Preliminary Tag and Recapture Data for the Sandbar Shark, *Carcharhinus plumbeus*, and the Blacktip Shark, *Carcharhinus limbatus*, in the Western North Atlantic

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Summary

Tagging and recapture (T/R) information from the National Marine Fisheries Service (NMFS) Cooperative Shark Tagging Program (CSTP) covering the period from 1963 through 2004 are summarized for the sandbar shark (*Carcharhinus plumbeus*) and the blacktip shark (*Carcharhinus limbatus*) in the western North Atlantic. The extent of the tagging effort, areas of release and recapture, sources of tags and recaptures, capture methods, and movements of tagged sharks are reported. Summary information includes number of males and females tagged and recaptured, overall recapture rate, and maximum distance traveled and time at liberty. In order to examine regional trends in size and maturation categories, the study area is divided into geographical areas. General migration patterns for life history stages for the two shark species are summarized and discussed.

Introduction

Sandbar Shark (*Carcharhinus plumbeus*)

The sandbar shark is an inshore-offshore, coastal-pelagic shark of temperate and tropical waters, found on continental and insular shelves and in deep water adjacent to them, and oceanic banks (Compagno 1984). They are a bottom dwelling species and are common at bay and river mouths, in harbors, and inside shallow muddy or sandy bays. Depths range from the intertidal to 280m depth (Springer 1960, Castro 1983). In the western North Atlantic, the sandbar shark is found from New England to southern Brazil including the Gulf of Mexico and Caribbean (Compagno 1984). Distribution along the US east coast extends from Massachusetts to the Florida Keys in the summer and from the Carolinas to Cape Canaveral during the winter months (Springer 1960, Castro 1996). Sandbar sharks demonstrate seasonal north-south migrations and show adult sexual segregation but are found in mix-sex schools on the nursery grounds (Compagno 1984, Castro 1996). They are highly migratory and it appears that sandbar sharks from the western North Atlantic and Gulf of Mexico comprise one interbreeding population (Heist et al. 1995, Kohler et al. 1998).

Primary nursery grounds for parturition of the western North Atlantic/Gulf of Mexico population extend from New Jersey to South Carolina (Castro 1993, Merson 1998) with some evidence of pupping occurring in the northeastern Gulf of Mexico **(**Carlson 1999). Pregnant female sandbar sharks move into shallow coastal bays and estuaries to pup in May and June with major primary nursery grounds occurring in the Chesapeake (Musick et al. 1993) and Delaware Bays (Merson and Pratt 2001). *C. plumbeus* is a viviparous species with a yolk-sac placenta (Compagno 1984, Castro 1996).

Worldwide, the number of young ranges from 1 to 14 per litter (Compagno 1984, Castro 1993) with mean litter sizes reported as eight (Sminkey and Musick 1996, Merson 1998) to nine (Springer 1960, Castro 1983). The young are born in a range from 38 to 59 cm fork length (FL) (Castro 1996, Merson 1998).

Sandbar sharks grow to a reported maximum size of 211 cm FL (Kohler et al. 1996) with 50% maturity of 149 cm and 157 cm FL for the males and females respectively (Merson 1998). The frequency of pregnancy is no less than every other year, but with a possible two-year resting period (Compagno 1984, Sminkey and Musick 1996, Merson 1998).

Age and growth estimates from multiple studies suggest slow growth and late age at maturity. Ages for maturity range from 12-34 years determined by vertebral rings and/or tag-recapture analysis (Casey et al. 1985, Casey and Natanson 1992, Sminkey and Musick 1995). Studies suggest that the sandbar shark may live to well over 30 yr (Casey and Natanson 1992, Sminkey and Musick 1995)

Prey consumed by sandbar sharks consists primarily of benthic and demersal species, both vertebrate and invertebrate with teleosts as the primary prey (Springer 1960, Compagno 1984, Stillwell and Kohler 1993). Food was present in up to 49% of the stomachs examined (Wass 1973, Stillwell and Kohler 1993).

Blacktip Shark (*Carcharhinus limbatus*)

The blacktip shark is a common tropical and subtropical species, widespread on continental and insular shelves (Compagno 1984); described as an active fast swimming shark that often forms large schools in shallow coastal and surface offshore waters (Dodrill 1977, Castro 1983, Dudley and Cliff 1993). In the western North Atlantic, the blacktip shark is distributed from Massachusetts to southern Brazil including the Gulf of Mexico and Caribbean (Compagno 1984) and is common along the southeast U.S. coast from the Carolinas to Florida (Castro 1996). Blacktip sharks show sexual segregation and seasonal variation in abundance (Compagno 1984, Castro 1996). They demonstrate seasonal north-south migrations and are thought to migrate to deeper waters in the winter months (Castro 1983).

In the western North Atlantic, pregnant female blacktip sharks move to inshore nursery areas to pup; young are born in late spring or early summer (April to June) (Compagno 1984). *C. limbatus* is a viviparous species with a yolk-sac placenta (Compagno 1984,

Castro 1996). Worldwide, the number of young ranges from 1 to 11 per litter (Dudley and Cliff 1993), commonly 4 to 7 (Compagno 1984). The reproductive cycle lasts 2 years (Bass et al. 1973, Dodrill 1977, Castro 1996) and includes biennial ovulation with a 10-12 month gestation period (Castro 1996). The young are born at about 39-47 cm FL (Branstetter 1981, Castro 1996).

Blacktip sharks grow to a reported maximum size of 165 cm FL (Castro 1996) with males maturing between 101-117 cm FL, and females maturing between 117-132 cm FL (Clark and von Schmidt 1965, Dodrill 1977, Branstetter 1987, Killam and Parsons 1989, Castro 1996, Castillo et al. 1998). Reported estimates of birth length, maximum length, and length at maturity can vary considerably among authors and vary geographically between regions.

Age and growth studies from the northern Gulf of Mexico reported males to mature at 4-5 years and females at 6-8 years (Branstetter 1987, Killam and Parsons 1989). Branstetter (1987) suggests that with slower growth after maturity, both males and females at their maximum length might be 15 yrs in age or greater.

Blacktip sharks are primarily piscivorous with teleost prey present in 60-100% of the stomachs examined with food. Teleost prey consists primarily of various species of schooling fishes (Bass et al 1973, Dodrill 1977, Dudley and Cliff 1993, Castro 1996) through which the sharks are known to launch themselves vertically, spinning and feeding in all directions (Compagno, 1984).

Materials and Methods

The purpose of this document is to summarize T/R information from the NMFS CSTP covering the period from 1963 through 2004 presenting the extent of the tagging effort, areas of release and recapture, sources of tags and recaptures, capture methods, and movements of tagged sharks. Data synopses include 1) numbers of fish tagged and recaptured, 2) overall recapture rate, 3) distance traveled, and 4) time at liberty. Summary information on the history and methods of the CSTP has been published

previously (Casey 1985, Casey and Kohler 1992, Kohler et al. 1998, Kohler and Turner 2001) and excerpts from these reports are included here. The two principal CSTP tags are 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 tagged shark is re-caught, information similar to that obtained at tagging is requested from the recapturer. Distance traveled in nautical miles (nm) between tagging and recapture sites is a minimum straight-line distance. Tagging and recapture sizes are originally recorded in fork length, total length (TL) and/or weight. Fork length is used throughout this report with TL and weights converted to FL using the relationships for sandbar and blacktip sharks reported in Castro (1996) and Kohler et al. (1996), respectively.

After examining various reported estimates, we have followed Merson (1998) for the sandbar shark of 50% maturity at 149 cm FL for males and 157 cm FL for females and for the blacktip shark from Castro's (1996) of 117 cm FL for the males, and 126 cm FL for the females. Since estimates of length at maturity vary by author and geographic area (especially for the blacktip shark), for the purposes of this study, we chose larger reported maturity sizes so that the majority of sharks would be mature throughout our study area by that size.

The study area is divided into geographical regions in order to examine trends in size and maturation (Figure 1). These areas are defined solely based on tagging distributions, which largely reflects the fishing effort patterns of cooperative taggers aboard private, commercial, and research vessels. The authors do not believe that these boundaries are associated with stock or management units. These tagging regions are defined as East Coast (US), Gulf of Mexico (US), Gulf of Mexico (Mexico), and Other. Only data with information on size, sex, and mark/recapture location were included in the regional analyses.

