Analysis of Preliminary Results for the Release of Satellite-Tracked Drifters over Gag Spawning Sites

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Introduction

It has been suggested a large number of larvae spawned in the South Atlantic Bight (SAB) might be lost through entrainment in the Gulf Stream (Govoni and Spach, 1999); however, the formation of both ephemeral and semi-permanent gyres and inshore countercurrents may limit this loss by retaining planktonic organisms within the SAB (Govoni and Hare, 2001). Several studies have shown evidence for the retention of gag larvae within the SAB. It has been shown that young-of-the-year gag are transported to nursery grounds where post-larval/juvenile gag are found to ingress into the estuaries at an average age of 43.3 days (Keener et al., 1988). Also, Sedberry et al. 2001, showed a direct link between the strength and location of the Charleston Gyre with cohort strength in gag landed by the commercial and recreational fisheries. But there is also evidence for expatriation of the larvae of gag and other reef fishes that get carried out of the SAB (Markle et al., 1980; Govoni and Spach, 1999; Grothues et al., 2002; Hare et al., 2002). Knowledge of the processes that transport the planktonic eggs and larvae from deepwater spawning grounds to the estuarine environments in the SAB are poorly understood; likewise it is unknown how much of the spawning output may be lost to the system by expatriation, or what oceanographic events and spawning cues may favor retention or expatriation.

In this study satellite-tracked drifters were deployed over gag spawning locations in February, March, and April of 2005 in an attempt to study the processes by which larval gag are transported from offshore spawning sites to estuarine nursery habitats. The spawning sites were chosen based on previous studies of gonad development collected through the MARMAP program at the South Carolina Department of Natural Resources. In addition to picking known spawning sites we also attempted to incorporate those sites designated as proposed MPAs by the SAFMC (Figure 1).

Methods

The types of drifters were the Argos surface drifter (CODE drifter) and the WOCE-SVP drifter (“holey sock” drogue deployed at a depth of 15 m). The WOCE-SVP drifter is the most commonly used drifter type (Brink et al., 2003) and has a 6.1 m tall drogue deployed to a depth of 15 m in order to track the mixed layer. The Argos or CODE drifter was designed to be a surface level (1 m) Lagrangian drifter. One of each type of drifter was deployed at each of five locations from Florida to North Carolina on the new and full moons during the gag spawning season. New and full moons have been shown to be the time of peak spawning activity for gag and other reef fishes (Johannes, 1978; Keener et al., 1988). The deployments occurred during the months of peak spawning activity for gag (February, March, April). We also deployed 100 drift bottles at each site during the two moon phases, with a postage-paid postcard to be returned by the finder with date and location information.

Results and Discussion

Preliminary results have shown a high degree of retention within the SAB for the drifters deployed during the gag spawning season. Defining the SAB as the area west of the Gulf Stream from Cape Canaveral, Florida (28.39248 N) to Cape Hatteras, North Carolina (35.24741 N) there was on average retention time of 26.6 days (range = 5-66 days) for all drifters deployed. If we remove the three drifters that were prematurely retrieved by fishermen and others we then had an average retention time of 29.5 days. While most drifters were eventually expatriated into the North Atlantic ,the tracks show evidence of retention due to inshore countercurrents and the influence of the both ephemeral gyres as well as the more permanent Charleston Gyre (Figure 2). There is also evidence of inshore transport by the Charleston Gyre as exhibited by the number of drift bottles recovered along the Core and Shackleford Banks of North Carolina between Cape Fear and Cape Lookout (Figure 3).

While there is evidence of retention of planktonic larvae within the SAB, dispersal is widespread and is dependent on a number of oceanographic and biological factors. Therefore, any attempt to utilize deepwater (shelf-edge and upper slope) MPAs in an effort to protect pre-settlement fish in order to enhance recruitment would prove unsuccessful. In such cases as gag, there is evidence for spawning aggregations within the SAB, although it is uncertain whether these aggregations represent a major reproductive output for the region (Sedberry et al., in press). An effective use of MPAs within the gag fishery is the utilization of these shelf-edge reserves to protect pre-spawners (in addition to the existing closed spawning season), which should enhance recruitment through the protection of spawning-stock biomass. The results of fishing spawning aggregations can have detrimental effects on the overall spawning behavior, health and viability of a population (Coleman et al., 1996), in addition to just removing spawners. Further research is needed on the reproductive behavior of gag and it appears the fishery would be best served by temporal and spatial closures that ensure the protection of fish in spawning condition due to its reliance on self-replenishment.

