Interannual site fidelity of bonnetheads (*Sphyrna tiburo*) to two coastal ecosystems in the western North Atlantic Ocean

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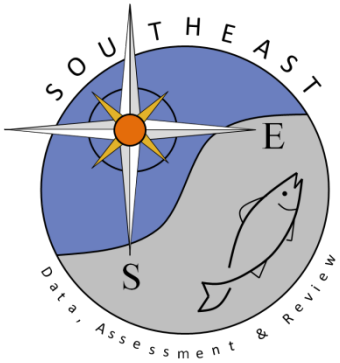

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Interannual site fidelity of bonnetheads (*Sphyrna tiburo*) to two coastal ecosystems in the western North Atlantic Ocean.

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Summary

Bonnetheads were tagged in the coastal waters of South Carolina from 1998-2012. Of the 2,014 sharks tagged, 112 individuals were recaptured after at least one calendar year at liberty. Over 90% of recaptured individuals were collected in the same estuary or bay where originally tagged. Three bonnetheads were collected off the east coast of Florida during the fall and spring, when the species is not present in South Carolina waters. With two exceptions, tagging data indicate bonnetheads display complete fidelity to specific systems in the coastal waters of South Carolina. All bonnetheads were recaptured in waters off the east coast of the United States and results suggest they remain within the region.

To examine the spatial and temporal utilization of South Carolina's inshore waters by bonnetheads (*Sphyrna tiburo*), gillnets and longline gear were deployed at fixed sampling stations between April and October from 1998-2012 (see Ulrich et al. 2007 for gear specifics). The majority of effort was expended in the Bulls Bay and North Edisto coastal systems (Figure 1). Abiotic characteristics of North Edisto are principally dictated by riverine and tidal influences and those in Bulls Bay primarily dictated by tidal forces. As such, the salinity of North Edisto is more dynamic than that of Bulls Bay, whereas seasonally mediated water temperatures in both systems are similar. Gear was also deployed in three adjacent estuaries with similar abiotic characteristics to North Edisto (Charleston Harbor, St. Helena Sound and Port Royal Sound) and one similar to conditions similar to Bulls Bay (Copahee Sound) (Figure 1).

Once a bonnethead was captured, the sex of the specimen was noted and body length measured. A Jumbo Rototag was then attached to the first dorsal fin of sharks

deemed in good condition. Tags were imprinted with unique alphanumeric identifiers to allow individual identifications and provided contact information to facilitate reporting of recaptures. If a shark was recaptured during scientific sampling operations (project recaptures), it was measured, tag number noted and the tag was cleaned of any biofouling prior to release. If a tag was damaged to a degree that obscured information, it was replaced. Tagged sharks were also recaptured within U.S. commercial and recreational fisheries.

Results

Over the course of the study, 3,167 bonnetheads were captured in the coastal waters of South Carolina, with the ratio of females to males being 8.7:1.0. Tags were attached to 2,014 individuals (1849 female, 153 male, 12 sex not recorded) in the North Edisto (n = 1251) and Bulls Bay (n = 763). Body length at time of tagging, ranged from 390-860 mm FL for males (mean = 662.5, S.D. = 103.4) and 375-1074 mm FL for females (mean = 822.7, S.D. = 120.5) (Figure 2) with the mean size of females being significantly larger in Bulls Bay (846 vs 804 mm FL; $t=7.45$, $p < 0.01$) and the mean size of males being significantly larger in North Edisto (688 vs 538 mm FL; $t = -6.44$, $p<0.01$). Of the 763 bonnetheads tagged in Bulls Bay, there were 30 project recaptures resulting in a recapture rate of 4% after 3-2528 days at liberty. Within North Edisto, there were 124 project recaptures after 3-3263 days at liberty, resulting in a recapture rate of approximately 10%. Additionally, there was a total of 36 recaptures within commercial and recreational fisheries, after 9-1526 days at liberty. The overall tag return rate (project returns combined with commercial and recreational fisheries returns) was 9% for bonnetheads tagged in Bulls Bay and North Edisto.

A total of 83 bonnetheads were project recaptures after at least one calendar year with times at liberty ranging from 278-3263 days (mean = 695.3 days, S.D. = 548.9). All but two of the recaptured sharks were females. All project recaptured bonnetheads were collected in the same system where they were originally tagged and, in most cases, at the same fixed sampling site. There were nine individuals that were recaptured on two or more occasions over multiple years (Table 2). For example, Shark B2077 was tagged in Bulls Bay in August 1998 and recaptured in Bulls Bay in August 2001 and recaptured again in September 2005. Additionally, there were seven instances when two or more sharks were captured at the same time, tagged, released and recaptured together at the same location, on the same date, after more than one calendar year at liberty (Figure 3).

