Mark/Recapture Data for the Atlantic Sharpnose Shark (*Rhizoprionodon terranovae)*, in the Western North Atlantic from the NEFSC Cooperative Shark Tagging Program

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Summary
Mark/recapture information from the National Marine Fisheries Service (NMFS) Cooperative Shark Tagging Program (CSTP) covering the period from 1969 through 2012 are summarized for the Atlantic sharpnose shark (*Rhizoprionodon terranovae)* in the western North Atlantic. The extent of the tagging effort, areas of release and recapture, and movements and length frequencies of tagged sharks are reported. Two areas were distinguished in order to identify exchange between the Atlantic and Gulf of Mexico. Overall, there was no movement between the Atlantic and Gulf of Mexico and limited exchange (8) between the US and the Mexican-managed portion of the Gulf of Mexico; the true extent of this movement is unclear due to the possibility of under-reporting of recaptures.

Introduction

The Atlantic sharpnose shark, *Rhizoprionodon terranovae*, inhabits coastal waters in the western North Atlantic, from the Bay of Fundy to shelf waters of the Gulf of Mexico (Castro 1983, Parsons 1983); inhabiting a seasonal temperature range of 18-27 °C (Branstetter 1987). Females reproduce annually with pups born late April to early June (Branstetter 1981, Parsons 1983). The gestation period is 11 months producing a litter size of one to eight pups, increasing with female size (Loefer and Sedberry 2003). Mating season is mid May to early July (Loefer and Sedberry 2003, Branstetter 1981). Sexual maturity for both sexes is reached at approximately age three (Loefer and Sedberry 2003). The maximum age is estimated to be between 8 and 10 years (Branstetter 1987). This species is frequently caught by a variety of commercial fishing gear such as bottom longline, gillnet, bandit reel, trawls, and hook-and-line fishing (Loefer and Sedberry 2003).

The purpose of this document is to summarize mark/recapture information from the NMFS Cooperative Shark Tagging Program (CSTP) for the Atlantic sharpnose shark (*Rhizoprionodon terranovae*) in the western North Atlantic. These data cover the period from 1969 through 2012 presenting the extent of the tagging effort, areas of release and recapture, and movements of tagged sharks. Data synopses include numbers of fish tagged and recaptured, overall recapture rate, maximum and mean distance traveled, maximum time at liberty, mean lengths, and length frequencies.

Materials and Methods

The NMFS Cooperative Shark Tagging Program (CSTP) was initiated in 1962. Information on the history and methods of the CSTP are detailed in Kohler et al. 1998 and Kohler and Turner 2001. Recreational and commercial fishermen conducted the majority of tagging for these sharks, providing information on size, sex, condition, location, and date of capture. The two primary types of tags used were a fin tag (Jumbo Rototag) and a dart tag ("M-tag"). Tagging studies have been mostly single release events in which recoveries are made opportunistically by recreational and commercial fishermen. When a marked shark is re-caught, information similar to that obtained at release is requested from the recapture, allowing for the calculation of time at large, displacement, and speed. Distance traveled in nautical miles (nm) between tagging and recapture sites is a minimum straight-line distance. For the purposes of these analyses, the boundary between the Gulf of Mexico and the Atlantic region was a line beginning on the east coast of Florida at 25º10.4'N latitude, proceeding due east to the U.S. EEZ.

This report summarizes the CSTP mark/recapture information for the Atlantic sharpnose shark in the western North Atlantic from 1969 through 2012. Length and weight for CSTP tag returns are reported with varying units of measure. Fork length (FL) was used when provided and converted to cm when applicable. Total length (TL) was converted to fork length by rearranging the following formula: TL (cm) = (1.158) FL (cm) + 1.476 (SEDAR 13 2007). When neither FL nor TL were provided, weight in kilograms was converted to FL by rearranging the following formula: weight (kg) = $(5.55519*10^{-6})$ FL (cm) $^{3.07395}$ (SEDAR 13 2007). Sharks were categorized into life stages according to length (cm, FL) determined from Loefer and Sedberry 2003 (Table 1). The boundaries

between young of the year and juvenile were defined at ~49cm. Sharks measuring less than 50cm FL were classified as young of the year. Sharks between 50cm FL and 67cm were considered to be juveniles. Males and females were considered mature when FL was greater than 67cm. Sharks without a size estimate or sharks of unknown sex were categorized as "unknown maturity". Sharks were classified as embryos when they were taken from pregnant females.

Results

A total of 4,653 Atlantic sharpnose sharks were released with tags along the U.S. east coast and the Gulf of Mexico between 1969 and 2012 (Table 2, Figure 1). Of the 4,370 fish of known sex, 2,612 (60%) were males and 1,758 (40%) were females resulting in a 1:0.67 male: female sex ratio. Atlantic sharpnose sharks were predominantly caught by rod and reel (70%), longline (24%), and gill net (6%). Sharks were also caught in smaller numbers (n<20) with handline, otter trawl, beach seine, set line, hand landing net, and by hand. Mature fish were the most commonly caught life stage for both males and females (Table 3, Figure 2, 3). The largest measured male and female fish were 109.2cm and 114cm FL, respectively. The mean fork length for both males and females and overall was 71 cm (Table 3).

A total of 77 sharks were recaptured from 1969 through 2012 with an overall recapture rate of 1.7% and mean distance traveled of 103nm (Table 2). Young of the year had the highest displacement (187nm) relative to the other life-stages (juvenile, 140 nm; mature, 83nm) (Figure 4). The Atlantic sharpnose shark at liberty the longest was 7.3 years and was recaptured 70nm from its original tagging location. The longest distance traveled was 570nm from a fish that was originally tagged off Texas and recaptured in Mexican waters 4.8 months later. There was no movement between the Atlantic and Gulf of Mexico (Figures 5-17). The majority of the recaptured fish showed Atlantic coastal movements with some exchange between US Gulf and Mexican waters. Eight Atlantic sharpnose sharks that were tagged off Texas were recaptured off Mexico; this represents 0.2% of the total numbers tagged.

Overall, there was no movement between the Atlantic and Gulf of Mexico and limited exchange (8) between the US and the Mexican-managed portion of the Gulf of Mexico. The true extent of this movement is unclear due to the possibility of under-reporting of recaptures.

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Table 1. Literature values for lengths associated with maturity.

Reference	n	Location	Condition	Female (FL)*	Male (FL)*
Parsons 1985	15	Alabama	YOY (birth)	26.36-30.68	26.36-30.68
			Juvenile	64.87	
			Mature	72.13-76.45	67.81-72.13
Parsons 1981			Length at birth	26.36	26.36
			Max. length	91.13	87.67
Branstetter 1987	8	Texas	Born	24.63	24.63
			Mature	73.85	67.81
			Max. length	89.40-93.71	89.40-93.71
Loefer,** Sedberry 2003	1093	Virginia to northern Florida	Length at birth	23.9	23.9
			Largest full term embryo	27.1	27.1
			Young of the year	48.9	49.2
			Mature	66.8	67.2
			Max. length	90.1	90.1
			Sex ratio 1:1		

*Values given in TL were converted to FL (cm) using formula from SEDAR 13
**Values given in PCL were converted to FL using formula from Loefer &Sedberry 2003

Table 2. CSTP data distributed by sex for Atlantic sharpnose sharks tagged and recaptured. Displacement and speed values are calculated using the straight line distance from the tagging location to the recapture location.

Sex	Tagged	Recaptured	Recaptured Rate	Mean Displacement (nm)	Max Displacement (nm)	Mean Time at Liberty (days)	Max Time at Liberty (days)	Mean Speed (nm/day)	Max Speed (nm/day)
Male	2612	44	1.7	99.3	570	655.2	2650	0.54	5.7
Female	1758	20	1.1	116.3	337	823.3	2233	0.46	2.3
Unknown	283	13	4.6	91.4	297	653.3	2379	0.41	1.6
Total	4653	77	1.7	102.6	570	699.3	2650	0.50	5.7

Sex ratio (M:F) 1: 0.67

Table 3. CSTP data distributed by sex and life stage for Atlantic sharpnose sharks tagged (including recaptures).
YOY = young of the year

							Fork Length				
Sex	Mature	Juveniles	YOY	Embryos*	Unknown Maturity	Total	Min	Max	Median	Mean	SD
Males	**1931** *40.85* *72.73* *58.13*	**456** *9.65* *17.18* *52.78*	**258** *5.46* *9.72* *50.39*	**0** *0* *0* *0*	**10** *0.21* *0.38* *34.48*	**2656** *56.17*	19	110.6	75	70.72	14.14
Females	**1249** *26.42* *70.25* *37.60*	**305** *6.45* *17.15* *35.30*	**219** *4.63* *12.32* *42.77*	**0** *0* *0* *0*	**5** *0.11* *0.28* *17.24*	**1778** *37.61*	20	114	76	71.13	16.33
Unknown Sex	**142** *3.00* *48.30* *4.27*	**103** *2.18* *35.03* *11.92*	**35** *0.74* *11.90* *6.84*	**0** *0* *0* *0*	**14** *0.30* *4.76* *48.28*	**296** 6.22	22.91	114.8	68.67	67.56	16.72
Total	**3322** *70.28*	**864** *18.28*	**512** *10.83*	**0** *0*	**29** *0.61*	**4730** *100*	19	114.8	76	71.13	16.72

