

THE CONCEPT OF CARRYING CAPACITY IN RED DRUM STOCK ENHANCEMENT

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The South Carolina Department of Natural Resources has been researching stock enhancement with red drum (*Sciaenops ocellatus*) since 1989. Our approach has been to conduct discrete studies in specific estuarine systems using differing numbers of marked fish of varying sizes. The focus is to obtain information on the impacts of multiple parameters and to begin to address the issue of carrying capacity. Carrying capacity is defined as the maximum sustainable biomass of stocked and wild animals using available habitat. In practice, carrying capacity is expected to be described with a range of values reflecting the natural biological perturbations associated with the particular life stage and ecosystem.

Over the last 10 years, research was focused in three systems with distinct ecological, geographic and geophysical characteristics. Each system was stocked during three consecutive years using small juveniles (20-60 mm TL). Data collection was based on fishery independent sampling, fishery dependent sampling, or a combination of both approaches. The first system was Callawassie Creek, Beaufort County. It is the most open system and consists of 534 ha of *Spartina* marsh and small creeks, positioned between two islands in the middle of a much larger estuarine system. The second system was the Ashley River, Charleston County. It is a riverine system in an urban setting associated with significant freshwater input from an upland watershed. The Ashley River discharges into a large harbor system (Charleston Harbor), which is also fed by additional rivers. The third system was Murrells Inlet, a semi-closed system with limited freshwater input and a small inlet connecting it to the open ocean.

To define carrying capacity of red drum in a system, the species life history must be considered and the specific “system” identified *a priori*. We partitioned life stages by their habitat usage to evaluate the estuarine dependent sub-adult sizes, which are spatially separate from the offshore adult population. Whenever possible, both contribution and changes in CPUE of long-term monitoring programs were compared from year to year as well as to the long-term mean (10 yrs without stocking). Results suggest that stocked red drum appeared to exceed the capacity of the release area and dispersed up to 24 km within the estuary, where they were found among schools of wild fish in specific habitats. These habitats offered refuge from predation from the piscivorous bottlenose dolphin, *Tursiops truncatus*, a known predator of sub-adult red drum. The movement of fish to adjacent refugia might suggest that carrying capacity of the stocked area was exceeded. GIS evaluation of habitat availability was estimated for each stocking location at both high and low tides. Results showed marked differences in available refugia that influenced interpretation of system carrying capacity. Changes in both fisheries dependent and independent catches suggest substantial annual variation in system carrying capacity probably related to biotic and or abiotic factors. Defining the “system” and evaluating localized contribution is essential to understanding the impacts of stocking, system carrying capacity, and methods to implement an appropriate stocking strategy.