

the role of males in population structure is provided that is not available from mtDNA. The results of recent nDNA analysis (Francisco-Pearce, 2001) show no substantial subdivisions across the loggerhead nesting colonies in the southeastern United States. These findings, which contrast with the mtDNA evidence showing general segregation of female lineages among the loggerhead subpopulations, suggest that male loggerheads from each subpopulation are able to breed with females from other southeastern United States subpopulations. This male-mediated gene flow would be sufficient to prevent the rise of detectable nDNA genetic differences among the subpopulations. These results should be interpreted cautiously, due to the preliminary nature of nDNA analysis for loggerheads; nDNA genetic differences between subpopulations may exist but will require larger sample sizes and additional multiple markers to detect.

We considered information on the degree of similarity in nesting variability within and between nesting assemblages as a possible indication of ecological or physiological factors that might indicate discreteness while acknowledging that the variability could be the result of other factors that are independent of discreteness. Loggerhead nesting typically shows high variability from year to year. The TEWG (2000) reported correlations of nesting variability within and between the Northern, South Florida, and Florida Panhandle nesting assemblages. Annual variation in nesting activity is significantly correlated across nesting beaches within the Northern subpopulation. Within the South Florida subpopulation, the correlation between the southeast and southwest portions of the subpopulation also were statistically significant. The correlation between the Northern and the South Florida subpopulations was lower than those within each of them, but still was statistically significant. The Florida Panhandle subpopulation results showed a high, significant correlation with nest numbers reported annually for the South Florida subpopulation as a whole, and for the portion in southwest Florida, but not with the southeastern Florida area or with the Northern nesting assemblage.

The correlations indicate support for the concept of a considerable degree of cohesiveness within the identified nesting subpopulations in terms of annual variability in nesting. However, the results also indicate some degree of similarity across the subpopulations. Compared to beaches within a subpopulation, the correlations between

the different nesting subpopulations are lower, but there is some degree of similarity and in some cases the correlations between subpopulations are statistically significant in terms of the annual variability in nesting. The mechanism(s) that drive annual variability within and between nesting assemblages is not well understood.

Because the sex of loggerhead hatchlings is environmentally determined by nest incubation temperatures, we considered information about the sex ratios of progeny from different nesting assemblages to evaluate whether they indicate marked separation of the assemblages as a consequence of environmental factors. Pivotal (i.e., the incubation temperature that produces equal numbers of males and females) and transitional ranges of temperatures determine whether a nest will produce males, females, or both (Mrosovsky and Pieau, 1991). For example, Mrosovsky and Provancha (1989) suggest that the majority of nests laid at a major rookery near Cape Canaveral, Florida, an area near where the segregation between the South Florida and Northern subpopulations occur, incubate at such warm temperatures that virtually no males are produced. In contrast, males are predominately although not exclusively - produced in rookeries of the Northern subpopulation, presumably because of a nesting season characterized by cooler incubation temperatures.

NMFS SEFSC (2001) evaluated a combination of genetic data and observed juvenile sex ratios from several southeast U.S. locations. They estimated that the South Florida nesting subpopulation produces 20 percent male hatchlings, the Yucatan subpopulation produces 31 percent males, and the Northern subpopulation produces 65 percent males. They did not assess the sex ratios of hatchlings from the Dry Tortugas or Florida Panhandle nesting assemblages. The Florida Cooperative Fish and Wildlife Research Unit, in response to NMFS' request for additional information, submitted data on loggerhead nesting in northwest Florida and reported that based on nest incubation temperatures, sex ratios of hatchlings from the Florida Panhandle subpopulation are mixed, with an apparently larger proportion of males than the 20 percent proportion found in nests from the South Florida subpopulation.

Since male-mediated gene flow appears to be keeping the subpopulations genetically similar on a nDNA level, the relatively higher percentage of males produced in the

smaller Northern and Florida Panhandle subpopulations is of management interest, as it may play an important role in providing males to mate with females from the other, female-dominated subpopulations, thereby helping to ensure reproductive success for loggerheads in the entire western North Atlantic. Although the South Florida nesting assemblage apparently produces only about 20 percent males, the total number of males produced is likely greater than that produced by the Northern and Florida Panhandle assemblages, due to the larger size of the South Florida assemblage. However, males produced from the Northern and Florida Panhandle nesting assemblages contribute to the overall number of males available for breeding and contribute to maintaining or increasing outbreeding.

In our evaluation of whether the two petitioned nesting subpopulations are markedly separated from other populations of the taxon, we also considered evidence of morphological discontinuity. Morphometrics is a common taxonomic tool used to establish stock distinctions, and a common feature of morphometric variation in widely distributed animals is a latitudinal cline in body size. Reviews of the standard sea turtle size measurements (Tiwari and Bjorndal, 2000; Stoneburner, 1980) found no evidence of this latitudinal cline in carapace length and width for Atlantic loggerheads. Stoneburner (1980) suggested that body depth of nesting female loggerheads decreases with latitude from North Carolina to Florida; however, more recent data and analyses (NMFS SEFSC, unpub. data) show no differences in body depth over the same area. The lack of morphometric variation among the western North Atlantic loggerhead subpopulations is consistent with the reported lack of nDNA genetic differentiation.

We have considered information on the non-nesting distribution of loggerheads to determine if it indicates that there is a marked separation of the petitioned subpopulations from other populations. As described below, this included consideration of information on foraging and stranded sea turtles, carapace epibionts (living organisms attached to the carapace), and migrations of post-nesting females.

Genetic samples (mtDNA) taken from immature loggerheads at representative foraging grounds from the northeast United States to Florida Bay (at the southern tip of the mainland of Florida) have been analyzed to determine the origin of the individuals (see review in TEWG 2000 and NMFS SEFSC 2001).