Results and Discussion

Sandbar Sharks

Tagging Data

A total of 25,968 sandbar sharks were tagged along the U.S. east coast and the Gulf of Mexico between 1963 and 2004. Recreational fishermen (47%) and NMFS and other biologists (43%) did the majority of the tagging, followed by commercial fishermen or observers aboard commercial vessels (10%). Primary gear types used were rod and reel (47%), longline (32%), and net (20%). Fish were tagged and released by fishermen representing seven countries (United States, Poland, Italy, Spain, Japan, Portugal, and Russia). Of the 21,702 fish of known sex, 8,504 (39%) were males and 13,198 (61%) were females resulting in a 1:1.6 male:female sex ratio.

For 21,669 sandbar sharks included in the regional database (Figure 2), the average overall size for males was 92 cm FL (range 36-214 cm) and females was 102 cm FL (range 28-229 cm) (Table 1). The mean FL for both sexes was larger with a higher percentage of mature fish in the Gulf of Mexico (US) region, however, the very largest fish were found in the East Coast (US) (Figures 3-6). Male:female sex ratios were nearly identical in the East Coast (US) and the Gulf of Mexico (US) (1:1.5 and 1:1.6, respectively). The majority of the neonate-(99%), juvenile-(97%) and mature-sized (84%) fish were tagged in the East Coast (US).

Recapture Data

A total of 1,340 *C. plumbeus* were recaptured from 1964 through 2004 with an overall recapture rate of 5.2%. Data on these fish were returned by commercial fishermen and observers on commercial vessels (68%), recreational anglers (29%), and NMFS and other biologists (3%) using primarily longline gear followed by rod and reel and gillnet. The percent recapture rate was calculated for the major tagging gear types. Sandbar sharks originally captured by gill net, rod and reel and longline had a 6%, 5%, and 4% recapture rate, respectively. Fish originally caught on hand lines and longlines had a 5.5% and 3.2% recapture rate, respectively. These recovery percentages are preliminary and may be influenced by differences in gear, Captain's experience level, geographic area of

tagging and times at liberty. Data were returned from fishermen representing five countries including the United States, Mexico, Cuba, Spain, and Poland. In contrast, recreational anglers (47%) fishing with rod and reel and NMFS and other biologists (46%) using longlines and gill nets did the majority of the original tagging of the recaptured fish from primarily U.S. vessels.

The sandbar shark at liberty the longest was tagged off Great Machipongo Sound, VA in June 1965 and recaptured 27.8 years later off the East coast of Florida in March. The longest distance traveled was 2039 nm established by a fish tagged off Rhode Island and recaptured off Tamaulipas, Mexico.

Movement Between Tagging Regions (N=1,010)

Sandbar sharks that were recaptured (Figure 7) were tagged within all areas except the Gulf of Mexico (Mexico) with the great majority (98%) tagged in the East Coast (US) (Tables 2-4). Of the fish tagged off the US East Coast, 19% moved to the US Gulf of Mexico and 3% moved to Mexican Gulf waters. Of the fish tagged in the US Gulf of Mexico, 27% moved to the US East Coast and 7% moved to Mexican Gulf waters. Overall, none of the neonate-sized fish moved between areas and a larger percentage of the mature fish of both sexes moved out of their original tagging area. In general, mean distance traveled increased with increasing life stage (Figure 8).

Blacktip Sharks

Tagging Data

A total of 6,373 blacktip sharks were tagged along the U.S. east coast, in the Bahamas, Gulf of Mexico, and the Caribbean Sea to northern Brazil between 1964 and 2004. Recreational fishermen did the majority (65%) of the tagging, followed by NMFS and other biologists (31%), and commercial fishermen or observers aboard commercial vessels (4%). Primary gear types used were rod and reel (65%), longline (31%), and net (3%). Fish were tagged and released by fishermen representing eight countries and island territories (United States, Venezuela, Bahamas, Barbados, England, Trinidad, Spain, and St. Thomas). Of the 5,674 fish of known sex, 2,267 (40%) were males and 3,407 (60%) were females resulting in a 1:1.5 male:female sex ratio.

For 5,618 blacktip sharks included in the regional database (Figure 9), the average overall size for males was 84 cm FL (range 30-183 cm) and females was 92 cm FL (range 30-190 cm) (Table 5). The largest mean FL for both sexes was in the Other region, however, the largest fish (female, 190 cm) were found in the East Coast (US). Small fish were found throughout the study area with the smallest mean FL for both sexes in the Gulf of Mexico (US). Male:female sex ratios ranged from 1:1.2 in the East Coast (US) to 1:1.7 in the Gulf of Mexico (US) and Other regions. The majority of the neonate-(68%) and juvenile-sized (60%) fish were tagged in the Gulf of Mexico (US) with nearly equal numbers of mature fish tagged in the East Coast (US) and Gulf of Mexico (US) regions (Figures 10-15).

Recapture Data

A total of 198 *C. limbatus* were recaptured from 1966 through 2004 with an overall recapture rate of 3.1%. Data on these fish were returned by recreational anglers (59%), commercial fishermen and observers on commercial vessels (37%), and NMFS and other biologists (4%) using primarily rod and reel followed by gillnet and longline. The percent recapture rate was calculated for the major tagging gear types. Blacktip sharks originally captured by gill net, rod and reel, and longline had a 6%, 4% and 1% recapture rate, respectively. These recovery percentages are preliminary and may be influenced by differences in gear, Captain's experience level, geographic area of tagging and times at liberty. Data were returned from fishermen representing four countries and island territories including United States, Bahamas, Mexico, and Surinam. In contrast, recreational anglers (86%) fishing with rod and reel (84%) did the majority of the original tagging of the recaptured fish from U.S. vessels. The blacktip shark at liberty the longest and the longest distance traveled was tagged off Galveston, TX in May 1991 and recaptured 7.8 years later and 632 nm away off Veracruz, Mexico in March of 1999.

Movement Between Tagging Regions (N=143)

Blacktip sharks that were recaptured (Figure 16) were tagged within all areas except the Gulf of Mexico (Mexico). Overall movement between tagging areas was rare and

occurred primarily between the Gulf of Mexico (US) and Gulf of Mexico (Mexico) regions (Tables 6-8). In general, mean distance traveled increased with increasing life stage (Figure 17).

A total of 30 *C. limbatus*, tagged off Texas, were recaptured off Mexico (Figure 16). This represents 21% of the recaptures and 1% of the number of tagged fish in the US Gulf of Mexico region. The recapture locations were distributed from the U.S. - Mexican border to Campeche, Mexico. All fish, except one, were recaptured within 1 year of tagging. Lengths at tagging were 51-112 cm FL with a mean of 64 cm FL. Recapture lengths ranged from 52-133 cm FL with a mean of 71 cm FL. Twenty-three were females and seven were males. All were tagged by recreational fishermen using rod and reel with the majority of tags applied from September to November and most were recaptured by Mexican fishermen using gill nets between the months of October and January. Castillo et al (1998) reports that the highest catches in the Mexican gulf region occurred in October and November, which coincides with the annual southward migration from U.S. to Mexican waters.

Overall, there was limited exchange between the tagging regions. Considerable movement did occur, however, 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. Regional tagging distribution of the sandbar shark by sex and life stage.

East Coast (US)					Fork Length (cm)		
Sex	Mature	Juveniles	Neonates	Total	Mean	Min	Max
Male	**620** *2.98* *7.58* *42.23*	**5346** *25.66* *65.39* *35.64*	**2210** *10.61* *27.03* *50.61*	**8176** *39.24*	90	36	214
Female	**848** *4.07* *6.7* *57.77*	**9655** *46.34* *76.26* *64.36*	**2157** *10.35* *17.04* *49.39*	**12660** *60.76*	101	28	229
Total	**1468** *7.05*	**15001** *72*	**4367** *20.96*	**20836** *100*	Sex Ratio (M:F) 1:1.5		

Gulf of Mexico (US)					Fork Length (cm)		
Sex	Mature	Juveniles	Neonates	Total	Mean	Min	Max
Male	**139** *16.75* *43.57* *50.92*	**161** *19.4* *50.47* *31.02*	**19** *2.29* *5.96* *50*	**319** *38.43*	128	46	202
Female	**134** *16.14* *26.22* *49.08*	**358** *43.13* *70.06* *68.98*	**19** *2.29* *3.72* *50*	**511** *61.57*	132	43	208
Total	**273** *32.89*	**519** *62.53*	**38** *4.58*	**830** *100*	Sex Ratio (M:F) 1:1.6		

Gulf of Mexico (Mexico)					Fork Length (cm)		
Sex	Mature	Juveniles	Neonates	Total	Mean	Min	Max
Male	**0**	**1** *100* *100* *100*	**0**	**1** *100*	140	140	140
Female	**0**	**0**	**0**	**0**			
Total	**0**	**1** *100*	**0**	**1** *100*	Sex Ratio (M:F)		

Other					Fork Length (cm)		
Sex	Mature	Juveniles	Neonates	Total	Mean	Min	Max
Male	**1** *50* *100* *100*	**0**	**0**	**1** *50*	175	175	175
Female	**0**	**1** *50* *100* *100*	**0**	**1** *50*	140	140	140
Total	**1**	**1**	**0**	**1**	Sex Ratio (M:F)		

Key

Frequency
Percent
Row Percent

50	*50*	*100*	1:1	*Column Percent*

Table 2. Regional movements of the sandbar shark.