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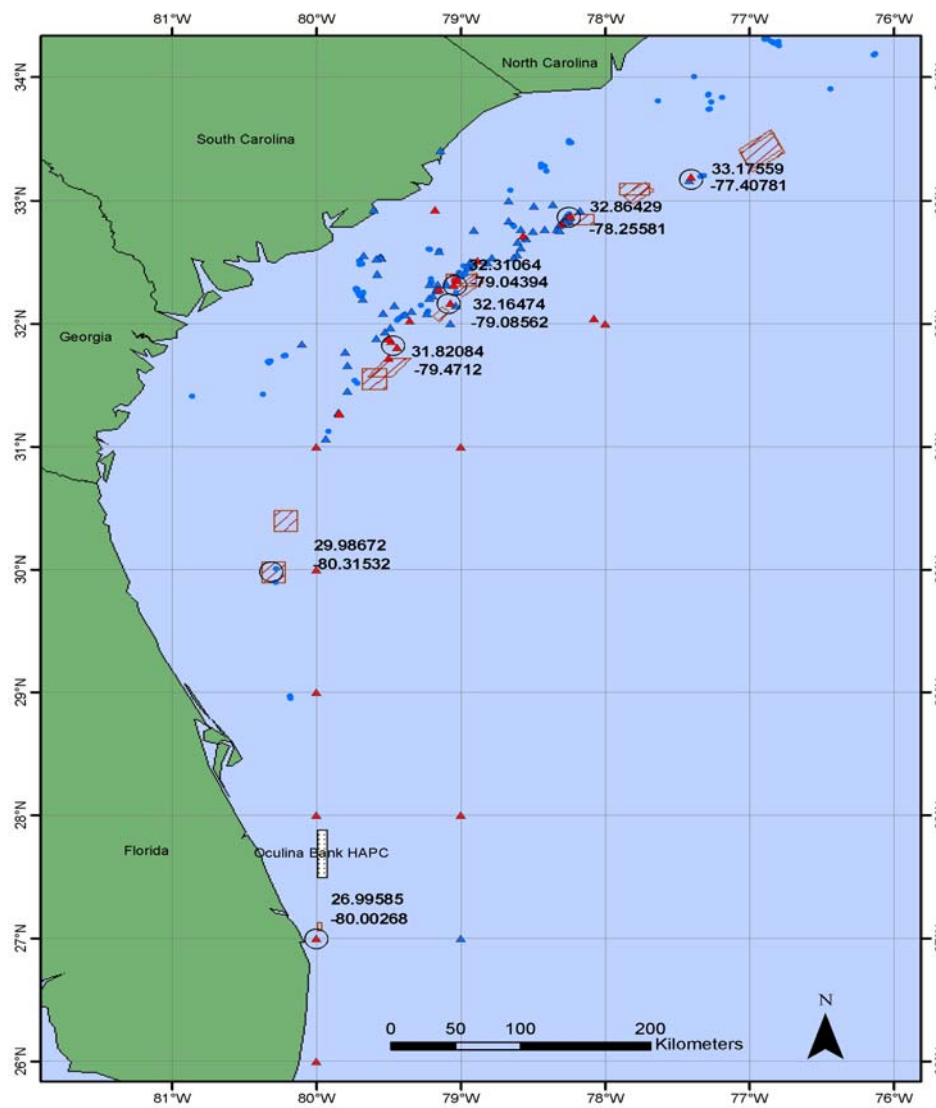

Figure 1. Gag caught in spawning condition (red symbols), proposed MPA sites (shaded boxes, and drifter deployment sites (black circles) are represented spatially within the SAB. Additional gag capture locations are indicated by blue symbols. Triangles indicate fishery-dependent locations that may be approximate (NMFS statistical grid cell location); circles are fishery-independent samples for which precise locations were recorded.