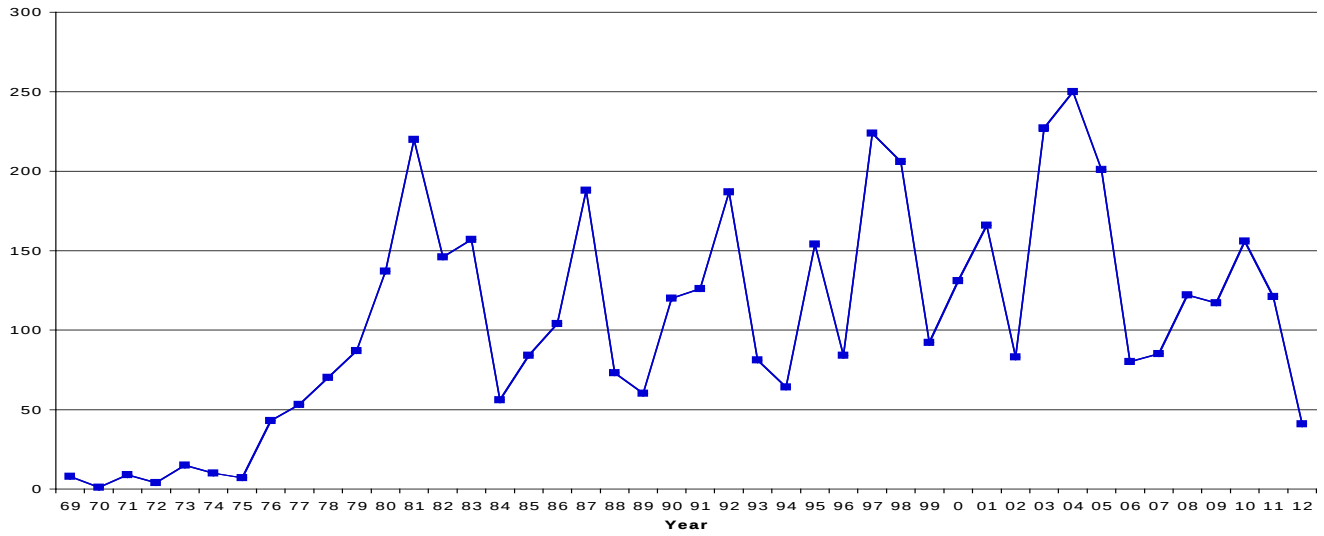
*embryos from captured pregnant females, that were tagged and released

Key

Frequency
Percent
Row percent
Column percent

Figure 1. Total number of Atlantic sharpnose sharks tagged (A) and recaptured (B) by year.

A.



B.

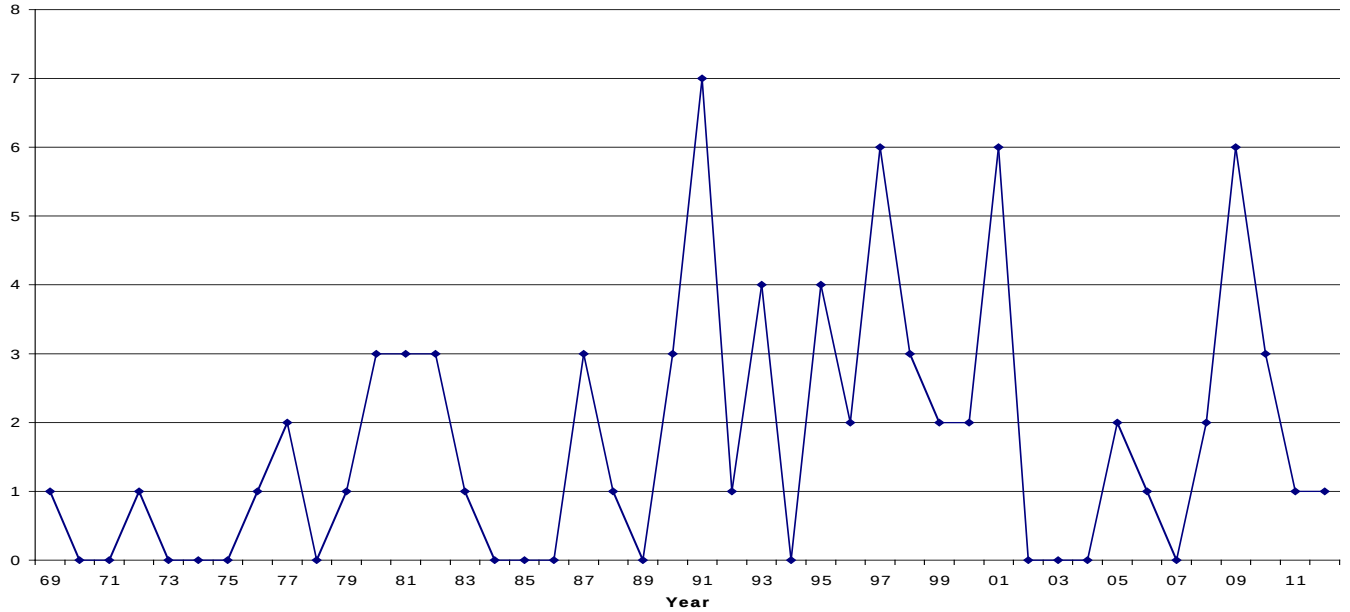


Figure 2. Length frequency for Atlantic sharpnose sharks tagged (including recaptures).

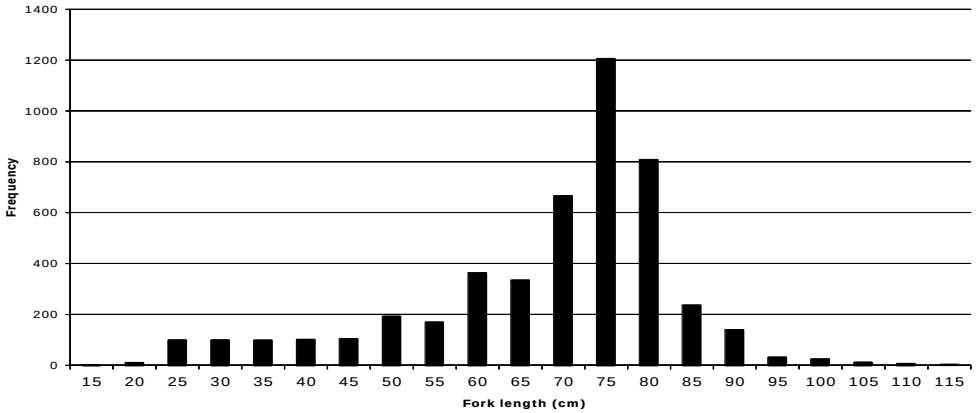


Figure 3. Length frequency by sex for Atlantic sharpnose sharks tagged (including recaptures).

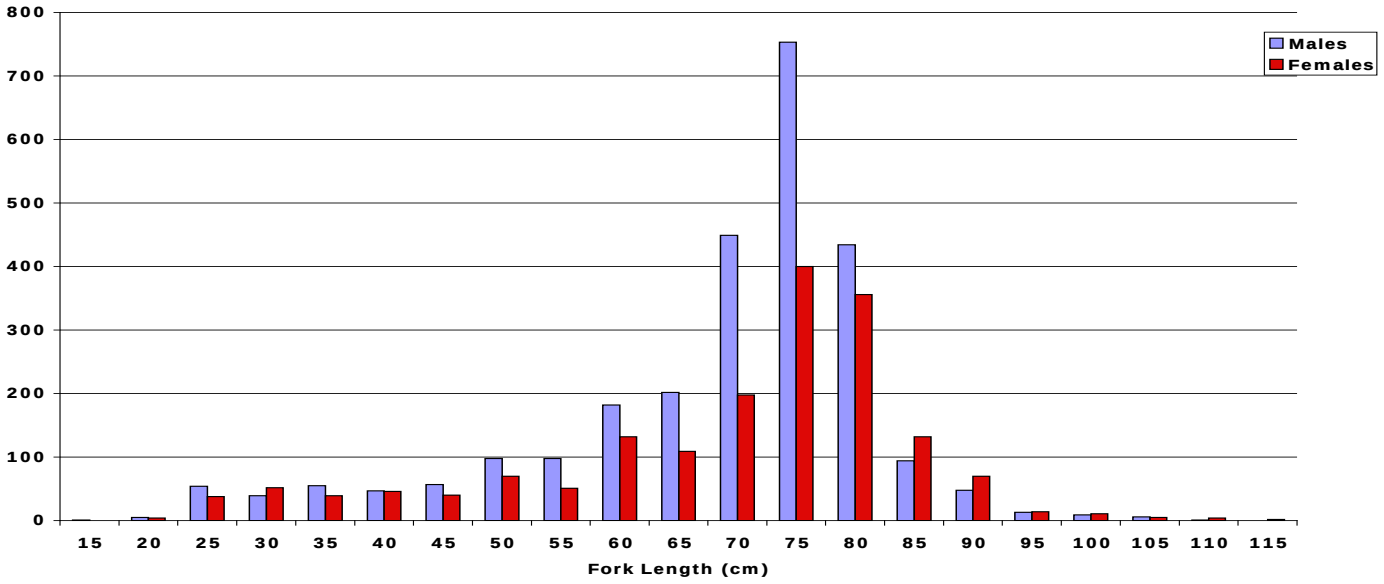


Figure 4. Mean displacement of Atlantic sharpnose sharks at large for 1-2650 days. N=3, 21, and 51 for young of the year, juveniles, and mature sharks, respectively. Displacement values are calculated using the straight line distance from the tagging location to the recapture location.