		Recapture Region				
		East Coast (US)	Gulf of Mexico (US)	Gulf of Mexico (Mexico)	Other	Total
Tagging Region	East Coast (US)	**766** *75.84* *77.06* *99.48*	**191** *18.91* *19.22* *95.02*	**32** *3.17* *3.22* *96.97*	**5** *0.5* *0.5* *83.33*	**994** *98.42*
	Gulf of Mexico (US)	**4** *0.4* *26.67* *0.52*	**10** *0.99* *66.67* *4.98*	**1** *0.1* *6.67* *3.03*	**0**	**15** *1.49*
	Other	**0**	**0**	**0**	**1** *0.1* *100* *16.67*	**1** *0.1*
	Total	**770** *76.24*	**201** *19.9*	**33** *3.27*	**6** *0.59*	**1010** *100*

Key

Frequency
Percent
Row Percent
Column Percent

Table 3. Regional movements of the sandbar shark originally tagged in the East Coast (US) tagging region by sex and life stage.

		Recapture Region				
		East Coast (US)	Gulf of Mexico (US)	Gulf of Mexico (Mexico)	Other	Total
East Coast (US) Tagging Region **Males**	Mature	**29** *6.99* *58* *9.01*	**16** *3.86* *32* *22.22*	**4** *0.96* *8* *22.22*	**1** *0.24* *2* *33.33*	**50** *12.05*
	Juvenile	**172** *41.45* *70.49* *53.42*	**56** *13.49* *22.95* *77.78*	**14** *3.37* *5.74* *77.78*	**2** *0.48* *0.82* *66.67*	**244** *58.8*
	Neonate	**121** *29.16* *100* *37.58*	**0**	**0**	**0**	**121** *29.16*
	Total	**322** *77.59*	**72** *17.35*	**18** *4.34*	**3** *0.72*	**415** *100*

		Recapture Region				
		East Coast (US)	Gulf of Mexico (US)	Gulf of Mexico (Mexico)	Other	Total
East Coast (US) Tagging Region **Females**	Mature	**46** *7.94* *64.79* *10.36*	**23** *3.97* *32.39* *19.33*	**1** *0.17* *1.41* *7.14*	**1** *0.17* *1.41* *50*	**71** *12.26*
	Juvenile	**288** *49.74* *72.36* *64.86*	**96** *16.58* *24.12* *80.67*	**13** *2.25* *3.27* *92.86*	**1** *0.17* *0.25* *50*	**398** *68.74*
	Neonate	**110** *19* *100* *24.77*	**0**	**0**	**0**	**110** *19*
	Total	**444** *76.68*	**119** *20.55*	**14** *2.42*	**2** *0.35*	**579** *100*

Key

Frequency
Percent
Row Percent
Column Percent

Table 4. Regional movements of the sandbar shark originally tagged in the Gulf of Mexico (US) tagging region by sex and life stage.

		Recapture Region				
		East Coast (US)	Gulf of Mexico (US)	Gulf of Mexico (Mexico)	Other	Total
Gulf of Mexico (US) Tagging Region **Males**	Mature	**2** *25* *40* *100*	**2** *25* *40* *40*	**1** *12.5* *20* *100*	**0**	**5** *62.5*
	Juvenile	**0**	**3** *37.5* *100* *60*	**0**	**0**	**3** *37.5*
	Neonate	**0**	**0**	**0**	**0**	**0**
	Total	**2** *25*	**5** *62.5*	**1** *12.5*	**0**	**8** *100*

		Recapture Region				
		East Coast (US)	Gulf of Mexico (US)	Gulf of Mexico (Mexico)	Other	Total
Gulf of Mexico (US) Tagging Region **Females**	Mature	**0**	**2** *28.57* *100* *40*	**0**	**0**	**2** *28.57*
	Juvenile	**2** *28.57* *40* *100*	**3** *42.86* *60* *60*	**0**	**0**	**5** *71.43*
	Neonate	**0**	**0**	**0**	**0**	**0**
	Total	**2** *28.57*	**5** *71.43*	**0**	**0**	**7** *100*

Key

Frequency
Percent
Row Percent
Column Percent

Table 5. Regional tagging distribution of the blacktip shark by sex and life stage.

East Coast (US)					Fork Length (cm)		
Sex	Mature	Juveniles	Neonates	Total	Mean	Min	Max
Male	**225** *11.19* *24.75* *49.23*	**553** *27.5* *60.84* *43.82*	**131** *6.51* *14.41* *44.86*	**909** *45.2*	91	35	174
Female	**232** *11.54* *21.05* *50.77*	**709** *35.26* *64.34* *56.18*	**161** *8.01* *14.61* *55.14*	**1102** *54.8*	93	31	190
Total	**457** *22.73*	**1262** *62.75*	**292** *14.52*	**2011** *100*	Sex Ratio (M:F) 1:1.2		

Gulf of Mexico (US)					Fork Length (cm)		
Sex	Mature	Juveniles	Neonates	Total	Mean	Min	Max
Male	**122** *3.68* *9.98* *25.79*	**755** *22.78* *61.73* *35.46*	**346** *10.44* *28.29* *48.6*	**1223** *36.9*	77	30	183
Female	**351** *10.59* *16.79* *74.21*	**1374** *41.46* *65.71* *64.54*	**366** *11.04* *17.5* *51.4*	**2091** *63.1*	91	30	187
Total	**473** *14.27*	**2129** *64.24*	**712** *21.48*	**3314** *100*	Sex Ratio (M:F) 1:1.7		

Gulf of Mexico (Mexico)					Fork Length (cm)		
Sex	Mature	Juveniles	Neonates	Total	Mean	Min	Max
Male							
Female							
Total				**0**	Sex Ratio (M:F)		

Other					Fork Length (cm)		
Sex	Mature	Juveniles	Neonates	Total	Mean	Min	Max
Male	**32** *10.92* *29.09* *39.02*	**53** *18.09* *48.18* *31.55*	**25** *8.53* *22.73* *58.14*	**110** *37.54*	93	48	174
Female	**50** *17.06* *27.32* *60.98*	**115** *39.25* *62.84* *68.45*	**18** *6.14* *9.84* *41.86*	**183** *62.46*	104	39	174
Total	**82**	**168**	**43**	**293**	Sex Ratio (M:F)		

Key

Frequency
Percent
Row Percent

	27.99	*57.34*	*14.68*	*100*	1:1.7	*Column Percent*

Table 6. Regional Movements of the blacktip shark.

		Recapture Region				
		East Coast (US)	Gulf of Mexico (US)	Gulf of Mexico (Mexico)	Other	Total
Tagging Region	East Coast (US)	**39** *27.27* *100* *97.5*	**0**	**0**	**0**	**39** *27.27*
	Gulf of Mexico (US)	**0**	**70** *48.95* *70* *100*	**30** *20.98* *30* *100*	**0**	**100** *69.93*
	Other	**1** *0.7* *25* *2.5*	**0**	**0**	**3** *2.1* *75* *100*	**4** *2.8*
	Total	**40** *27.97*	**70** *48.95*	**30** *20.98*	**3** *2.1*	**143** *100*

Key

Frequency
Percent
Row Percent
Column Percent

Table 7. Regional movements of the blacktip shark originally tagged in the East Coast (US) tagging region by sex and life stage.

