha.

It is also possible that oysters can be cultured in canals on floating rack systems together with cages of fish. This could add a tremendous amount to the value of these canals.

Other Uses

Many recreational camps have been constructed on the canal spoil banks. It is conceivable that some canals could be managed for optimum recreational purposes by stocking them with various sport fishes. The canals might then be operated as privately owned fee-fishing ventures or as state owned lakes, opened to the public.

SUMMARY AND CONCLUSIONS

Many of the closed-off canals in estuarine areas can be managed to produce annual crops of fishes and shellfishes of commercial and recreational value. Some canals have yielded high standing crops of several fish species, shrimps and crabs. One of the most promising management techniques is that of using cage culture for a commercial fish species, such as channel catfish or pompano. This method of fish culture eliminates problems of predation, flooding of canals and harvesting. Sport fishes, such as speckled trout, red drum and others, with forage species, could be stocked and managed in the same canals. Another alternative would be to stock shrimp or oysters in canals, with fish raised in cages. The shrimp would eat waste material from under the cages, and oysters, grown on racks, would filter out algae and other foods from the canal waters. This system would provide maximum benefits from a relatively unused resource, increasing its commercial value by several hundred dollars per hectare. For these reasons, it is imperative that research be continued towards development of canal fisheries management techniques, so that these valuable resources will not be lost.

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