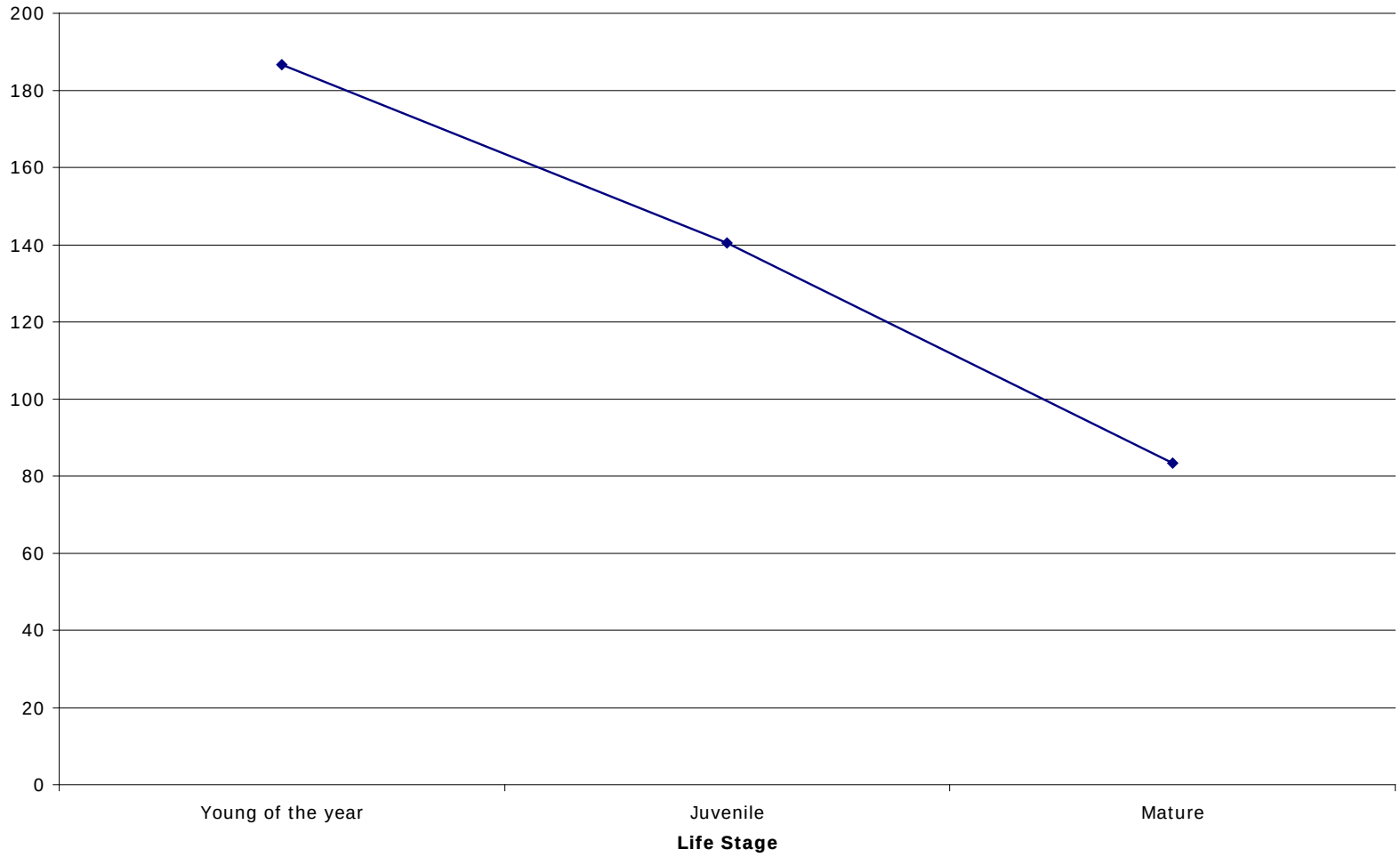


Figure 5. Atlantic sharpnose shark tagging data (including recaptures) by sex. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

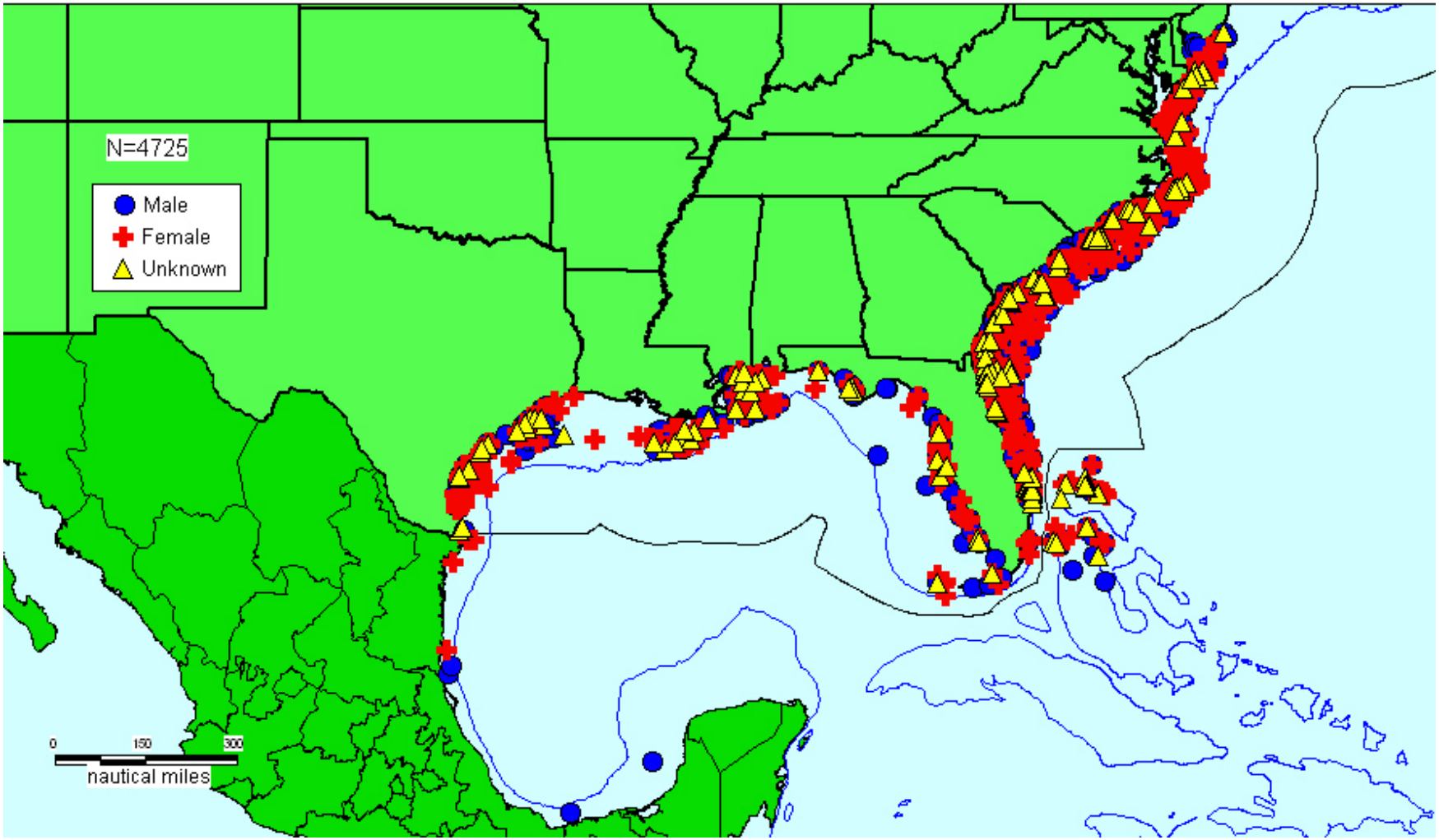


Figure 6. Atlantic sharpnose shark tagging data (including recaptures) in the Gulf of Mexico by sex. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

