

Spatial clustering of loggerhead sea turtles in coastal waters of the NW Atlantic Ocean: implications for management surveys

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Supplement. Overview of input data for 2 cluster analyses used to examine the influence of 53 co-occurring species groupings (Table S1) and 25 biotic and abiotic parameters (Table S2) on subsequent classification of trawling events as hotspots, cold spots, or locations where spatial clustering was not observed

Table S1. Frequency (%) of 4756 trawling events and sum (counts) of bycatch groupings (53) used to evaluate potential relationships between spatial clusters and biotic factors. Numbers in the ID field correspond to the dendrogram in Fig. 4A in the main article

| Invertebrate groups | ID | Frequency | Sum | Teleost groups | ID | Frequency | Sum |
|----------------------------|-----------|------------------|------------|-----------------------|-----------|------------------|------------|
| Stomolophidae | 1 | 42.3 | 116655 | Carangidae | 28 | 79.5 | 215931 |
| Cubozoa | 2 | 27.5 | 19967 | Stromateidae | 29 | 39.1 | 17753 |
| Other Scyphozoa | 3 | 14.7 | 18574 | Engraulidae | 30 | 9.3 | 2251 |
| Ctenophora | 4 | 1.1 | 107 | Clupeidae | 31 | 6.4 | 728 |
| | | | | Trichiuridae | 32 | 2.9 | 497 |
| Asteroidea | 5 | 33.1 | 26902 | Scombridae | 33 | 5.2 | 355 |
| Echinoidea | 6 | 44.4 | 23551 | Echeneididae | 34 | 2.1 | 153 |
| Ophiuroidea | 7 | 3.9 | 1914 | Pomotomidae | 35 | 1.6 | 88 |
| Holothuroidea | 8 | 7.7 | 1089 | Rachycentridae | 36 | 0.9 | 53 |
| | | | | Other mid-water | 37 | 0.1 | 40 |
| Loliginidae | 9 | 23.4 | 3886 | | | | |
| Gastropoda | 10 | 5.0 | 379 | Sciaenidae | 38 | 34.3 | 32654 |
| Pelcypoda | 11 | 1.8 | 145 | | | | |
| Octopodidae | 12 | 2.0 | 107 | Sparidae | 39 | 27.7 | 18548 |
| | | | | Ephippidae | 40 | 23.1 | 13504 |
| Majidae | 13 | 18.6 | 8415 | Diodontidae | 41 | 46.2 | 6696 |
| Other Crustacea | 14 | 28.6 | 3390 | Balistidae | 42 | 5.3 | 477 |
| Portunidae | 15 | 18.5 | 1811 | Serranidae | 43 | 5.2 | 354 |
| Limulidae | 16 | 7.1 | 1596 | Tetrodontidae | 44 | 2.4 | 154 |
| Ostraciidae | 17 | 9.8 | 1012 | Haemulidae | 45 | 1.5 | 109 |
| | | | | Other reef fish | 46 | 0.1 | 23 |
| Tunicata | 18 | 56.7 | 13726 | | | | |
| Demospongea | 19 | 29.9 | 4984 | Triglidae | 47 | 37.6 | 10965 |
| Anthozoa | 20 | 4.5 | 1340 | Synodontidae | 48 | 23.0 | 2651 |
| Bryozoa | 21 | 4.0 | 674 | Other demersal | 49 | 0.3 | 80 |
| | | | | | | | |
| Elasmobranch groups | ID | Frequency | Sum | Bothidae | 50 | 15.9 | 1305 |
| Dasyatidae | 22 | 34.1 | 4980 | Other flatfish | 51 | 0.1 | 31 |
| Myliobatidae | 23 | 9.5 | 863 | | | | |
| Other rays | 24 | 0.9 | 270 | Blenniidae | 52 | 3.0 | 251 |
| | | | | Other cryptic | 53 | 0.2 | 24 |
| Sphyrnidae | 25 | 34.2 | 3860 | | | | |
| Carcharhinidae | 26 | 33.9 | 3808 | | | | |
| Other sharks | 27 | 0.4 | 39 | | | | |

Table S2. Derivation of and descriptive statistics for temporal, spatial, and environmental attributes compared between coldspots, non-spatial clusters, and hotspots. Labels in the ID field correspond to labels in the dendrogram in Fig. 4B in the main article.

Temporal parameters consisted of year, day of the year (DOY), and binned time of day at the start of each trawling event (1 = $\leq 09:59$ h local standard time; 2 = 10:00 to 12:59 h; 3 = 13:00 to 15:59 h; 4 = $\geq 16:00$ h).

