

MARINE STOCK ENHANCEMENT IN FLORIDA: A MULTIDISCIPLINARY, STAKEHOLDER-SUPPORTED, ACCOUNTABILITY-BASED APPROACH

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Saltwater fishery management in Florida, USA, is mandated to include user-supported hatchery-based stock enhancement. Scientists at the Florida Fish and Wildlife Conservation Commission (FWC) and Mote Marine Laboratory (MML) have taken a multidisciplinary, quantitative approach to developing effective strategies for integrating stocking into traditional fishery management. In Florida, focus has shifted over the past eight years from production-oriented marine stocking to an assessment-driven development approach. The goal is to develop and expand an economically successful and ecologically sound stocking technology for rapidly replenishing depleted fish stocks in a multi-billion dollar (US) saltwater fishing industry.

Florida's marine stock enhancement program is guided in part by a stakeholder board called the Florida Marine Stock Enhancement Advisory Board (MSEAB), which meets with program biologists and administrators semi-annually to discuss program achievements and planning. This advisory board is comprised of representatives from the recreational fishing industry, conservation groups, anglers, fishing guides, scientists, and FWC commissioners. Fishery managers and science advisors provide updates to the board and seek consensus on adaptive-management recommendations, which can change the direction of the program to achieve program goals. For example, the MSEAB agreed with management/advisors to pull stocking out of Biscayne Bay in Miami to finish development of stocking protocols in Tampa Bay Florida, an ecosystem less affected by anthropogenic disturbances of age-0 red-drum recruitment habitats.

The marine stocking program in Florida is entirely user-supported, with costs paid for by state and federal fishing-license proceeds. Moreover, stakeholder groups operating in partnership with FWC have developed a satellite nursery facility at a remote location to help in the fish production process. This effort has been surprisingly successful, albeit at a small scale so far.

The FWC/MML scientific team has developed and implemented environmentally responsible protocols for protecting genetic diversity, health, and ecological attributes of target stocks. Team members have also participated in the development of genetics and health policies that apply to the release of cultured fishes statewide. These policies have provided the foundation for legislative rule-making and activity permitting.

In an ongoing stocking effort involving the release of cultured red drum (*Sciaenops ocellatus*), empirical culture-tag-release-recapture experiments have been used to explore the effectiveness of different release strategies. Fishery independent stratified-random sampling has been used to identify initial hatchery contributions to annual recruitment and to explore the effects of various stocking variables (e.g., size-at-release, release location, release season) on early recapture rates. Fishery-dependent monitoring has provided quantitative data from contact interviews with fishers, stratified by gear, location, and time of day, to characterize the red drum sport fishery and to evaluate hatchery contributions to the fishery. The local fishing community has also participated in data recovery through a fin-clip return program. All fin clips, whether procured from anglers or fishery-dependent/independent sources, are analyzed using microsatellite DNA-based assays to identify recaptured members of particular hatchery release groups and to estimate the hatchery contribution to the catch-and-release red drum sport fishery.

Release-recapture experiments have been underway in Tampa Bay for 6 years. This research has involved replicate stratified releases of $\sim 4 \times 10^6$ red drum hatchlings. To date, more than 20,000 red drum tissues, obtained from fishery-independent and fishery-dependent sampling and from the angler-return program, have been tested. Of these, approximately 3,000 specimens have been genetically assigned to hatchery breeding pairs; the remaining specimens were presumed to be products of natural recruitment.

Even while post-release monitoring continues, experimental findings are being coupled with associated production costs to determine the culture and release strategies for red drum that are the most cost-effective and likely to achieve management objectives. The potential to positively impact fishery catch rates will be subsequently tested via a large-scale release program. Results of this comprehensive R & D process are thus being used to evaluate the efficacy of stocking as a fishery management tool and to model the economic impact of stocking on the sport fishing industry in Florida.