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Coastal Habitat Restoration
As A Fishery Management Tool

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Stemming The Tide of Coastal Fish Habitat Loss

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Declines in both the commercial and recreational harvests of fishery species have been attributed to a number of problems including overharvesting, water pollution, and habitat loss (Stroud 1983, Royce 1987). In response to these declines, a number of fishery management tools have been proposed and implemented. They include legally limiting harvests by size and number, closed seasons, limited entry, stocking from hatcheries, and fisheries enhancement, the latter most often defined as the creation of artificial reefs (Royce 1987).

Nearly all of these management tools have been directed at increasing the survival of late juveniles or adults in order to restore or increase levels of egg production. As noted in some detail by Magnuson (1991), this emphasis was due to the prevailing theory that the major limiting factor on stock size was egg production. Magnuson (1991) states that this theory prevailed in spite of "The realization that reproductive success of fishes depends more on larval mortality than on egg production. . .," which realization, he notes, emerged from the work of Hijort, published in 1914! The result is that, "to this day inconsistencies between recruitment and reproductive stock size impart uncertainty into fishery management. . . ."

One of the first definitive research efforts in the United States to target early juvenile fish habitat modification as a major limiting factor on a fishery stock was that of Gilmore et al. (1983). This research documented the life history of the common snook *(Centropomus undecimalis)* in the Indian River on the east coast of Florida. This species is a prized game fish that had been primarily managed by closure of its fishery to commercial harvest in 1957, and subsequent recreational harvest limits, neither of which has been shown genuinely to maintain or increase the adult stock.

Gilmore et al. (1983) determined that, while adult snook spawn in higher salinity coastal passes, the early juvenile snook (average standard length of 27.5 mm, or one inch) are found in shallow freshwater tributary streams entering estuarine waters. These zones have been termed oligohaline habitats in older literature, or Component 1 habitats in more recent work (Bulger et al. 1990). Subsequent juvenile habitats include marsh-mangrove areas, at average standard length of 67 mm (2 inches), and seagrass meadows, at average standard length of 240 mm (10 inches).

Gilmore et al. (1983) concluded that, ". . . loss of habitat and general degradation of water quality has undoubtedly had a more permanent and therefore far greater effect on reducing snook populations than the fishery. Removal of juvenile habitat curtails recruitment from the largest portion of the snook population and that portion which is most susceptible to natural mortality." Similar life history strategies are employed by other key commercial and recreationally important estuarine fish species such as redfish *(Sciaenops ocellatus)*, spotted seatrout *(Cynoscion nebulosus)* and tarpon *(Megalops atlanticus)* (Lewis et al. 1985).

Lewis et al. (1985), noting the above listed facts, define the habitat types used by these and other species as a "mosaic" of habitats, wherein the availability of a single habitat type may be the limiting factor on the eventual recruitment of juveniles to the adult population. The primary fishery management tool recommended by Lewis et al. (1985) for species with these life history strategies is the protection and restoration of critical limiting habitat types. Gilmore et al. (1982) have in fact demonstrated that restoring previously impounded marsh-mangrove wetlands provides habitat that is used by juvenile snook, tarpon, and ladyfish *(Elops saurus)*, and juvenile and adult forage fish species *(Fundulus, Cyprinodon, Poecilia)* important as food for larger fish and wading birds.

Table 1 lists on-going studies and published and unpublished research on the technical feasibility of creating or restoring coastal wetlands as a fishery management tool. It is obvious from that table that one of the reasons that wetlands restoration is not generally listed or used as a fishery management tool is the paucity of published documentation of the success of such efforts. In addition, the concept of creating or restoring coastal wetlands, just because they need to be restored due to historical losses, or because they might help to increase fish and wildlife populations, is philosophically confused with the same activities associated with regulatory permits to destroy wetlands, known as wetlands mitigation. It is not my intent here to elaborate on the success or failure of wetlands mitigation programs. Ample documentation of the controversy can be found in Kusler and Kentula (1990). The bottom line of the difference be-

Table 1. Fisheries studies in created, restored, or enhanced coastal wetlands.

Location	*Researcher*	*Dates*	*Published?*
1. NC	Rulifson	1984-1991	Yes (Rulifson 1990)
2. NC	Fonseca	1987-1989	No
3. Texas	Webb	1976-1977	Yes (Webb et al. 1978)
4. Texas	Zimmerman and Minello	1986-1990	No
5. Florida (Indian River)	Gilmore	1980-1990	Partially (Gilmore 1982)
6. Florida (Tampa Bay)	Whitman	1985-1991	No
7. Florida (West Lake)	Whitman and Lewis	1985-1988	No
8. Florida (Tampa Bay)	Peters/McMichaels (FMRI)	1980-1985	Yes (Peters & McMichaels 1987)
9. Florida	Roberts	1987-1988	Yes (Roberts 1989)
10. California (San Diego Bay)	Zedler	1988-1990	Yes (PERL 1990)
11. California (San Francisco Bay)	Josselyn	1981-1983	Yes (Josselyn and Buchholz 1984)

tween coastal wetland restoration, just for the sake of restoration, and restoration, as part of a mitigation program, is that functional equivalency of the restored system is essential in a mitigation program in order adequately to offset the wetland values lost through the permitted activity (wetland filling or excavation). Is it necessary in a fish and wildlife habitat restoration program? I think the answer is "no"! Others disagree.