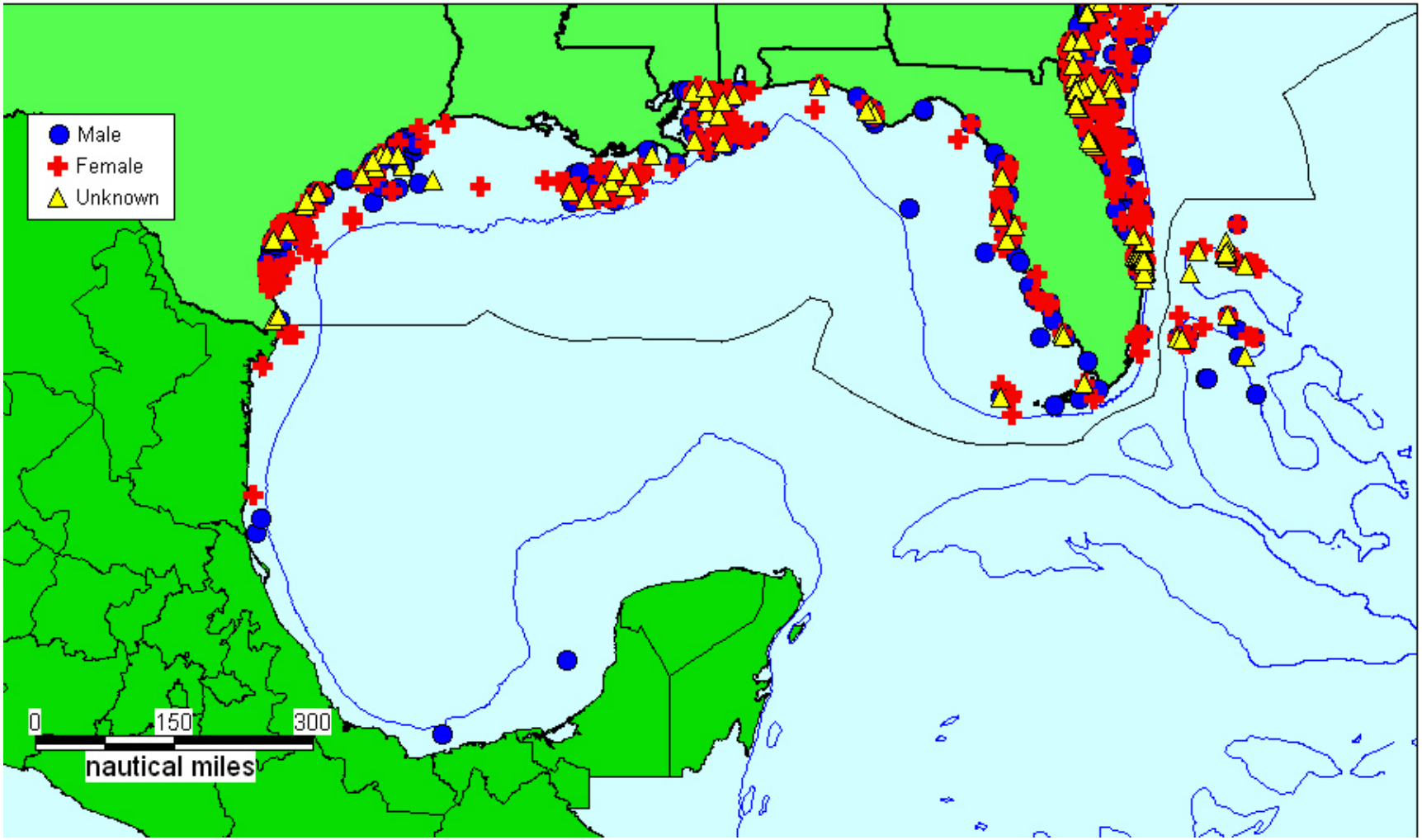


Figure 7. Atlantic sharpnose shark tagging data (including recaptures) off the Atlantic Coast by sex. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

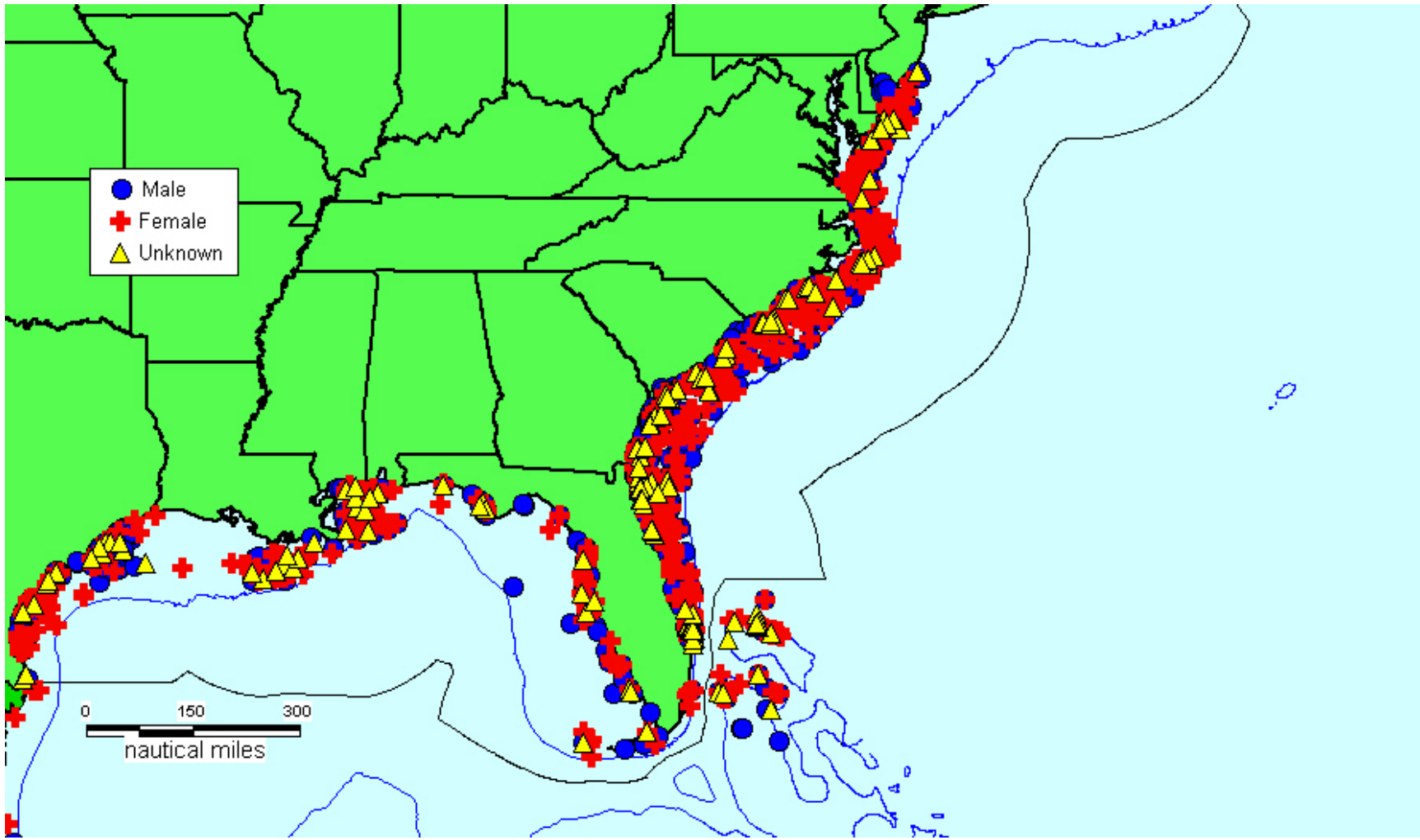


Figure 8. Atlantic sharpnose shark tagging data (including recaptures) by life stage. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