		Recapture Region				
		East Coast (US)	Gulf of Mexico (US)	Gulf of Mexico (Mexico)	Other	Total
East Coast (US) Tagging Region **Males**	Mature	**7** *41.18* *100* *41.18*	**0**	**0**	**0**	**7** *41.18*
	Juvenile	**5** *29.41* *100* *29.41*	**0**	**0**	**0**	**5** *29.41*
	Neonate	**5** *29.41* *100* *29.41*	**0**	**0**	**0**	**5** *29.41*
	Total	**17** *100*	**0**	**0**	**0**	**17** *100*

		Recapture Region				
		East Coast (US)	Gulf of Mexico (US)	Gulf of Mexico (Mexico)	Other	Total
East Coast (US) Tagging Region **Females**	Mature	**6** *27.27* *100* *27.27*	**0**	**0**	**0**	**6** *27.27*
	Juvenile	**15** *68.18* *100* *68.18*	**0**	**0**	**0**	**15** *68.18*
	Neonate	**1** *4.55* *100* *4.55*	**0**	**0**	**0**	**1** *4.55*
	Total	**22** *100*	**0**	**0**	**0**	**22** *100*

Key

Frequency
Percent
Row Percent
Column Percent

Table 8. Regional movements of the blacktip shark originally tagged in the Gulf of Mexico (US) tagging region by sex and life stage.

		Recapture Region				
		East Coast (US)	Gulf of Mexico (US)	Gulf of Mexico (Mexico)	Other	Total
Gulf of Mexico (US) Tagging Region **Males**	Mature	**0**	**1** *2.27* *100* *2.7*	**0**	**0**	**1** *2.27*
	Juvenile	**0**	**16** *36.36* *80* *43.24*	**4** *9.09* *20* *57.14*	**0**	**20** *45.45*
	Neonate	**0**	**20** *45.45* *86.96* *54.05*	**3** *6.82* *13.04* *42.86*	**0**	**23** *52.27*
	Total	**0**	**37** *84.09*	**7** *15.91*	**0**	**44** *100*

		Recapture Region				
		East Coast (US)	Gulf of Mexico (US)	Gulf of Mexico (Mexico)	Other	Total
Gulf of Mexico (US) Tagging Region **Females**	Mature	**0**	**2** *3.57* *100* *6.06*	**0**	**0**	**2** *3.57*
	Juvenile	**0**	**19** *33.93* *51.35* *57.58*	**18** *32.14* *48.65* *78.26*	**0**	**37** *66.07*
	Neonate	**0**	**12** *21.43* *70.59* *36.36*	**5** *8.93* *29.41* *21.74*	**0**	**17** *30.36*
	Total	**0**	**33** *58.93*	**23** *41.07*	**0**	**56** *100*