Bonnetheads recaptured in commercial and recreational fisheries also showed high site fidelity. Twenty-nine sharks were captured after at least one calendar year at liberty. The time at liberty for these sharks ranged from 159 – 1526 days (mean = 600.6 days, S.D. = 364.1). All recaptured sharks were female and 79% were recaptured within the same system where originally tagged. Of those that were recaptured outside of the original location of tagging, three were in the coastal waters of eastern Florida during the fall and spring, which coincides with the time when bonnetheads are not present in SC waters (Ulrich et al 2007). Remarkably, one individual was tagged in Bulls Bay in July 2001, recaptured off Melbourne Beach, Florida in March 2002, and then recaptured again in May 2002 at the same exact location in Bulls Bay where originally tagged. Five other individuals were recaptured in South Carolina coastal waters associated with the timing of bonnethead movements into or out of the area during the spring and fall. One

bonnethead was recaptured off the coast of North Carolina and one individual tagged in North Edisto was recaptured in St. Helena's Sound. This last individual was the only bonnethead recaptured in an estuarine system other than where it was originally tagged.

Literature cited:

Ulrich, G.F., Jones, C.M., Driggers, W.B. III, Drymon, J.M., Oakley, D. and Riley, C. 2007. Habitat utilization, relative abundance, and seasonality of sharks in the estuarine and nearshore waters of South Carolina. *In* Shark nursery grounds of the Gulf of Mexico and east coast waters of the United States. McCandless, C.T., Kohler, N.E. and Pratt, H.L. Jr. eds. American Fisheries Society Symposium. 50: 125-139.

	Bulls Bay		North Edisto	
	Female	Male	Female	Male
Total caught	872	33	1241	190
Size range (mm FL)	319 - 1074	392 - 815	371 - 1065	345 - 860
Mean size ± SD (mm FL)	844.1 ± 126.6	560.3 ± 128.9	800.8 ± 123.1	682.7± 92.1
Number tagged	742	16	1103	137
Size range (mm FL)	375 - 1074	412 - 741	429 - 1065	440 - 860
Mean size ±SD (mm FL)	846.3 ± 118.9	598.2 ± 122.8	803.9 ± 210.2	687.6 ± 83.0
Total interannual recaptures	18	0	62	3
Range of days at liberty	282 – 2528	-	278 – 3263	230 – 367
Mean days at liberty ± SD	870.8 ± 632.8	-	662.9 ± 525.2	313.0 ± 73.0

Table 1. Summary of capture, tagging and recapture information for bonnethead (*Sphyrna tiburo*) collected in Bulls Bay and North Edisto. Total interannual recaptures do not include those reported from commercial and recreational fisheries.

Shark ID Number	Tagging / Recapture Location	Tagging / Recapture Dates	Days at Liberty After Tagging
B2077	Bulls Bay	August 1998 / August 2001 / September 2005	1083 / 2528
B8434	Bulls Bay	July 2002 / July 2003 / August 2006	351 / 1475
B2916	North Edisto	June 2002 / May 2006 / May 2011	1449 / 3263
B8882	North Edisto	June 2003 / August 2003 / May 2006 / May 2007	74 / 1081 / 1435
B8893	North Edisto	June 2003 / August 2003 / May 2006 / August 2006	74 / 1081 / 1160
B11236	North Edisto	September 2004 / June 2005 / August 2005	294 / 337
B11584	North Edisto	June 2005 / May 2007 / May 2008	680 / 1063
B11933	North Edisto	August 2005 / May 2006 / June 2007	283 / 663
B18091	North Edisto	June 2007 / May 2008 / June 2008	357 / 383

Table X. Bonnetheads (*Sphyrna tiburo*) recaptured multiple times after at least one calendar year at liberty in the coastal waters of South Carolina. All individuals were females.