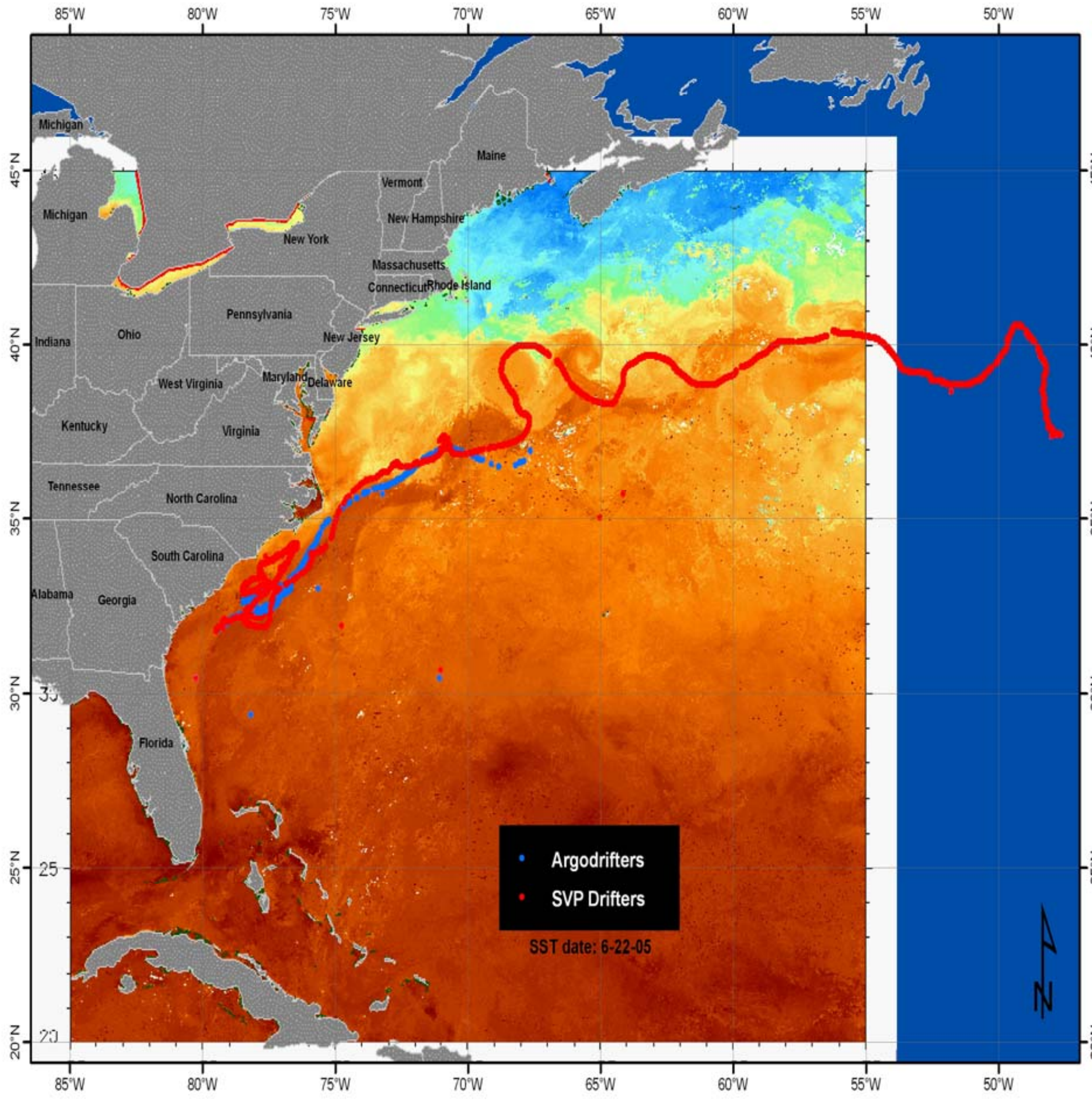

Figure 2. Drifter track for Argo-drifter 56311 and SVP drifter 56345 deployed over gag spawning site on 3/10/2005