Key

Frequency
Percent
Row Percent
Column Percent

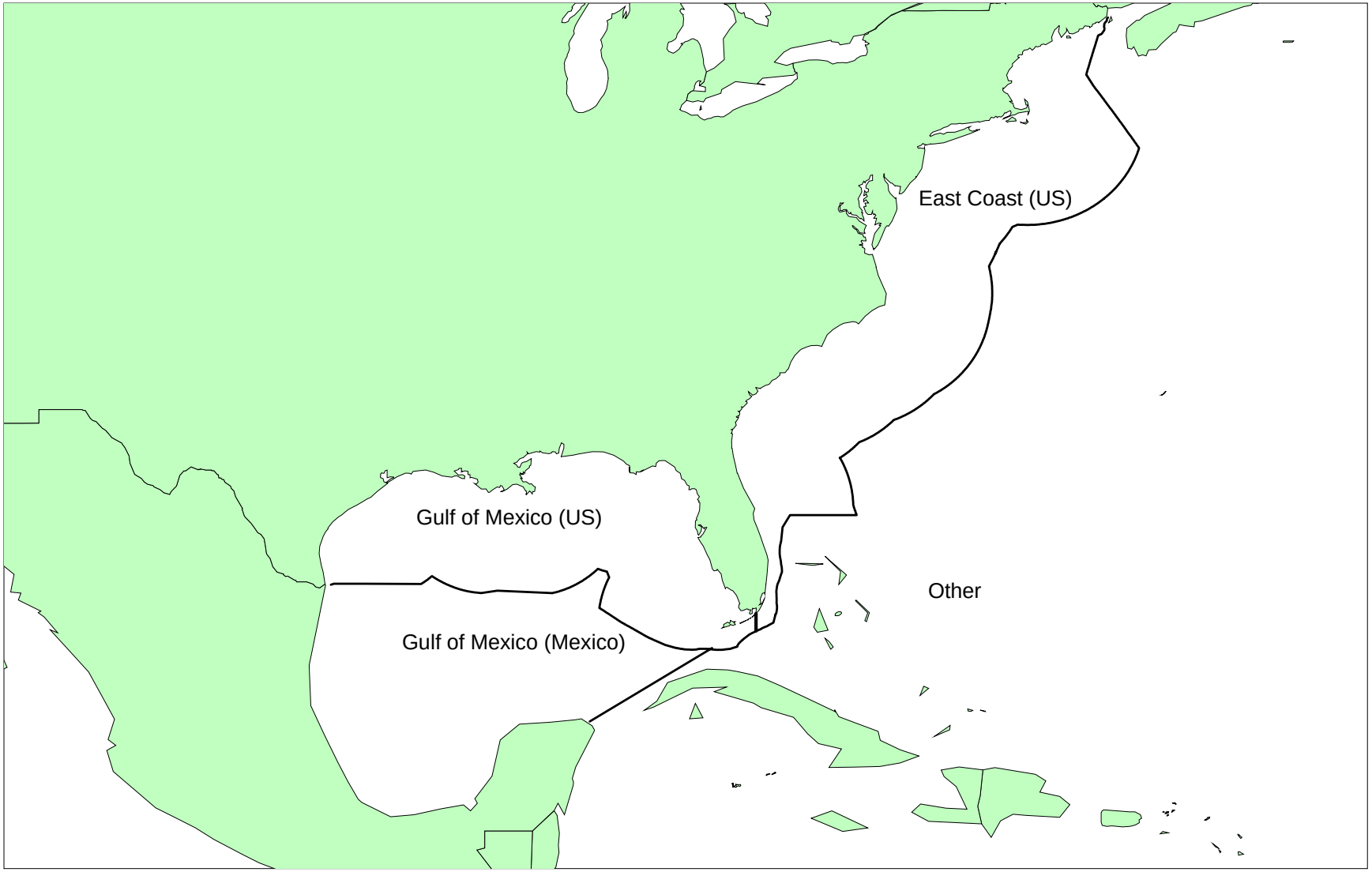

Figure 1

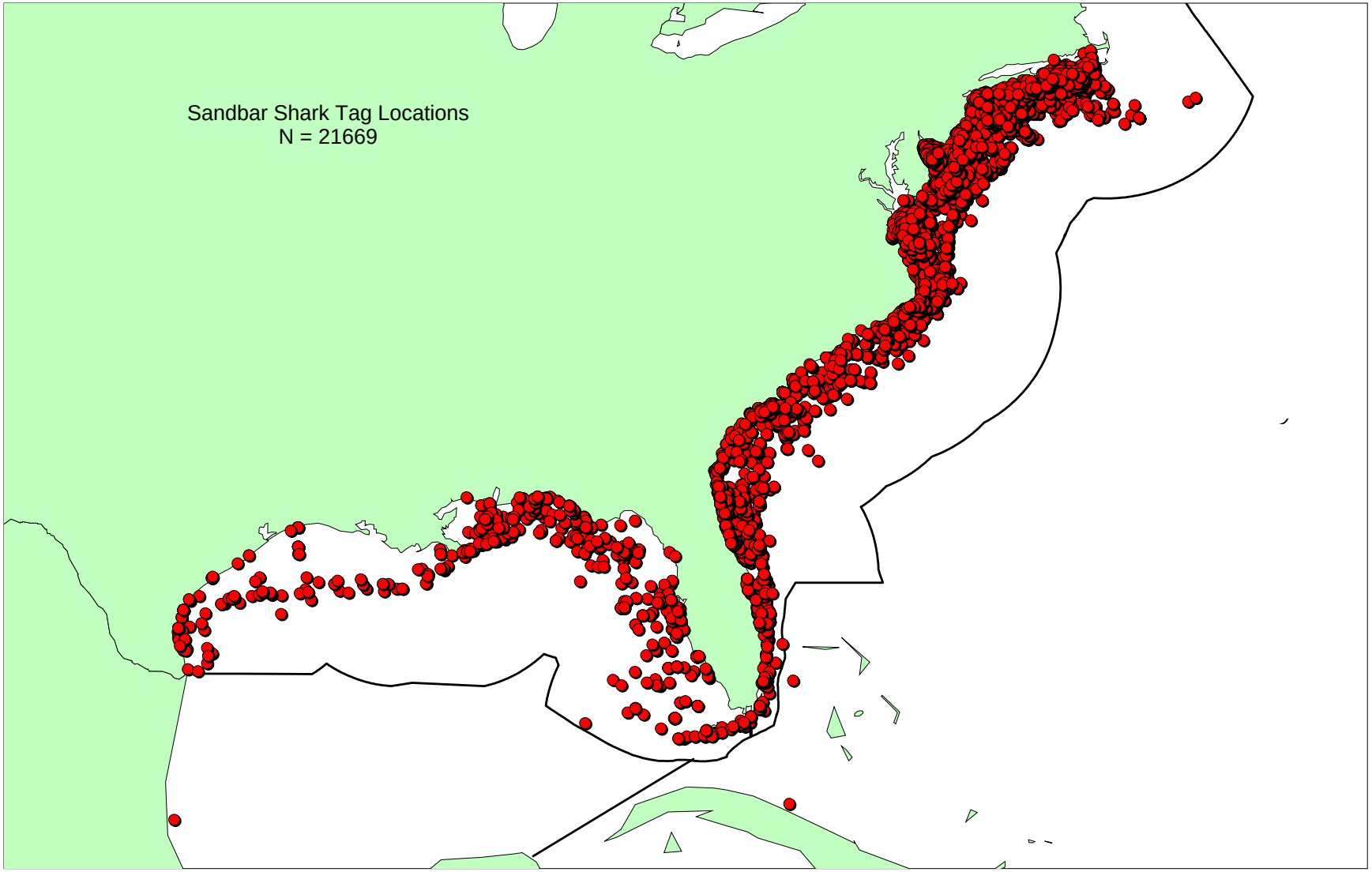

Figure 2

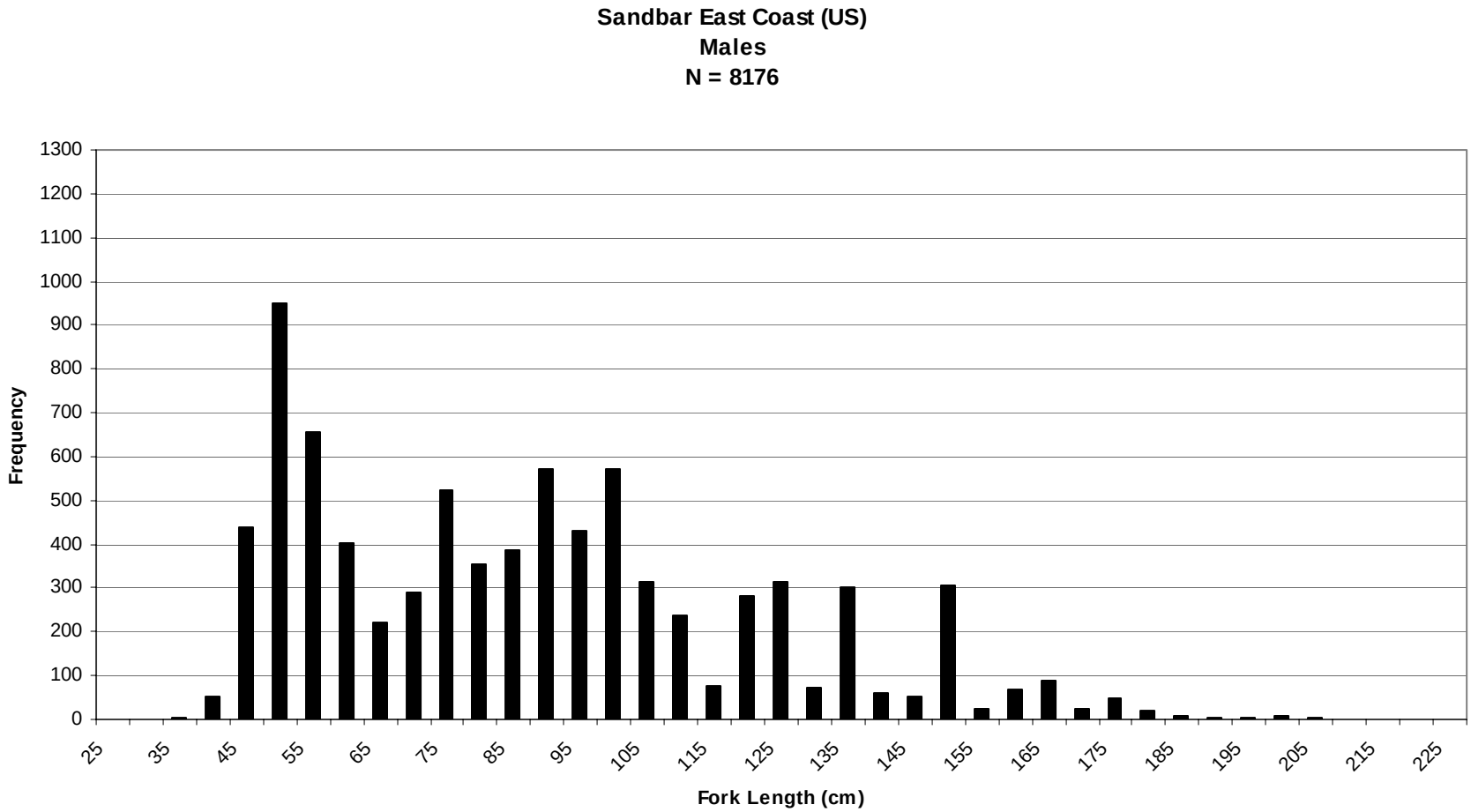
Sandbar East Coast (US)
Males
N = 8176
Frequency
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
25
35
45
55
65
75
85
95
105
115
125
135
145
155
165
175
185
195
205
215
225
Fork Length (cm)

Figure 3

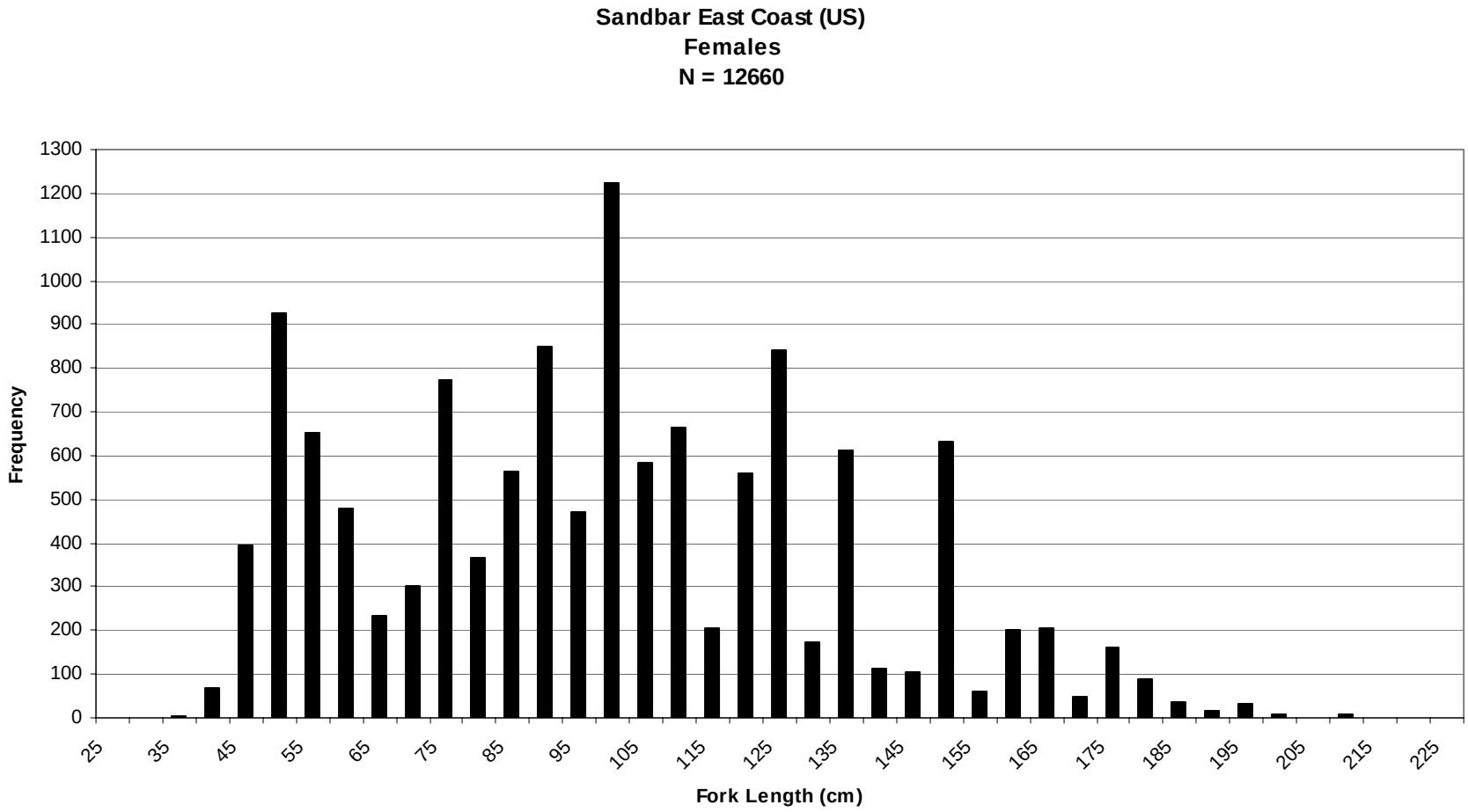
Sandbar East Coast (US)
Females
N = 12660
Frequency
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
25
35
45
55
65
75
85
95
105
115
125
135
145
155
165
175
185
195
205
215
225
Fork Length (cm)