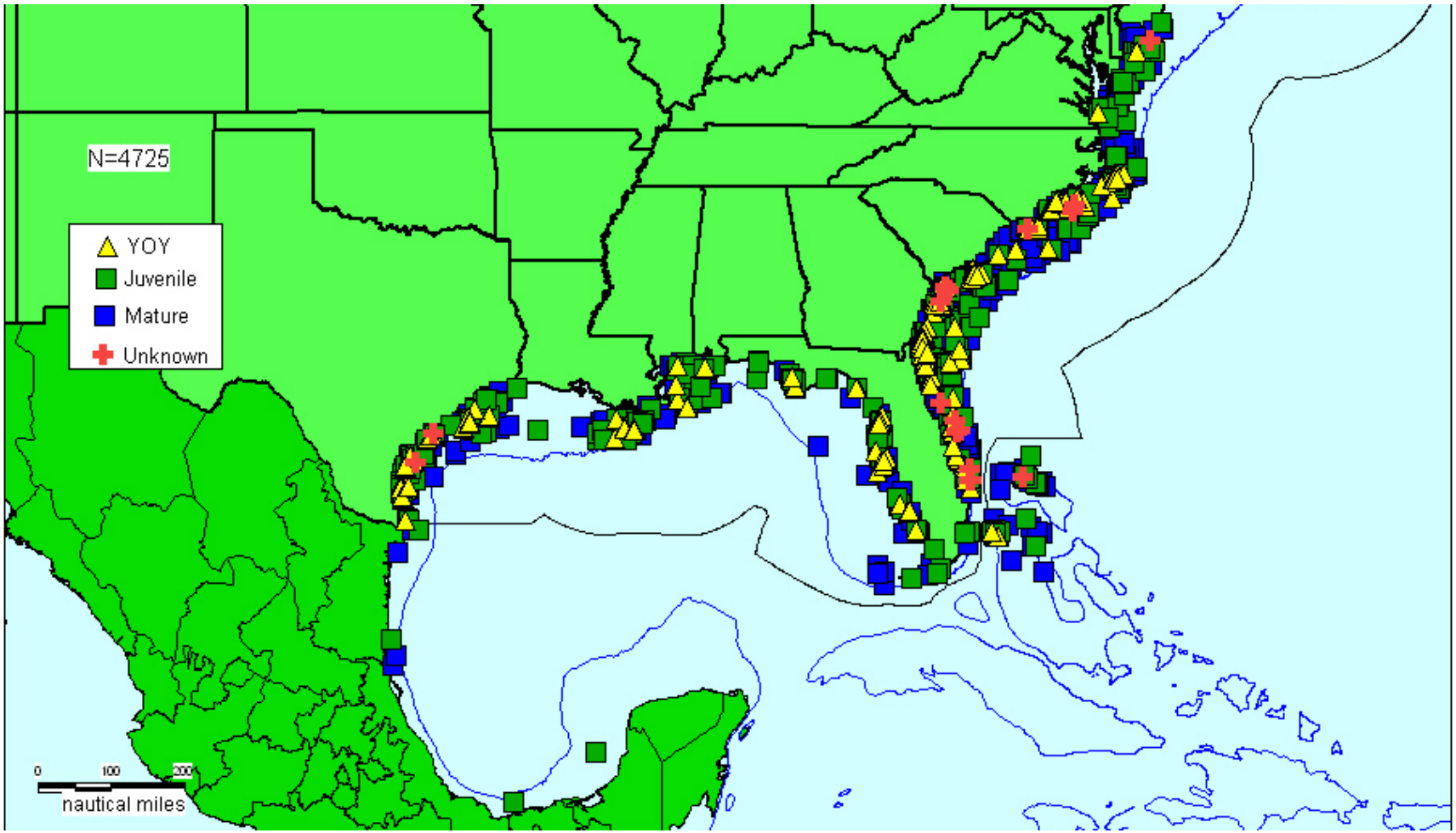


Figure 9. Atlantic sharpnose shark tagging data (including recaptures) in the Gulf of Mexico by life stage. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

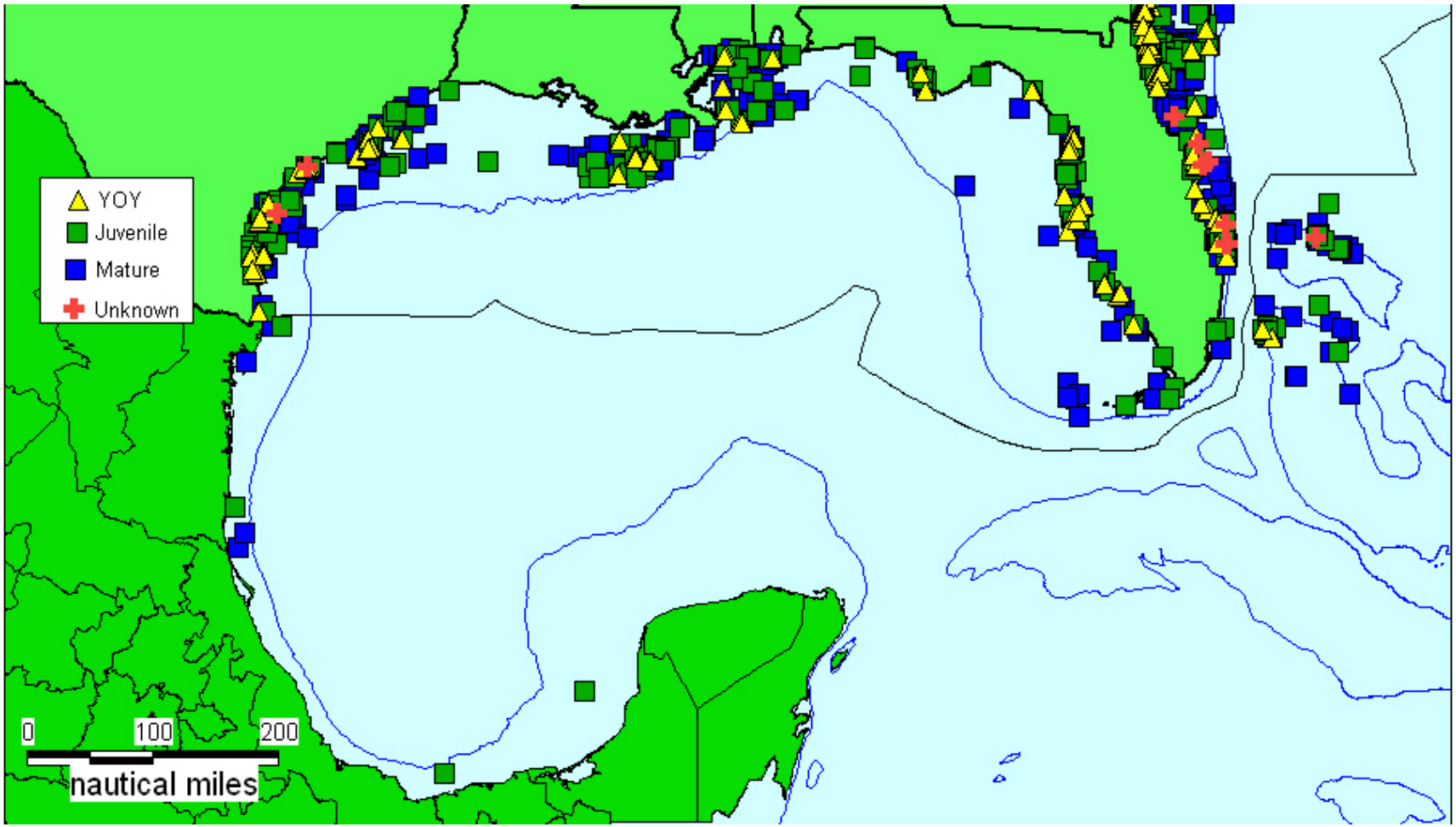


Figure 10. Atlantic sharpnose shark tagging data (including recaptures) off the Atlantic Coast by life stage. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