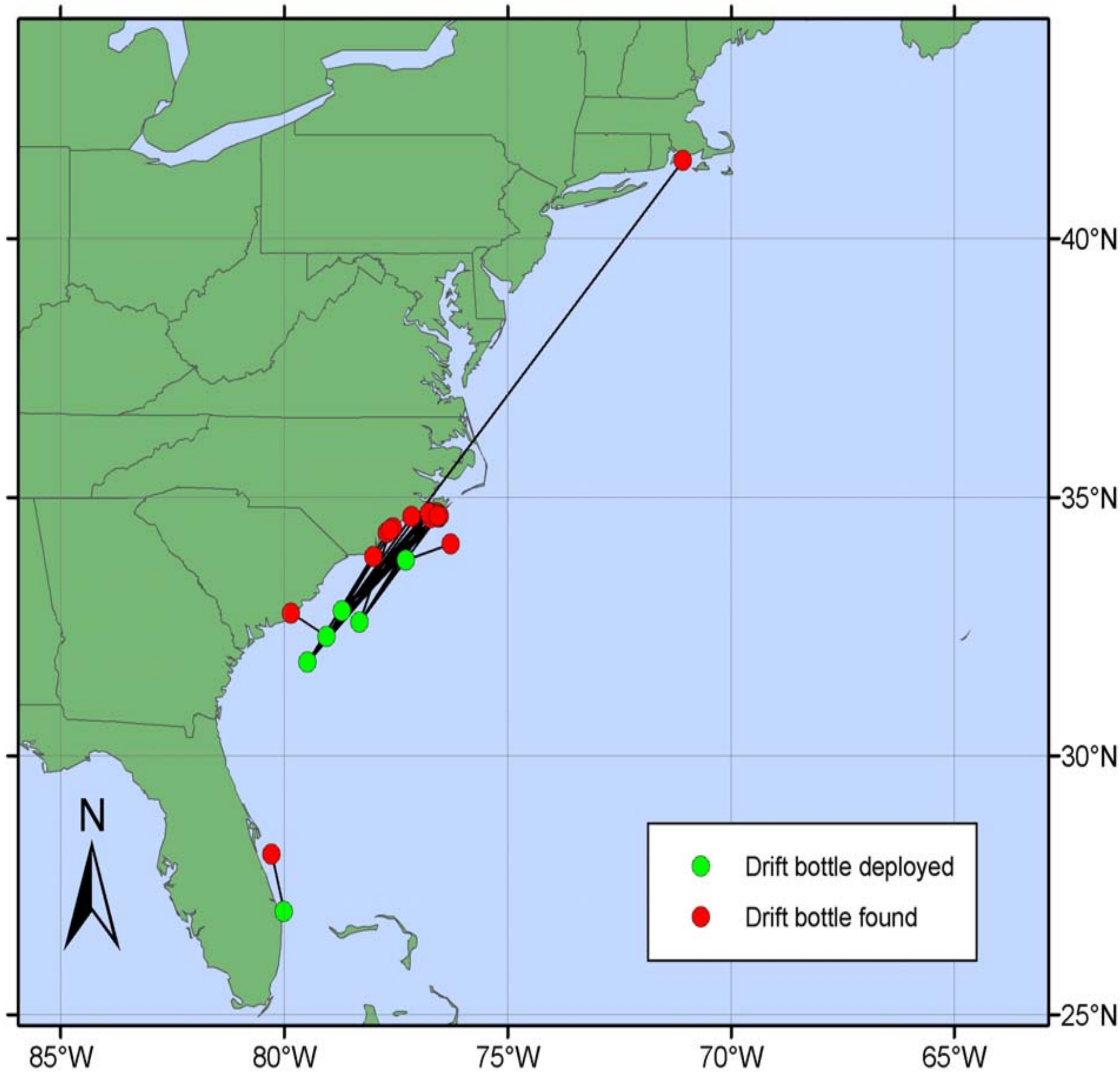

Figure 3. Bottle deployment (green symbol) and recovery (red symbol) sites for deployments made over gag spawning locations.