

THE TEXAS MARINE HATCHERY PROGRAM – IT WORKS!

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ABSTRACT

Red drum (*Sciaenops ocellatus*) is an estuarine-dependent sciaenid that ranges from New York to Mexico and has historically supported sport and commercial fisheries throughout its range. Red drum populations in Texas began a dramatic decline in the 1970s, prompting regulatory measures such as size, bag, and possession limits; restrictions on gill nets and their operation; a commercial quota; and license restrictions. These measures proved ineffective, and finally in 1981 the commercial sale of red drum was banned. Presently the sport bag limit on red drum is three per day, and only fish that are 20–28 inches may be retained.

In 1982, the Texas Parks and Wildlife Department began operating a marine fish hatchery to enhance dwindling populations of red drum. To date, over 42 million red drum fingerlings (25 mm TL) have been raised and stocked into Texas bays. Recent expansions of the facility have boosted production capabilities to 20 million fingerlings annually. Impact evaluations begun in 1983 indicate that the enhancement of red drum populations in Texas bays by stocking is a successful and effective management tool.

RESUMEN

La corvina roja (*Sciaenops ocellatus*) es un sciánido de estuario cuya distribución geográfica se extiende desde Nueva York hasta México, y que históricamente ha soportado la presión de pesca tanto deportiva como comercial. Durante la década del 70 las poblaciones de corvina roja en Texas experimentaron una caída dramática, lo cual llevó a poner en práctica ciertas medidas reguladoras limitando el tamaño y la cantidad de la captura, restringiendo el uso de redes de enmalle, limitando la cuota comercial e imponiendo restricciones a los permisos de pesca. Estas medidas no resultaron satisfactorias y finalmente en 1981 se prohibió la venta comercial de la corvina roja por completo. Actualmente, la pesca deportiva está restringida a 3 corvinas por día, de talla 20 a 28 pulgadas.

En 1982 el Departamento de Parques y Vida Silvestre de Texas ("Texas Park and Wildlife Department") comenzó a operar un criadero con el objeto de realzar la población de corvina roja mermada.

Hasta la fecha, más de 42 millones de alevinos (de talla total 25 mm) han sido criados y sembrados en las bahías de Texas. Gracias a una expansión en la infraestructura, la capacidad de producción de alevinos aumentó a 20 millones por año. En 1983 se comenzó a evaluar el impacto de criaderos; estas evaluaciones demostraron que la siembra de crías en las bahías de Texas para realzar las poblaciones de corvina roja es una herramienta exitosa y efectiva en el manejo pesquero.

INTRODUCTION

Red drum (*Sciaenops ocellatus*) is an estuarine-dependent sciaenid that ranges from New York to Mexico, and historically supported sport and commercial fisheries throughout its range. Unfortunately, this species has become another poignant example of the pervasive attitude that fishing (both sport and commercial) can have no significant impact on marine fisheries (Rutledge and Matlock 1986). Red drum populations that had experienced dramatic declines over a ten-year period were dealt a severe blow in 1983 when the blackened redfish craze created strong consumer demand for the fish (NMFS 1986). This demand increased commercial fishing for the spawning stock in the Exclusive Economic Zone (EEZ), accelerating the move toward the extreme regulatory measures that are now in effect to protect this species.

Today, red drum caught in South Carolina, Alabama, Texas, Louisiana, and the Gulf of Mexico EEZ cannot be sold. Greater restrictions on harvest have also been placed on all fishermen in every Gulf state. In Texas, commercial harvest of red drum has been prohibited; bag limits have been reduced from five to three; and a size limit of 20–28 inches has been imposed. In 1988, netting of any type was prohibited in Texas waters to reduce the by-catch and illegal netting of this species.

Managers in Texas have also been fortunate to have the opportunity to use hatchery-produced red drum to evaluate stock enhancement. Based on the preliminary successful results from Texas, Florida and Alabama are also going to use red drum from saltwater hatcheries for stock enhancement, and California is presently considering the feasibility of saltwater hatcheries.

In the fall, Texas red drum spawn in the surf. Their larvae migrate through passes into estuarine nursery grounds. Matlock (1987) postulated that larval recruitment into the bays could be a limiting factor of annual year class abundance. He presented results showing that in the bay hardest hit by Hurricane Beulah in 1967, the recruitment of red drum was larger than during any of the eight previous years. Further, this bay was the only one to show an increase in recruitment. Increased larval transport into estuarine nursery areas caused by high tides was listed as one explanation for this phenomenon.