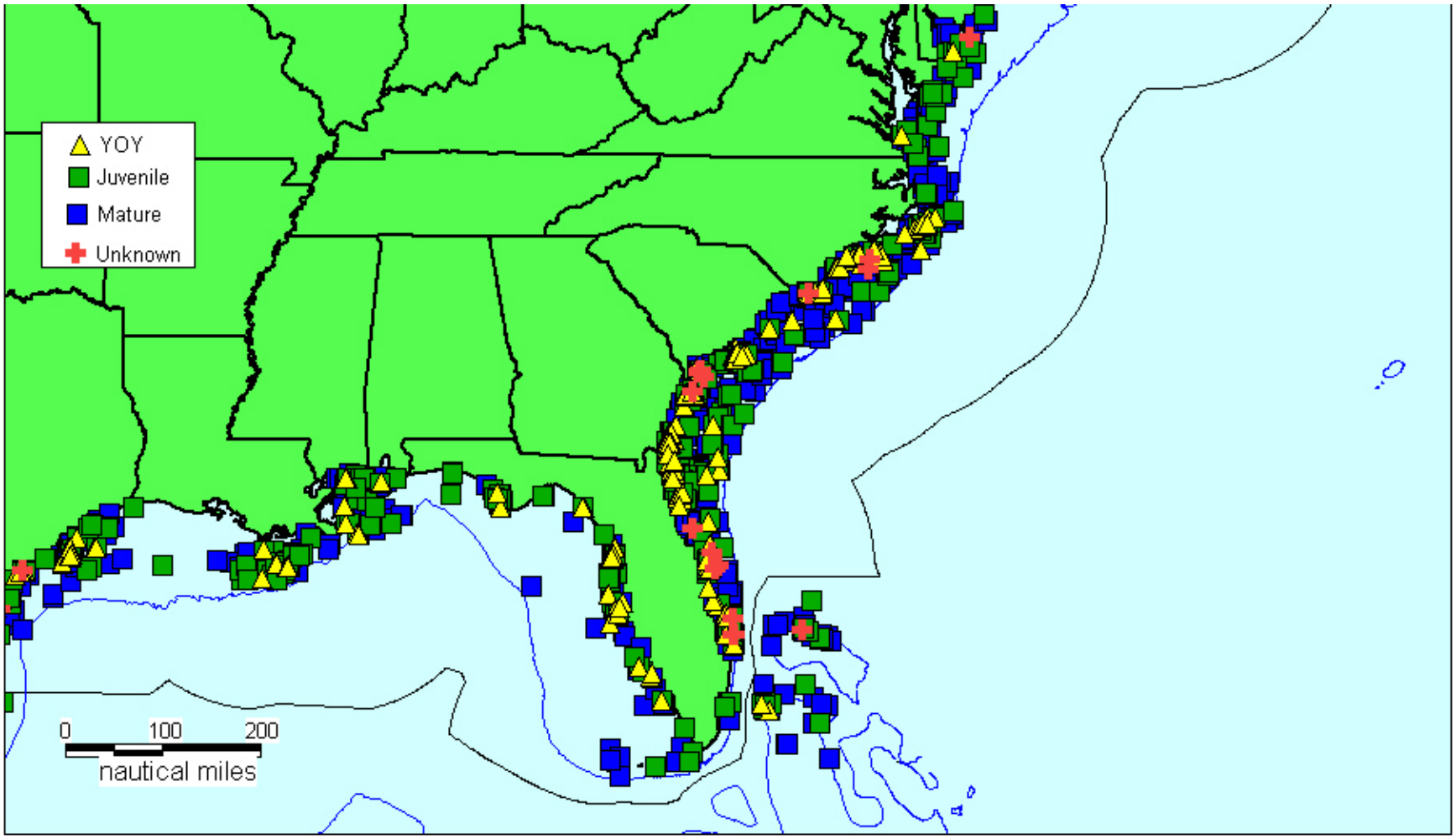


Figure 11. Locations of tagged young of the year and pregnant Atlantic sharpnose sharks (including recaptures). The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

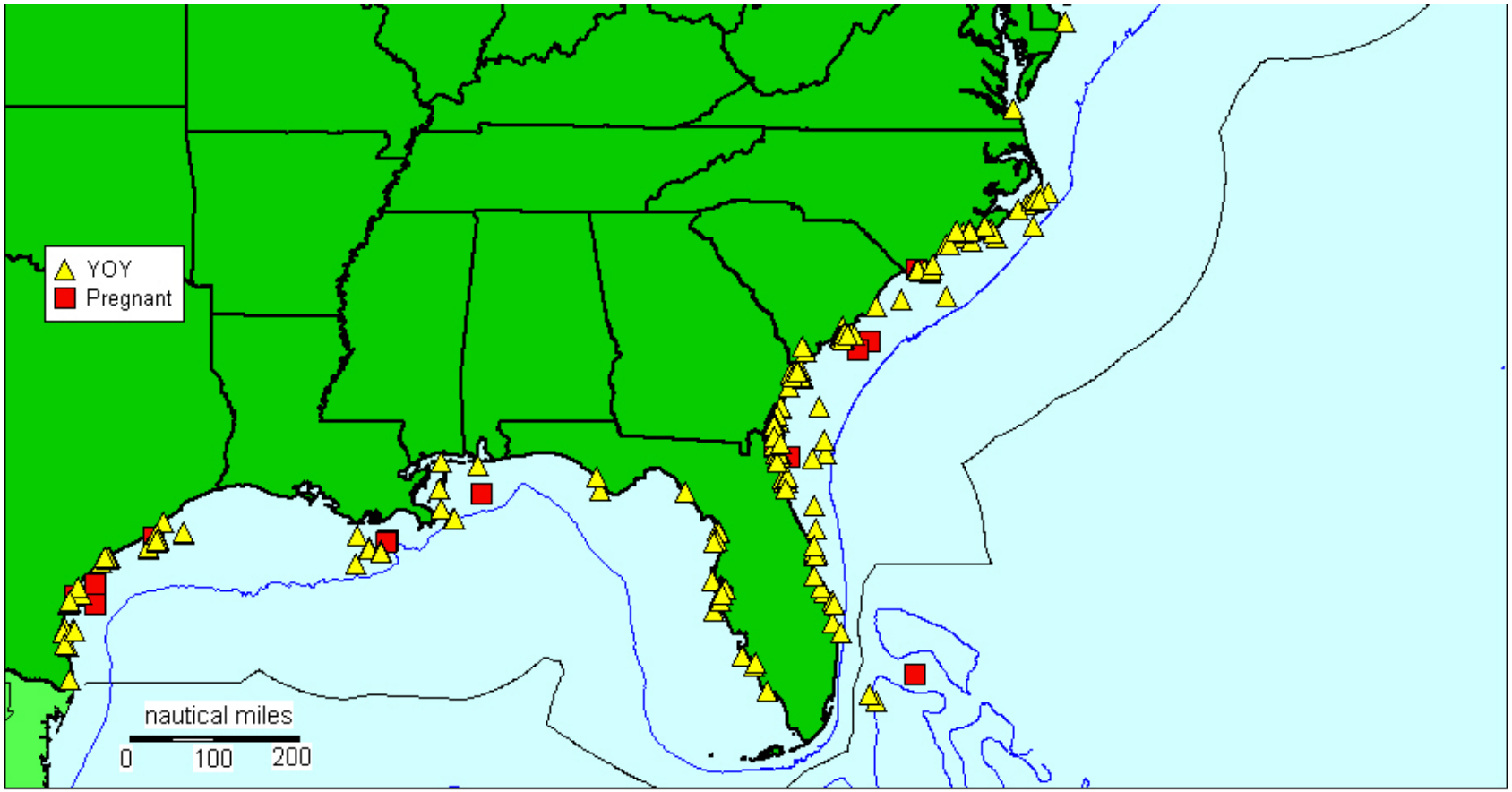


Figure 12. Atlantic sharpnose shark recaptures by sex. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