Figure 4

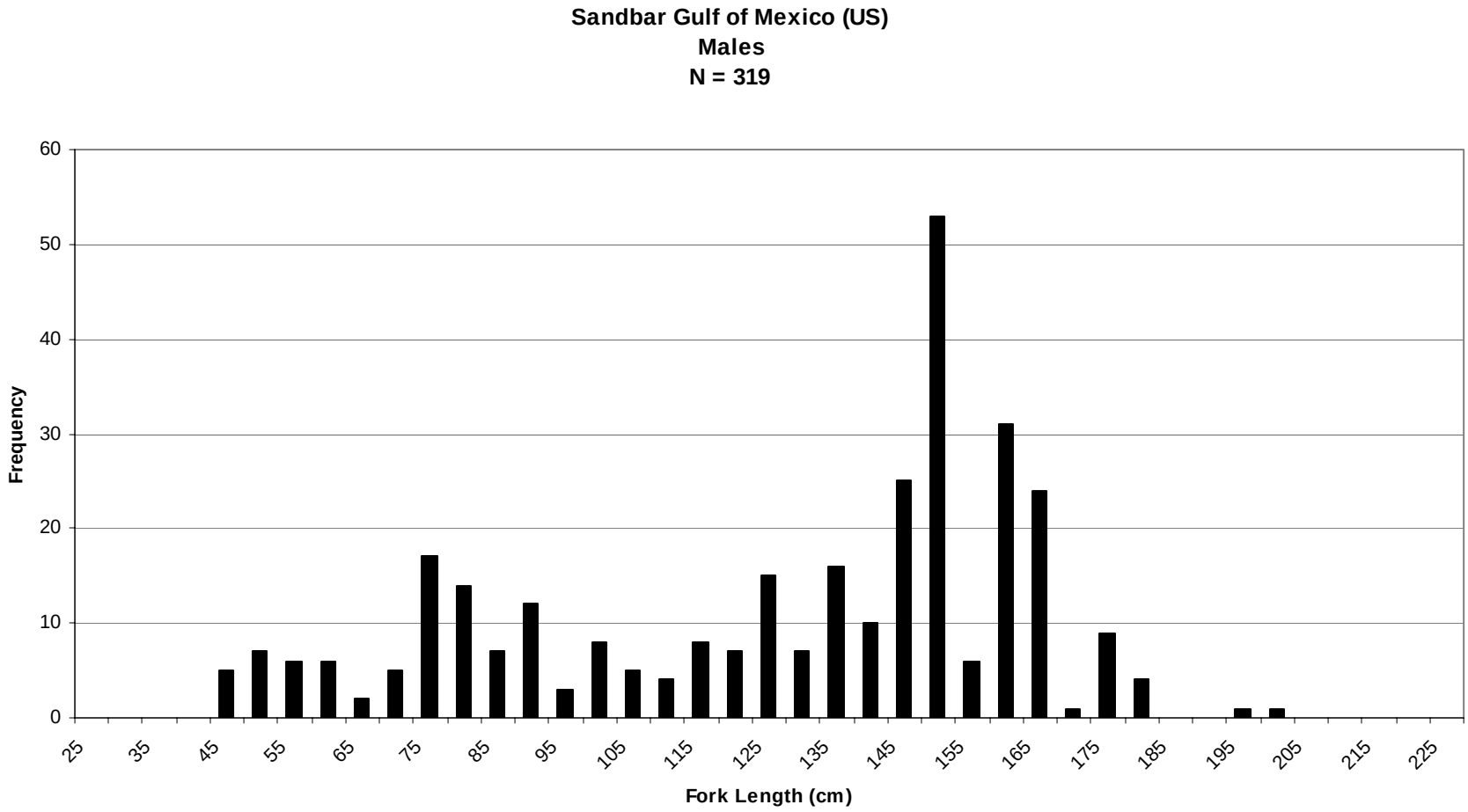
Sandbar Gulf of Mexico (US)
Males
N = 319
Frequency
0
10
20
30
40
50
60
25
35
45
55
65
75
85
95
105
115
125
135
145
155
165
175
185
195
205
215
225
Fork Length (cm)

Figure 5

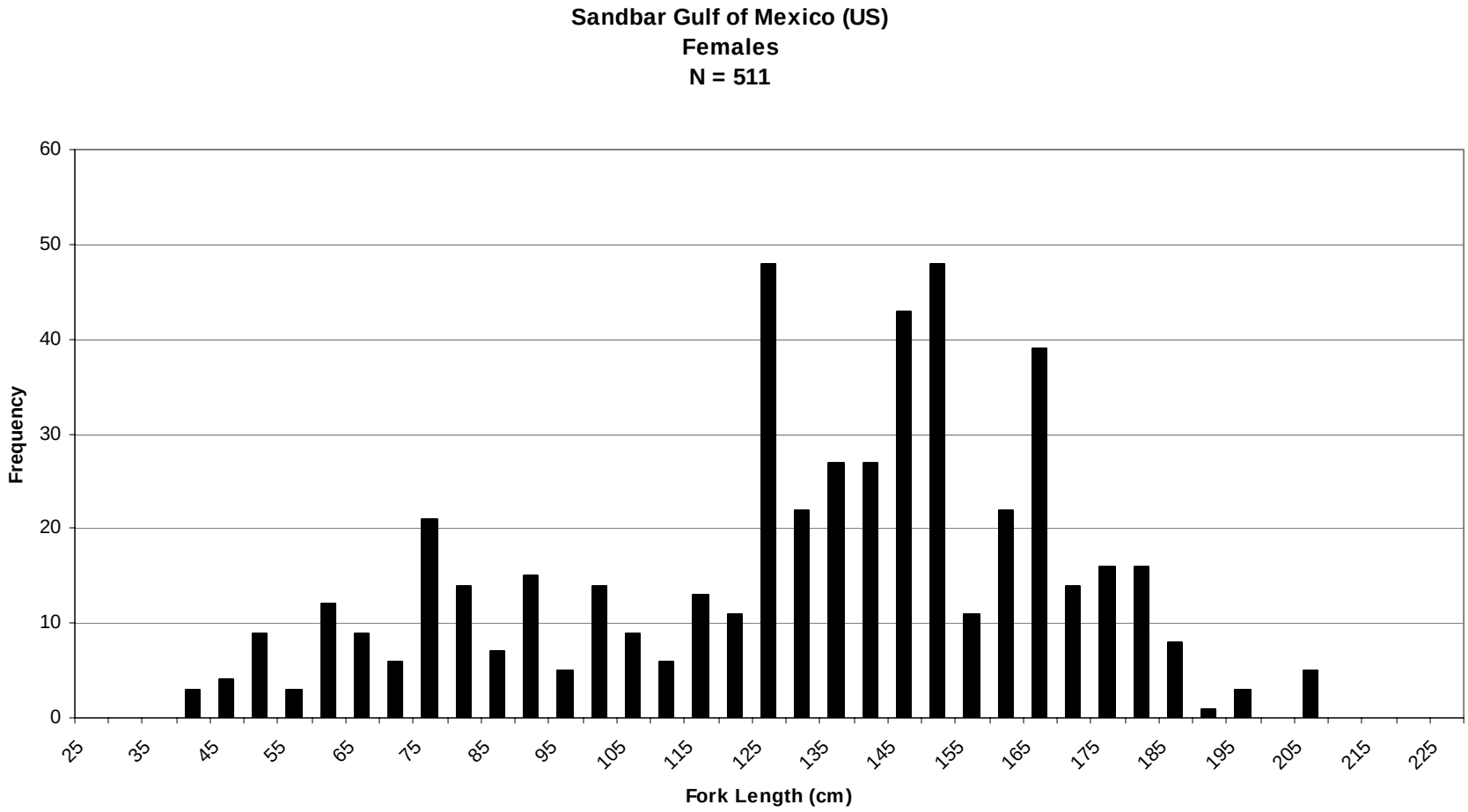
Sandbar Gulf of Mexico (US)
Females
N = 511
Frequency
0
10
20
30
40
50
60
25
35
45
55
65
75
85
95
105
115
125
135
145
155
165
175
185
195
205
215
225
Fork Length (cm)