RESULTS AND DISCUSSION

St. Charles Bay Study, 1979–1981

Matlock's limited recruitment theory and the possible use of hatchery-produced fish for stocking purposes was tested in St. Charles Bay from 1979 through 1981 (Matlock et al. 1986). This 3,400-hectare bay was stocked with 978,829 fingerlings in 1979, 276,540 in 1980, and 577,500 in 1981. Fish were stocked in the summer of 1979, fall of 1980, and spring of 1981. Because red drum spawn in the fall, fish stocked the following spring and summer were smaller and were tracked by length frequency for up to 9 months in both bag seine and gill net samples. Fish released in August 1980 apparently did not survive, possibly because of a hurricane later that month that caused salinities to drop from 25 to 9 ppt almost overnight.

Matlock found a significantly higher mean catch of red drum in bag seines for 1979 and 1981 in St. Charles Bay compared to an adjacent bay that was not stocked. However, the 1980 summer catch was similar in both areas when only native fish were present. He also concluded that "poststocking surveys indicated that fish stocked in 1979 and 1981 enhanced the native population to different degrees, undoubtedly because almost twice as many fish were stocked in 1979 as in 1981. Therefore, future evaluations should concentrate on repeated stockings into limited areas to determine the relationship between stocking rate and enhancement."

GCCA/CPL Marine Development Center

The St. Charles Bay pilot study, and other evidence that had been accumulated from previous years, sparked the interest of the Gulf Coast Conservation Association (GCCA). This group of conservationists enlisted the support of the Central Power and Light Company (CPL), a public utility company, and a unique tripartite project was devel-

oped. The GCCA provided money to construct a 20-acre fish hatchery on land provided by CPL. The Texas Parks and Wildlife Department provided personnel and annual operating expenses for the project. The hatchery produced its first fingerlings in 1983. The success of the hatchery in the past six years has resulted in additional support from the corporate sponsors, and a major \$4.3 million expansion of the facility is nearing completion. To date, the facility has produced over 42 million red drum fingerlings; the annual production from the expanded facility can reach 20 million fingerlings.

Evaluations of Stocking Success

The success of enhancing red drum populations using hatchery-reared fingerlings has been evaluated since 1983. One of the first evaluations involved the initial survival of stocked fishes. Hammerschmidt and Saul (1984) reported that average survival of stocked fish that were held for 24 hours in cages was $89.4\% \pm 2.7\%$. Similar tests were conducted in 1984 and 1985; overall 24-hour survival of pond-reared red drum held in cages was $86.2\% \pm 2.2\%$ (Hammerschmidt 1986). Mortality associated with harvest and hauling stress usually occurs within 24 hours; therefore the 24-hour survival experiments have been discontinued.

Biweekly bag seine samples in the vicinity of the stocking site were used to determine longer-term survival. Dailey and McEachron (1986) captured stocked red drum fingerlings in San Antonio Bay up to 1.5 months after stocking. After that period of time, fingerlings were not vulnerable to capture gear.

An intensive study to determine long-term effects of stocking red drum was begun in 1983 in the San Antonio and Corpus Christi bay systems. The preliminary results of this work were presented by Matlock (1986b), and a detailed analysis is currently being prepared. About 14 million fish were released in 1983, late 1984, and early 1985 into these two bay systems. In the two stocked bays and one unstocked bay sport-boat anglers were surveyed, and fishery-independent monitoring was done with gill nets (7.6, 10.2, 12.7, and 15.2-cm stretched meshes). Results indicated that mean catch rates in gill nets in the Corpus Christi Bay system were much higher in the two years after stocking than in the years before stocking. Matlock also noted that the increased catches after stocking were primarily in the 7.6-cm stretched mesh. This pattern was not apparent in the unstocked bay, reflecting recruitment of the stocked fishes one year after each stocking. Stocked fish also were evident in each subsequent

season in the larger-mesh portions of gill nets. Stocking apparently increased the fishing success of sport-boat anglers for red drum. The mean landing rate by these fishermen increased 150% over the mean historic rate in the stocked bay system. Harvest rate in the unstocked bay also increased, but only by 50%.

