

## Multicharacter Taxonomic and Fisheries Stock Identification of Stone Crabs (*Menippe* spp.) in the Southeastern USA: A Progress Report

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Stone crabs, *Menippe* spp., are commercially important species in Florida; the fishery is the fourth most valuable marine fishery in the state (Harper *et al.*, 1991). The majority of Florida landings are recorded from the Gulf of Mexico coast, where the fishery is managed as a single stock (Costello *et al.*, 1978). Two species of stone crab: *M. adina*, which occurs in northwestern Florida, and *M. mercenaria*, which occurs in peninsular Florida (Bert, 1986; Williams and Felder, 1986) are commercially important in Florida. A hybrid zone is found at the junction of their ranges in northwestern Florida (Bert, 1986). A second region of hybridization is located along the Atlantic coast northward from central Florida (Bert, 1986). Genetically pure individuals of both species co-occur with hybrid forms in the northwest Florida hybrid zone. Identification of individuals in that area is complicated by introgression of *M. mercenaria* color pattern characteristics into *M. adina* allozyme genotypes (Bert and Harrison, 1988).

The geographic variation in species composition, and differences in fishery practices and economics, between northwestern and southwestern Florida (Costello *et al.*, 1978; Adams and Prochaska, in press) have led fishery managers and fishing industry representatives to consider managing the Florida fishery as multiple, separate stocks (Bert, in press). The principal problem with this management approach concerns delineating the geographic limits of separate stocks. One possibility is to define stocks by their species composition. Three character traits have been used to taxonomically identify stone crabs: diagnostic allozymes (Bert, 1986), color patterns (Bert, 1986; Williams and Felder, 1986), and morphometrics (Williams and Felder, 1986). A fourth character, mitochondrial DNA (mtDNA) restriction fragment patterns (RFPs), is frequently used to define fishery stocks (e.g., Ward *et al.*, 1989). We examined these four characters to determine which combination of traits provided the best taxonomic resolution among *Menippe* forms, and consequently, to distinguish between possible unit stocks (see Gulland, 1983) of stone crabs on the Florida Gulf coast.

Stone crabs were collected from within the known ranges of *Menippe adina* and *M. mercenaria* (Bert, 1986; Williams and Felder, 1986) from the northwestern Florida hybrid zone. Three morphometric measurements described as diagnostic by Williams and Felder (1986) (anterolateral tooth 3 length, anterolateral tooth 4 length, and carapace length), diagnostic color patterns and allozymes defined by Bert (1986), and mtDNA RFPs of digests produced using six restriction endonucleases (BcIII, BstBI, BstNI, HaeIII, HindIII, MapI) were obtained from each individual. Statistical analyses of those data were used to determine which of the traits were taxonomically most informative. The morphometric data were initially examined using regression analysis. An iterative process using principal component analysis (PCA) was applied to the morphometric, color pattern, and allozyme data. The mtDNA data were analyzed by examining the distribution of mtDNA RFPs among the sampling sites.

## RESULTS

The distribution of mtDNA RFPs among sampling sites indicated that this character was only semidiagnostic in the identification of stone crabs. Regression analysis applied to the morphometric data was also of limited use in identifying individuals taxonomically. Principal components analysis applied to the morphometric data alone provided little taxonomic resolution. When combined with color pattern or allozyme data, morphometric data decreased the resolving power of those characters in PCA. Color pattern and allozyme data, examined separately and in combination using PCA, clearly distinguished the two species and identified hybrid individuals.

When color pattern and/or allozymes were analyzed, the stone crab populations sampled in northwestern and southwestern Florida had clear differences in PC scores, indicating significant differences in their phenotypic and genetic character traits. A review of the literature revealed that the two regions also differed in fishing methodology (e.g., vessel and crew sizes, nearshore vs. offshore fishing, and number of traps utilized [Bert *et al.*, 1978; Costello *et al.*, 1978]), economic factors (ex-vessel value of catch [Adams and Prochaska, in press]), and sociology (Costello *et al.*, 1978). In addition, physiological differences have been reported between crabs from the two areas, particularly in the timing of reproductive activities (e.g., spawning season [Bender, 1971; Bert *et al.*, 1978]).

## DISCUSSION

Some biological differences between stone crabs in northwestern and southwestern Florida suggest that they could be considered as separate stocks, whereas other characteristics suggest that stone crabs throughout Florida constitute a single stock. The disparity in fishery operations between the two

regions supports the idea that the two fisheries could be separately managed. Management of the stone crab fishery in Florida as two separate units, however, could be complicated. If the two fisheries had different fishing seasons, for example, conflicts could arise between local and "outsider" fishermen (Overbey, in press) as the fishermen moved between areas to take advantage of differences in open seasons. The ambiguity associated with the definition of stocks and the socioeconomic implications of alternative management strategies make the Florida stone crab fishery a paradigm of the complexities of fishery management.

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