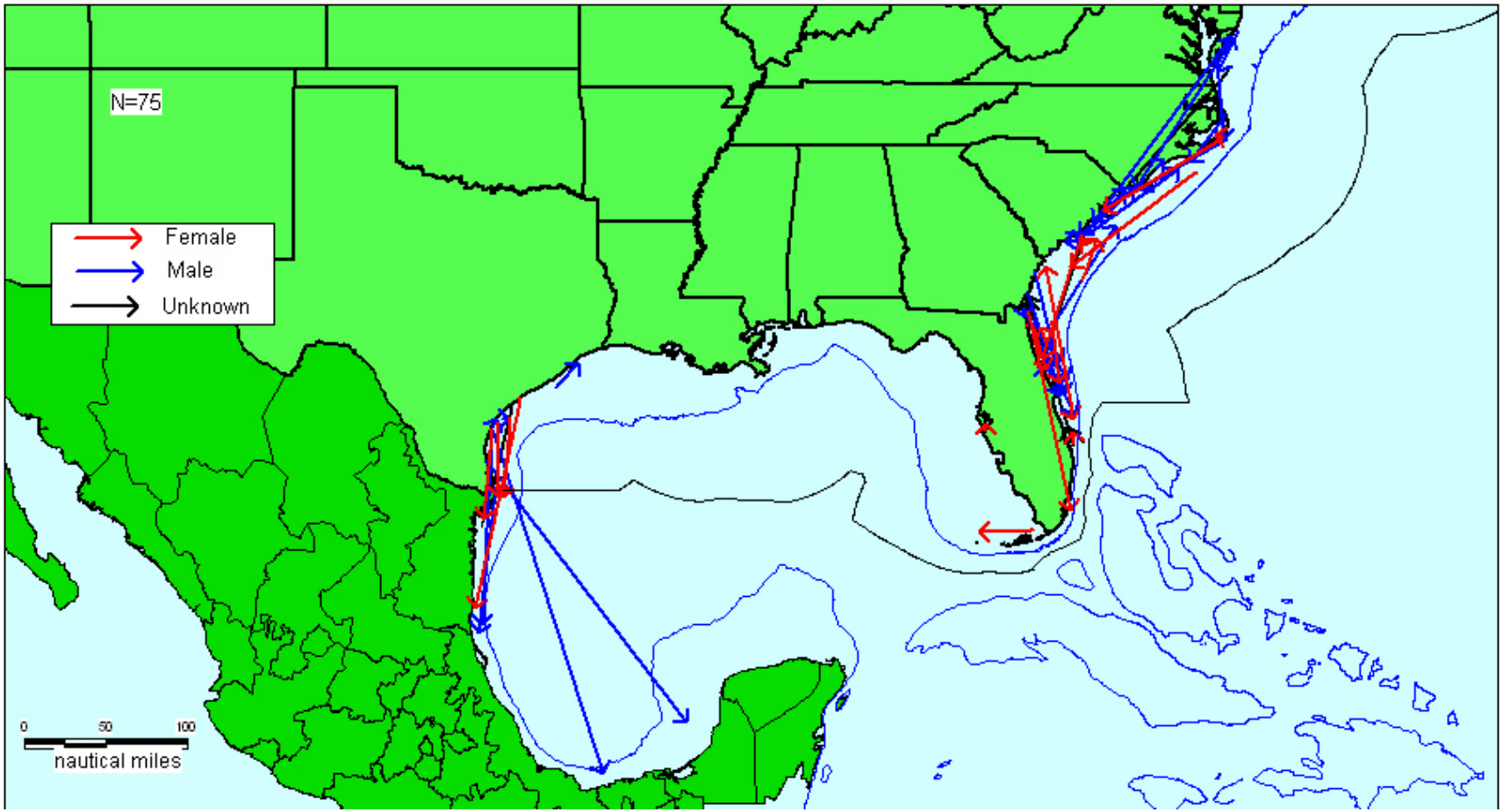


Figure 13. Atlantic sharpnose shark recaptures off the Atlantic Coast by sex. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

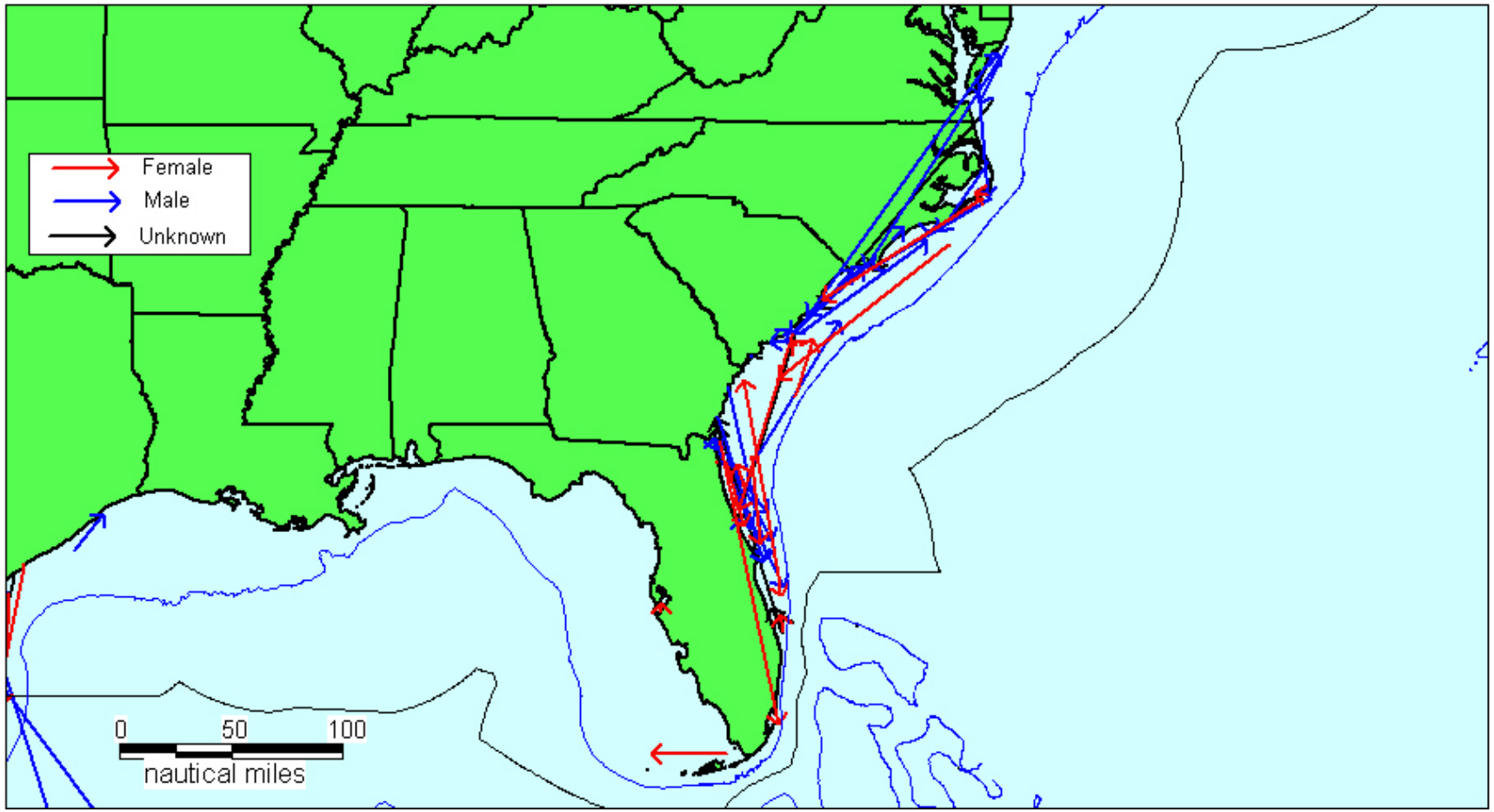


Figure 14. Atlantic sharpnose shark recaptures in the Gulf of Mexico by sex. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

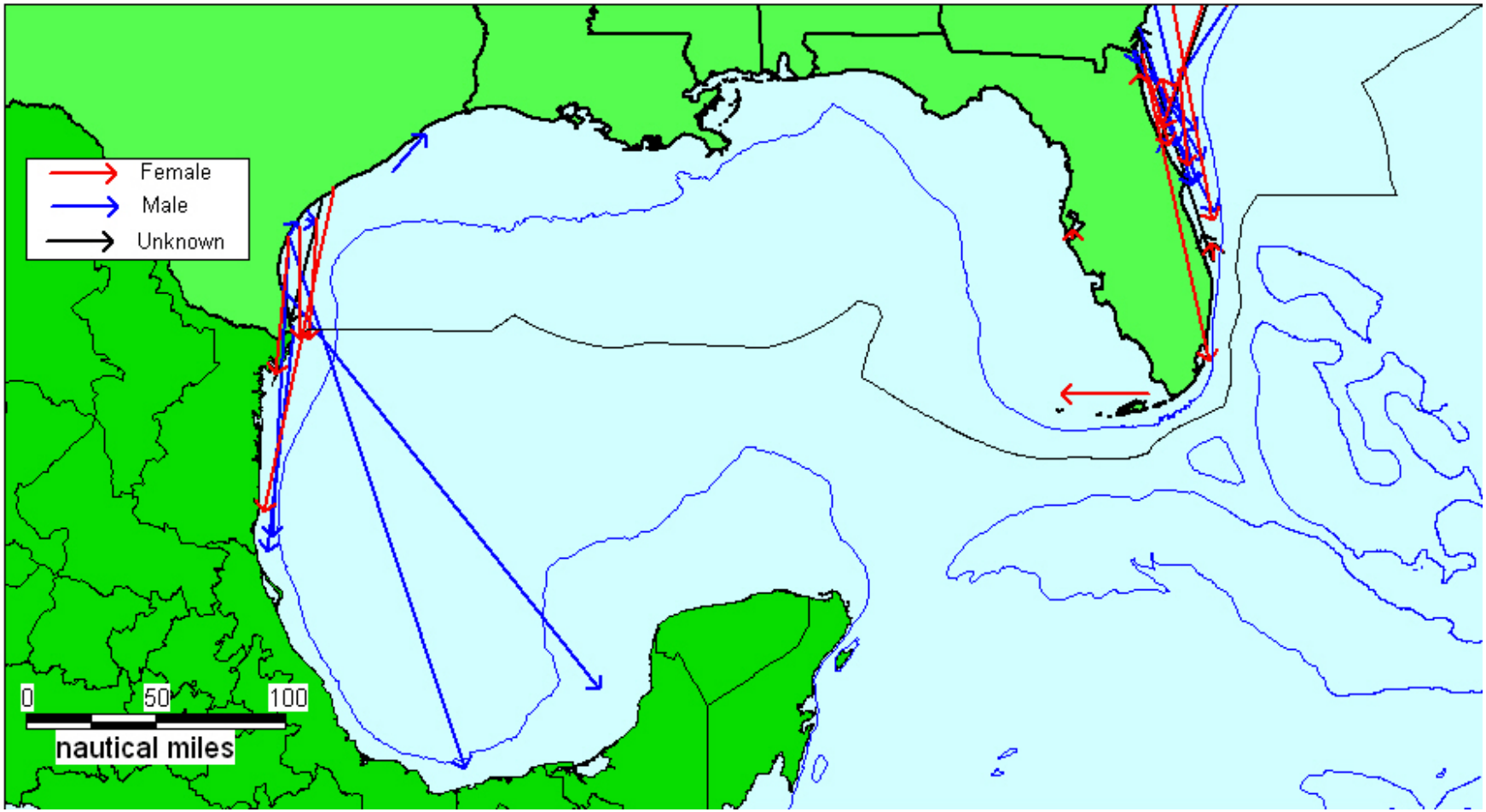


Figure 15. Atlantic sharpnose shark tagging data (including recaptures) by sex and life stage. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