Results of Tagging Efforts

Precise determination of the contribution of hatchery-reared fish to the sport creel requires a reliable method of marking. In the case of red drum in Texas, this is the single hurdle left to overcome in evaluation efforts. Initial efforts to tag red drum using magnetic coded wire tags inserted in the snout were unsuccessful. Gibbard and Colura (1980) reported tag loss rates ranging from 59% within 3 months to 73% at 12 months. Matlock et al. (1986) reported that only 3 of the 38,000 fish that were tagged in this manner were recovered in the St. Charles Bay study. More recent studies using the same type of tag implanted in the cheek musculature revealed that the minimum size fish that could be tagged was 70 mm TL, which is larger than fish that are currently being introduced (Bumguardner et al. 1988). Current research efforts center around the use of oxytetracycline, optical pattern recognition using scales and otoliths, and genetic marking. Genetic marking would provide the most valuable tag because it can label very small fish (even fry); it will last the lifetime of the fish; and it will pass to future generations.

Cost-Benefit Analysis

The question of cost versus benefits is constantly raised in analyses of the effectiveness of hatchery stocking programs. Fisheries managers question whether stocking hatchery-reared fish constitutes the best use of resource dollars, especially when stocking programs require capital investment to build hatcheries. The cost benefit of a stocking program can be calculated with the formula

$$\text{Cost benefit} = \frac{\text{number harvested} \times \text{value of fish}}{\text{operating costs}}$$

where number harvested is the number of hatchery fish that enter the anglers' creels; value of fish is the value to the state of an angler catching a single fish (usually calculated as direct expenditures multiplied by a factor of 3 to account for indirect and induced costs); and operating costs include annual salaries, operating expenditures, equipment, and depreciation on capital expenditures. For the Texas situation, number harvested has not yet been

determined. Value of fish, however, was calculated by Matlock (1986a). He estimated the direct market value of the angling experience for red drum at \$29.7 million in 1976. This amounts to \$89.1 million in direct, indirect, and induced impacts. This value adjusted with the Consumer Price Index to 1987 dollars would be \$178 million. Sport harvest in 1976 was approximately 400,000 red drum, making each fish worth \$445 in 1987 dollars. Operating costs for 1989 are estimated at \$362,000 for salaries, operating expenses, and equipment. An additional \$285,500 was added for depreciation of capital construction costs (straight-line depreciation of \$5.71 million over 20 years), making total operating costs \$647,500 each year.

Having two factors in the equation permits the calculation of the break-even point (number of fish that must enter the creel to produce a 1:1 cost-benefit ratio). Based on these figures, 1,455 red drum would have to survive and be harvested each year for the state to receive \$1 of benefit for every \$1 of cost to operate the hatchery. Based on a conservative anticipated production of 15 million fingerlings per year, cost benefits of 1% survival would be 1:103; 5% survival would be 1:515; and 10% survival would be 1:1031. Seneca and Taussig (1974) indicate that opportunity costs must be included in evaluations of cost benefits using public expenditures. Opportunity costs account for the rationale that money invested in fish hatchery construction, for example, could be invested in an interest-bearing account. The interest that could be earned on this money becomes an opportunity cost that must be added to the operational costs of the hatchery. Addition of opportunity costs (construction costs \times 10%) would increase operating costs to \$1.2 million per year; but still only 2,738 fish would have to survive to break even. These very positive cost-benefit projections demonstrate the economic viability of a saltwater hatchery even at low survival rates.

CONCLUSIONS AND RECOMMENDATIONS

Evaluation of the 6-year red drum stocking program in Texas highlights the success of enhancing red drum populations using hatchery-reared fish. Stocked fish do survive for the first 24–48 hours (>84%). Bag seine samples in the stocking areas have documented but not quantified survival up to 60 mm (at which size the fish escape the capture gear). But most important, the number of fish harvested in bays that have been stocked has nearly doubled over historic mean harvest rates in those systems.

The Texas experience has shown several things that are generically applicable to the evaluation of other marine stocking programs:

1. The effectiveness of marine fisheries stock enhancement programs cannot be evaluated on an a priori basis. To measure the impact, fish must be stocked. Once they have been stocked successfully, the system will be forever changed.

2. Substantive impact on a large, dynamic fishery may require massive stockings. Experimental designs using small numbers of fish may not show up against annual variation in population abundance.

3. Although managers may strive for statistical accuracy measured with a micrometer, benefits may only be measurable with a yardstick. Long-term trends may be the only indicator of success.

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