The Coastal Society has adopted the following policy statement regarding the question:

1. Since the science of wetlands restoration and creation is still largely *experimental*, use of such is independent of any mitigation and intended to promote a net gain of wetlands. (emphasis added)
2. Proactive steps are needed on the part of resources agencies to improve restoration and creation techniques. Successful efforts *must* demonstrate they achieve the *functional equivalency* of natural wetlands. (emphasis added)

As this policy statement applies to the restoration of coastal wetlands to promote a net gain in fish and wildlife habitat, I would strongly disagree with two points. First, coastal wetland restoration is not "largely experimental". Ample documentation attests that the technology is available to restore most coastal wetland types except seagrass meadows (Josselyn and Buchholtz 1984, Lewis 1990, Landin et al. 1989, Kusler and Kentula 1990). There are in fact hundreds of created or restored tidal marshes and mangrove forests nationwide that support diverse fish and wildlife populations. Are they functionally equivalent to natural wetlands? Most have not been studied, but the data I will present following indicate that they are not sterile and, when specifically examined for fish and wildlife use, that most have fish and wildlife populations closely approximating those found in natural wetlands. Is this then justification to allow coastal wetlands to be filled and replaced by constructed coastal wetlands? Absolutely not! It is, however, justification to take a damaged, diked, or historically-filled wetland and restore it. True, it may only support 50% or 70% of the species numbers or biomass of a natural marsh, but that is 50% or 70% more than was there before. Anyone who argues that coastal wetland habitat restoration to expand the existing habitat base (net gain) should wait for perfection in the coastal wetland restoration process ignores the documented value of restored coastal wetlands as habitat for many species of fish and wildlife.

Despite the generally negative attitude among some researchers about our ability to restore wetlands in general, restoration of coastal wetlands is generally acknowledged as being more predictable and assured of success if the basic principles of successful design are followed (Lewis 1990, Josselyn et al. 1990, Broome 1990, and Shisler 1990). The major exception is seagrass meadows (Fonseca 1990), where water quality improvements are the key to major restoration of this habitat type (Johansson and Lewis in press). It is certainly accurate to state that many failures have occurred, but not due to lack of the technology to do it right. Without adequate compliance monitoring and enforcement, many untrained and inexperienced individuals will continue to make mistakes. This is a problem of management, not a lack of knowledge of how to do it right nearly every time.

Roberts (1989) compared twenty-one man-made *Spartina alterniflora* marshs and one *Juncus roemerianus* marsh to six natural marshes in Florida. The man-made marshes ranged in age from 1 to 10 years. Comparisons were made of vegetation characteristics, and fish, bird, and mammal populations. A total of 31 species of fish were collected. Roberts (1989) concluded that the differences between fish populations in Gulf marshes "were not great and all but one of the man-made marshes supported at least 5 of 8 common species" found in natural marshes. He concluded that:

> "Most man-made *Spartina* marshes in northern and central Florida were utilized by species of fish and wildlife commonly associated with naturally occurring marshes. Although there was variability among sites, marshes of all ages were used by marsh-dependent birds, small mammals and fish. If properly planned, constructed, and maintained, I found that man-made *Spartina* marshes have similar fish and wildlife habitat value to naturally occurring marshes." (p. 177)

Peters and McMichaels (1987), in sampling for juvenile red drum in Tampa Bay, noted that:

> "We found juveniles to be most abundant during early winter at a size range of 30-60 mm. Most came from a few large seine hauls (500 to 2,000 fishes) at station 9B, near the mouth of the Alafia River." (p. 97)

Station 9B was at a man-made marsh-mangrove tidal stream.

Rulifson (1990) compared fish utilization of several man-made and natural (control) smooth cordgrass marshes in North Carolina. He concluded, after four years of sampling, that the total number of fish collected was statistically similar in both man-made and control marshes. A total of 48 fish species were collected.

Finally, in a southern California (San Diego Bay) case study, PERL (1990) concluded that:

> "In comparing the total fish caught over the three sampling dates, the natural marshes contained 15 species of fish. The Connector Marsh stations [restored marsh], when combined, contained all of these species and more. The average number of individuals caught at the connector marsh stations over the three sampling periods was 630, compared to an average catch of 610 fish at the reference marsh stations. This indicates that for year 5, with 3 sampling periods, the Connector Marsh has 100% of the species and similar numbers of individuals as are found in the reference marshes." (p. 27)

Conclusion

While the published data are sparse, the data discussed here for four studies in three states indicate that rapid (3-5 years) establishment of comparable fish communities in created and restored coastal wetlands, when compared with natural wetlands, is a generally documented observation.

Can the same be said for fish aggregation devices and artificial reefs, other fishery management tools that receives wide public support and funding?

I conclude from the data presented here that coastal wetland restoration is an underutilized fishery management tool, particularly for those estuarine-dependent species whose life histories include a resident period in shallow low-salinity marine habitats.

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