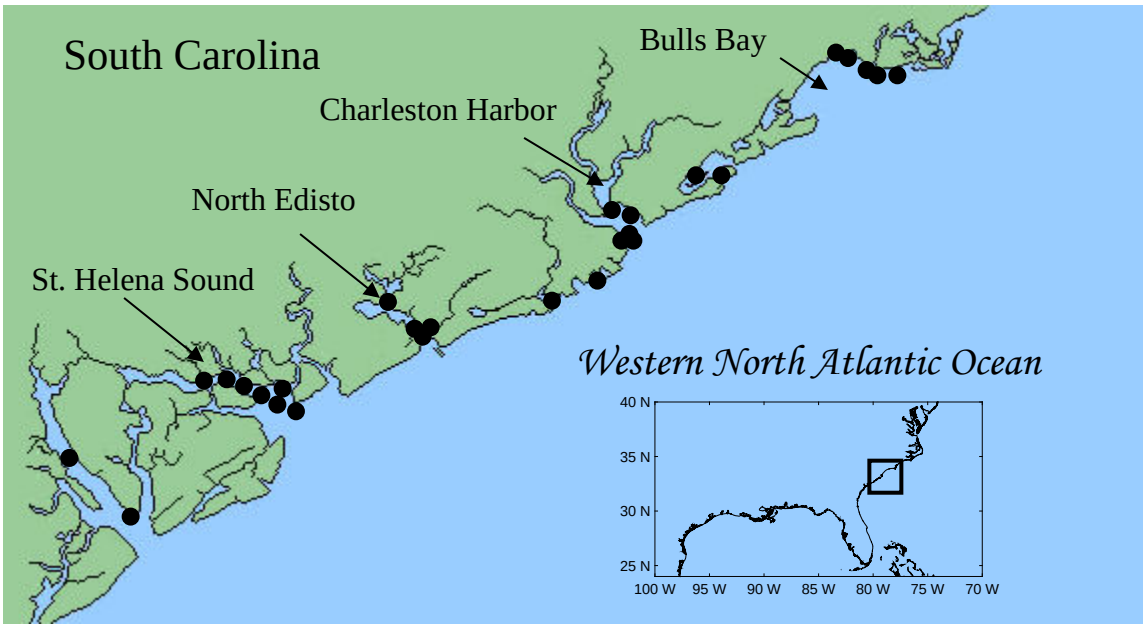

Figure 1. Sampling locations (black dot) within the coastal waters of South Carolina. Black circles indicate areas where gillnet and hand deployed longline gear were deployed.

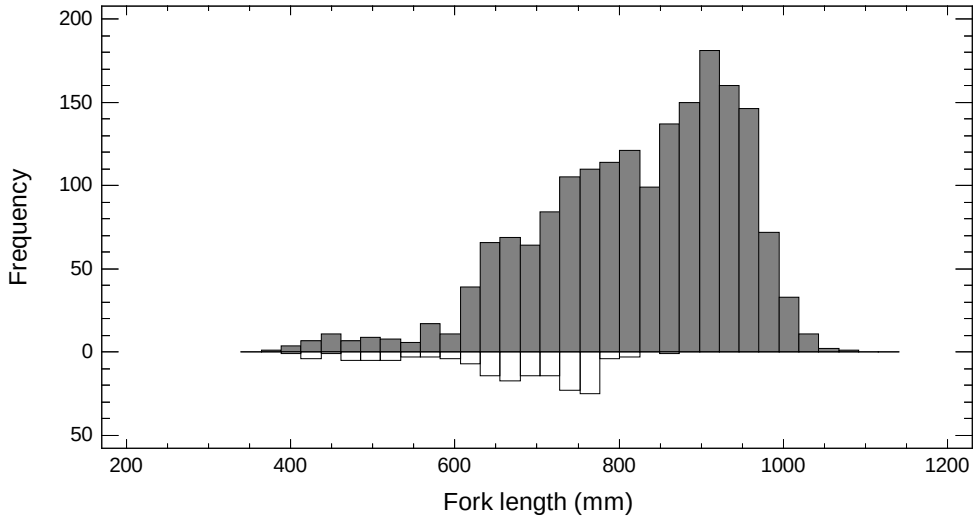

Figure 2. Length frequency distribution of bonnetheads (*Sphyrna tiburo*) tagged during the study from 1998-2012. Grey and white bars represent females and males, respectively.

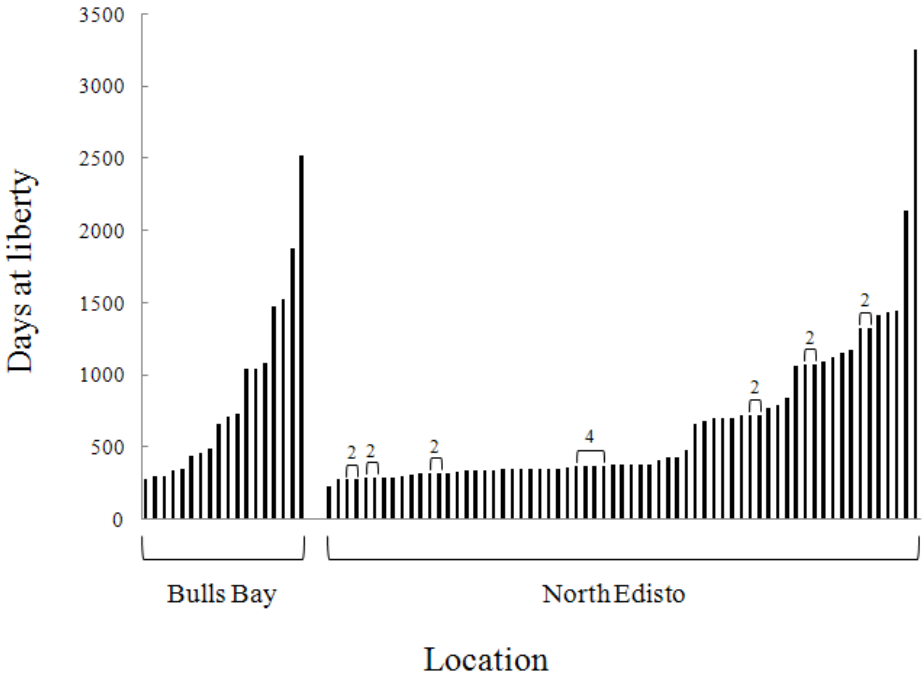

Figure 3. Histogram of days at liberty for interannual recaptures. Brackets and numbers above bars represent the number of individuals in groups that were tagged and recaptured on identical days and locations. Note two sharks were not included that were tagged in Bulls Bay on 08/27/2003 and 08/29/2003 and subsequently recaptured together on 07/10/2006 after 1048 and 1046 days at liberty, respectively.