Figure 6

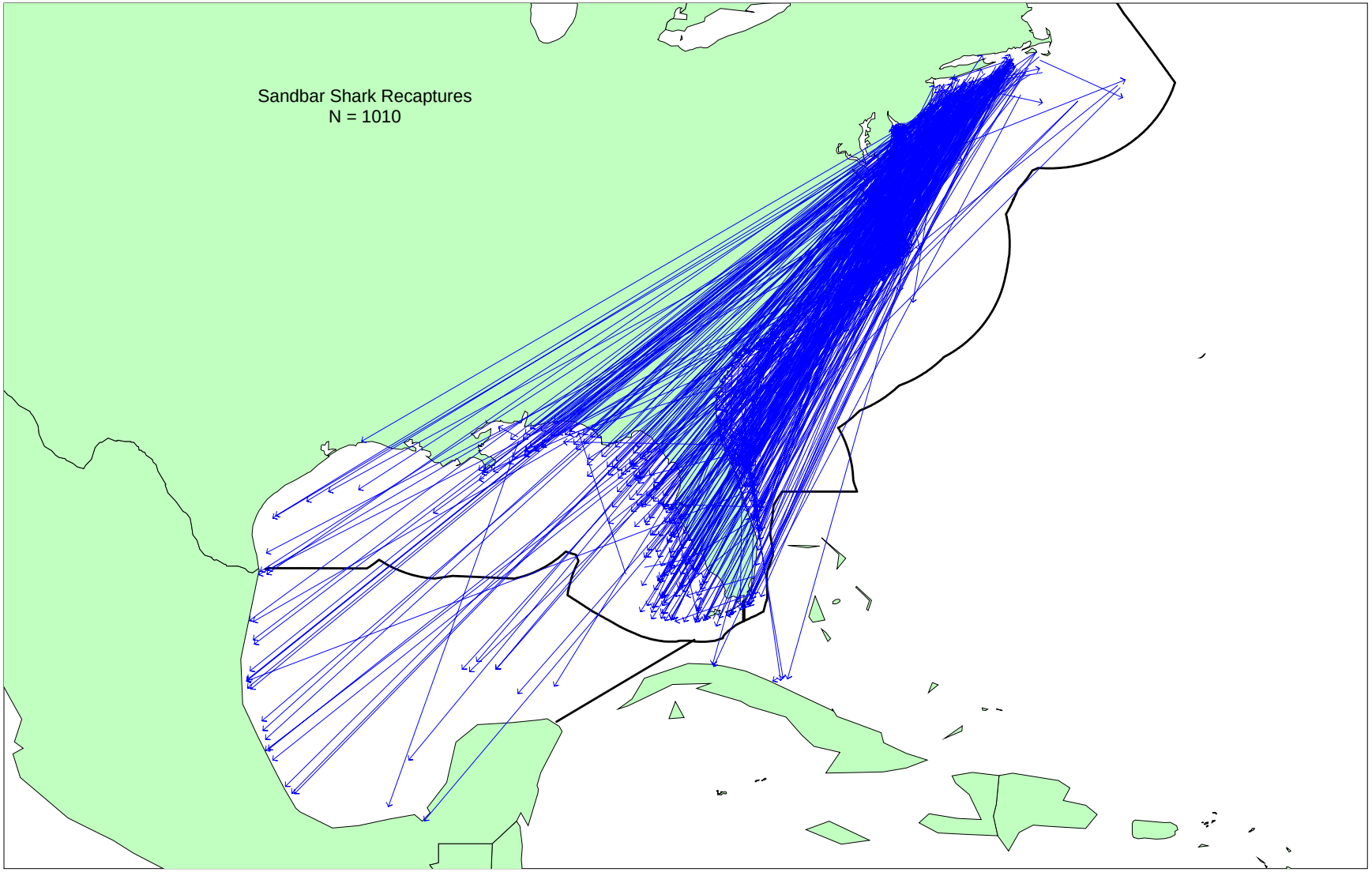

Figure 7

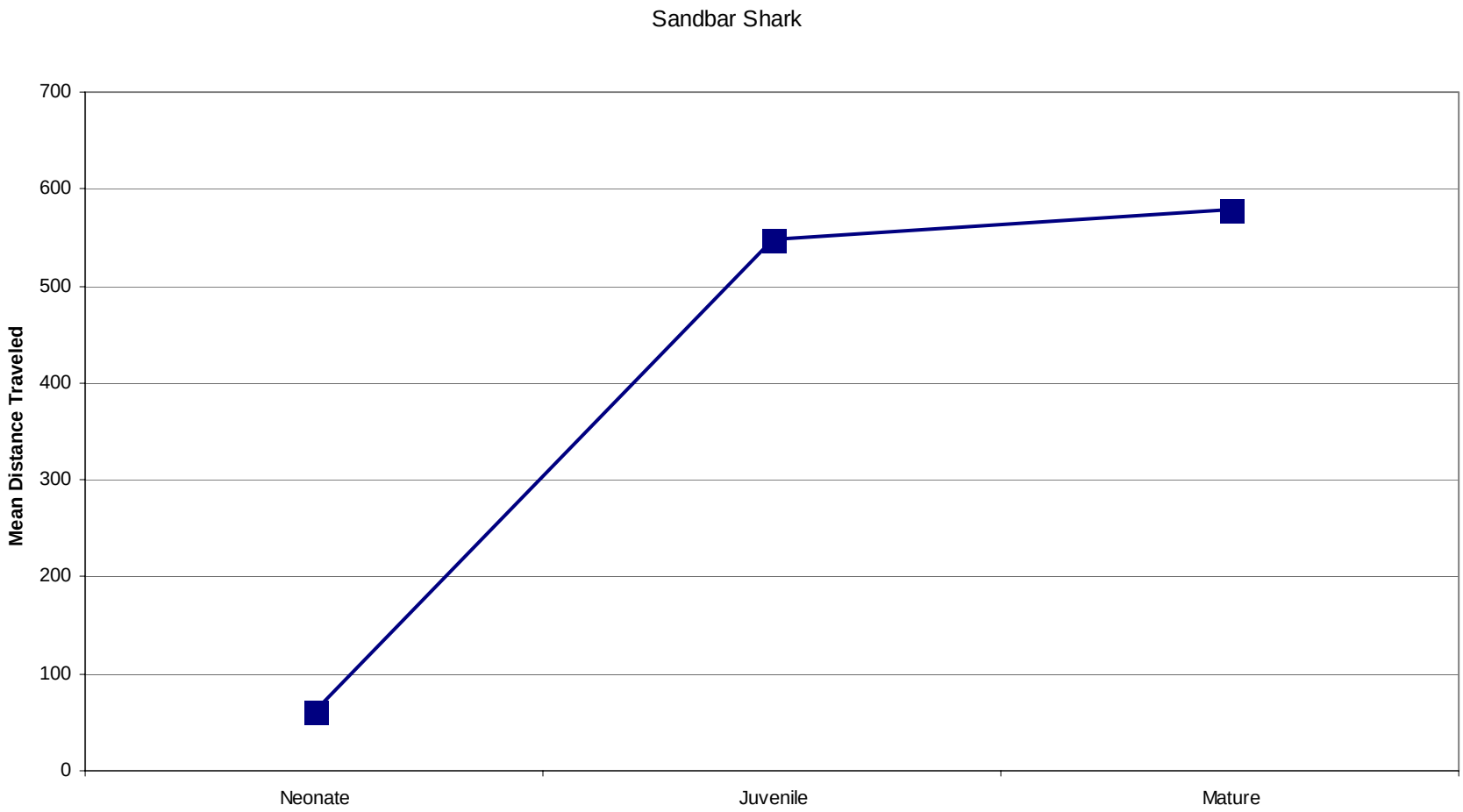
Sandbar Shark
Mean Distance Traveled
700
600
500
400
300
200
100
0
Neonate
Juvenile
Mature