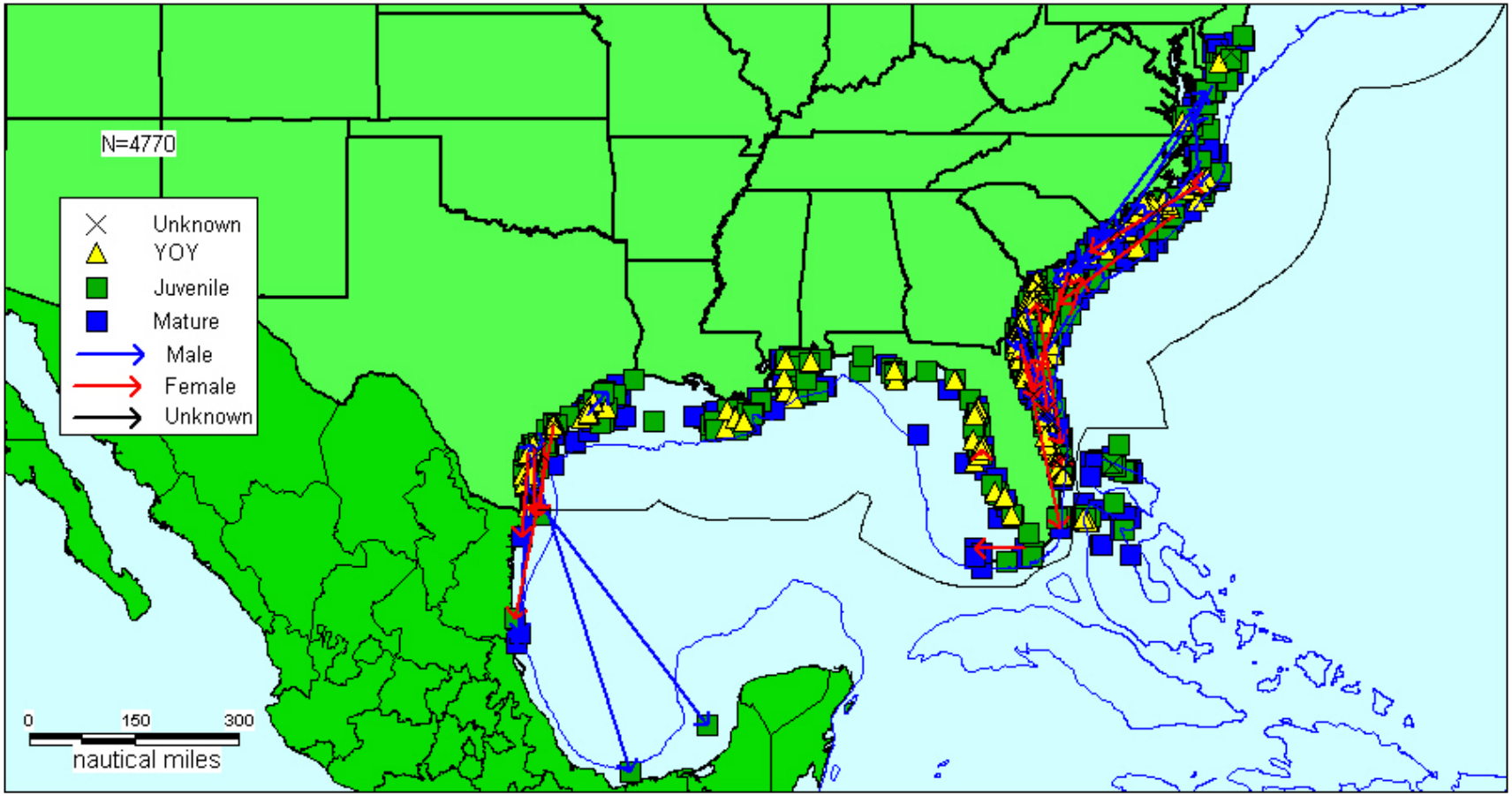


Figure 16. Atlantic sharpnose shark tagging data (including recaptures) off the Atlantic Coast by sex and life stage. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.

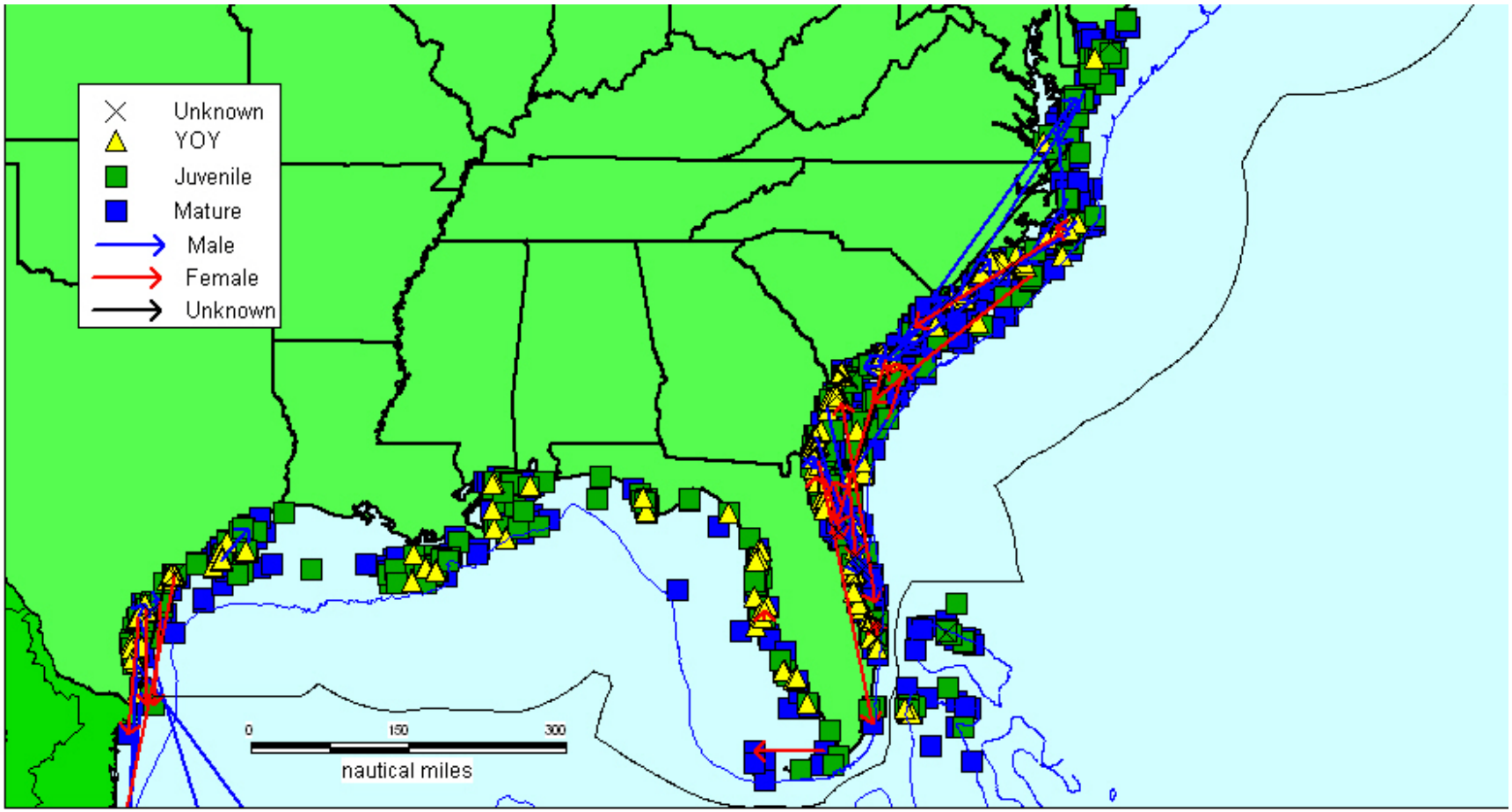


Figure 17. Atlantic sharpnose shark tagging data (including recaptures) in the Gulf of Mexico by sex and life stage. The solid blue line represents the 200m depth contour. The solid black line represents the U.S. EEZ.