Spatial parameters consisted of mean water depth (m) and change (%) in water depth during the trawling event; distance from shore (km) at the trawl start computed in ArcGIS ArcInfo 10.0 (ESRI); distance (km) and bearing ($^{\circ}$) to the closest inlet and trawl transect distance (km) and bearing ($^{\circ}$) computed by Pythagorean Theorem; vessel towing speed recorded at the start of the trawling event; geographic sub-region ordered north (1 = Charleston to Winyah Bay, South Carolina) to south (4 = St. Augustine, Florida, to Brunswick, Georgia); bottom type (1 = not hard, 2 = probable hard, 3 = hard) estimated from the co-occurrence of ≤ 1 , 2, or 3 or more invertebrate (Reed 2004) or finfish (Van Dolah et al. 1994) habitat indicator species, respectively; and capture (1) or non-capture (0) of a loggerhead sea turtle in the previous tow if completed on the same day.

Environmental parameters measured *in situ* at the start of each trawling event consisted of sea-surface temperature measured by the ship's transducer or read by thermometer for a bucket of surface water, estimated percent cloud cover, and wind speed (kn) and direction (N = 0° ; NNE = 22.5° ; etc) recorded by an anemometer and wind vane, respectively; if wind velocities were recorded as calm, the wind direction during the trawling event prior to the winds becoming calm was assigned.

Environmental parameters measured ad hoc consisted of daily means and the change in daily mean barometric pressure (mb) recorded hourly at Gray's Reef National Marine Sanctuary (GRNMS; www.ndbc.noaa.gov; Station 41008); satellite measurements of chlorophyll *a* (mg ml^{-3}) for 8-d data sets at 9 km (SEAWIFS; 2000 to 2002) and 4 km (MODIS-A; ≥ 2003) obtained from the National Aeronautical and Space Administration (<http://disc.sci.gsfc.nasa.gov/giovanni/overview/index.html#>); stage, range, and percent of tide change elapsed at the onset of each trawling event determined from hourly data at the closest of 3 National Ocean Service stations near Winyah Bay, South Carolina (8662245), Charleston, South Carolina (8665530), Savannah, Georgia (8665530), and Mayport, Florida (8670870); and daily moon phase and percent of the moon illuminated determined from data archived with the U.S. Naval Observatory (<http://aa.usno.navy.mil/data/docs/MoonFraction.php>). Hourly sea-surface temperature data from the GRNMS buoy were substituted for 539 trawling events with missing sea-surface temperature, given $\pm 10\%$ agreement for 95% of 3100 paired observations from both data sets

| ID | Type | Parameter | Min. | Max. | Mean | SD |
|----|---------------|--|--------|--------|--------|-------|
| a | Temporal | Year | 2000 | 2011 | | |
| b | Temporal | DOY | 144 | 230 | 179 | 19 |
| c | Temporal | Time of day (factor) | 1 | 4 | | |
| d | Spatial | Mean depth (m) | 3.7 | 17.0 | 10.2 | 2.4 |
| e | Spatial | Depth change (%) | 0.0 | 182.9 | 13.3 | 13.8 |
| f | Spatial | Distance from shore (km) | 0.0 | 28.5 | 8.6 | 4.4 |
| g | Spatial | Distance from inlet (km) | 1.2 | 28.9 | 11.0 | 4.6 |
| h | Spatial | Bearing from inlet ($^{\circ}$) | 0.0 | 356.2 | 126.8 | 58.2 |
| i | Spatial | Transect bearing ($^{\circ}$) | 0.1 | 359.8 | 168.7 | 104.1 |
| j | Spatial | Vessel towing speed (kn) | 1.7 | 3.5 | 2.8 | 0.2 |
| k | Spatial | Transect length (km) | 1.2 | 3.6 | 2.2 | 0.5 |
| l | Spatial | Sub-region (factor) | 1 | 4 | | |
| m | Spatial | Bottom type (factor) | 1 | 3 | | |
| n | Environmental | Water temperature ($^{\circ}\text{C}$) | 20.3 | 39.5 | 27.3 | 1.6 |
| o | Environmental | Chlorophyll <i>a</i> (mg ml^{-3}) | 0.1 | 75.3 | 3.1 | 2.5 |
| p | Environmental | Cloud cover (%) | 0 | 100 | 42 | 32 |
| q | Environmental | Wind velocity (kn) | 0.0 | 33.0 | 9.1 | 5.0 |
| r | Environmental | Wind direction (factor) | 0.0 | 337.5 | 173.3 | 77.1 |
| s | Environmental | Mean daily barometric pressure (mb) | 1006.5 | 1025.4 | 1016.3 | 3.5 |
| t | Environmental | Daily change in barometric pressure (mb) | -5.1 | 6.6 | 0.1 | 2.1 |
| u | Environmental | Tide stage (factor) | 0 | 1 | | |
| v | Environmental | Tide range (m) | 0.7 | 3.0 | 1.4 | 0.4 |
| w | Environmental | Percent of tide stage elapsed | 0.0 | 99.8 | 8.3 | 19.2 |
| x | Environmental | Moon phase (factor) | 0 | 1 | | |
| y | Environmental | Moon illumination (%) | 0.0 | 1.0 | 0.5 | 0.3 |