Figure 8

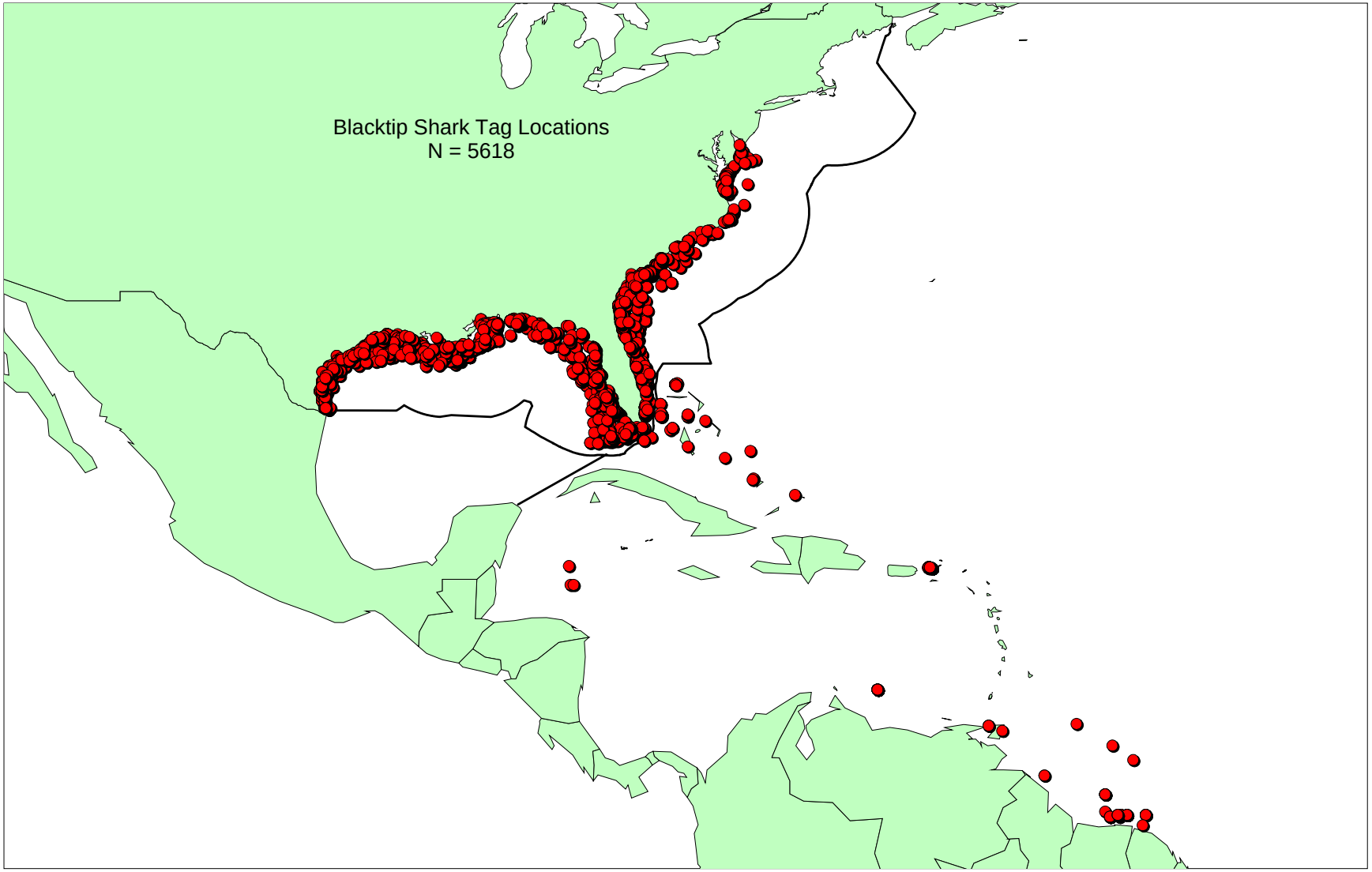

Figure 9

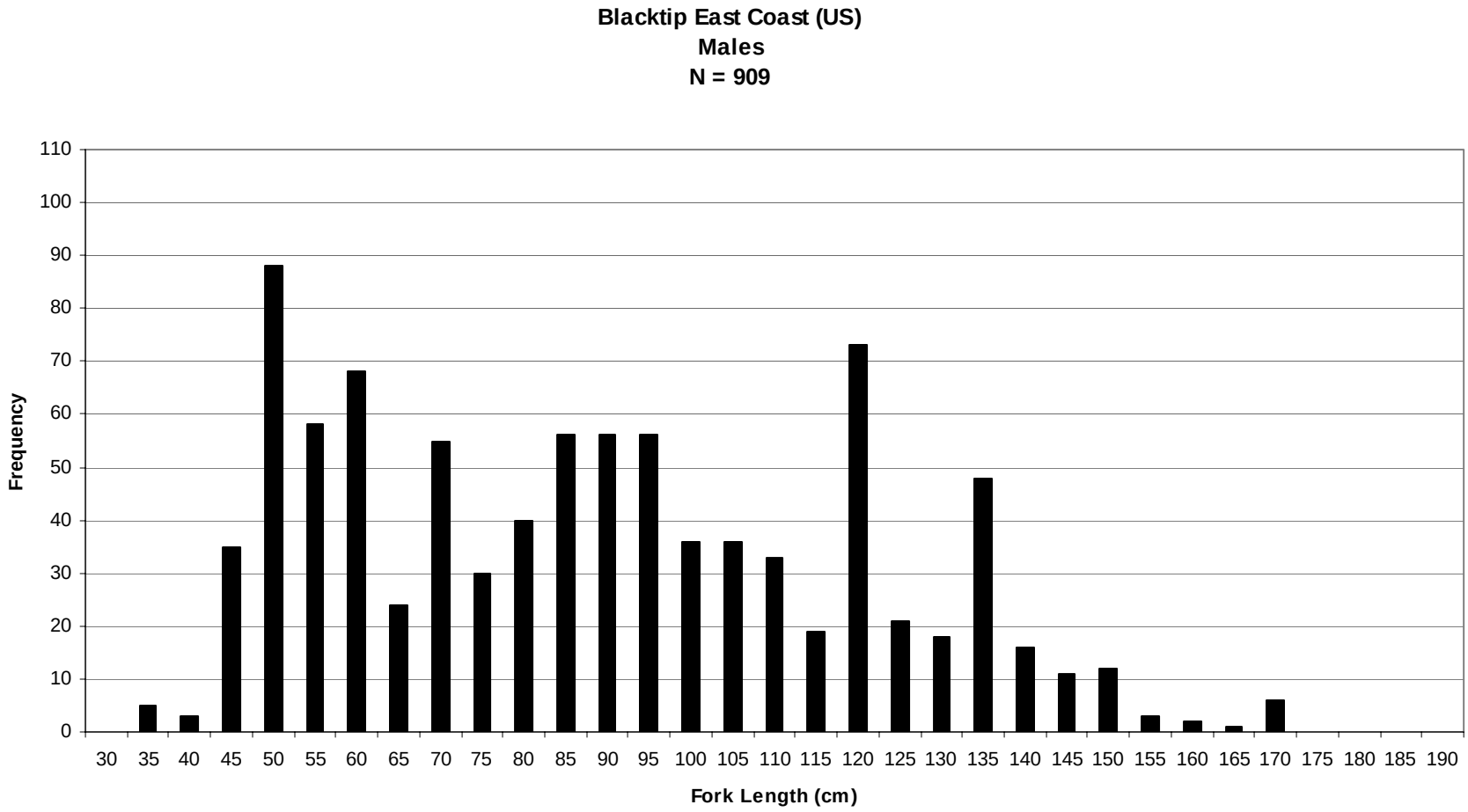
Blacktip East Coast (US)
Males
N = 909
Frequency
0
10
20
30
40
50
60
70
80
90
100
110
30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190
Fork Length (cm)

Figure 10

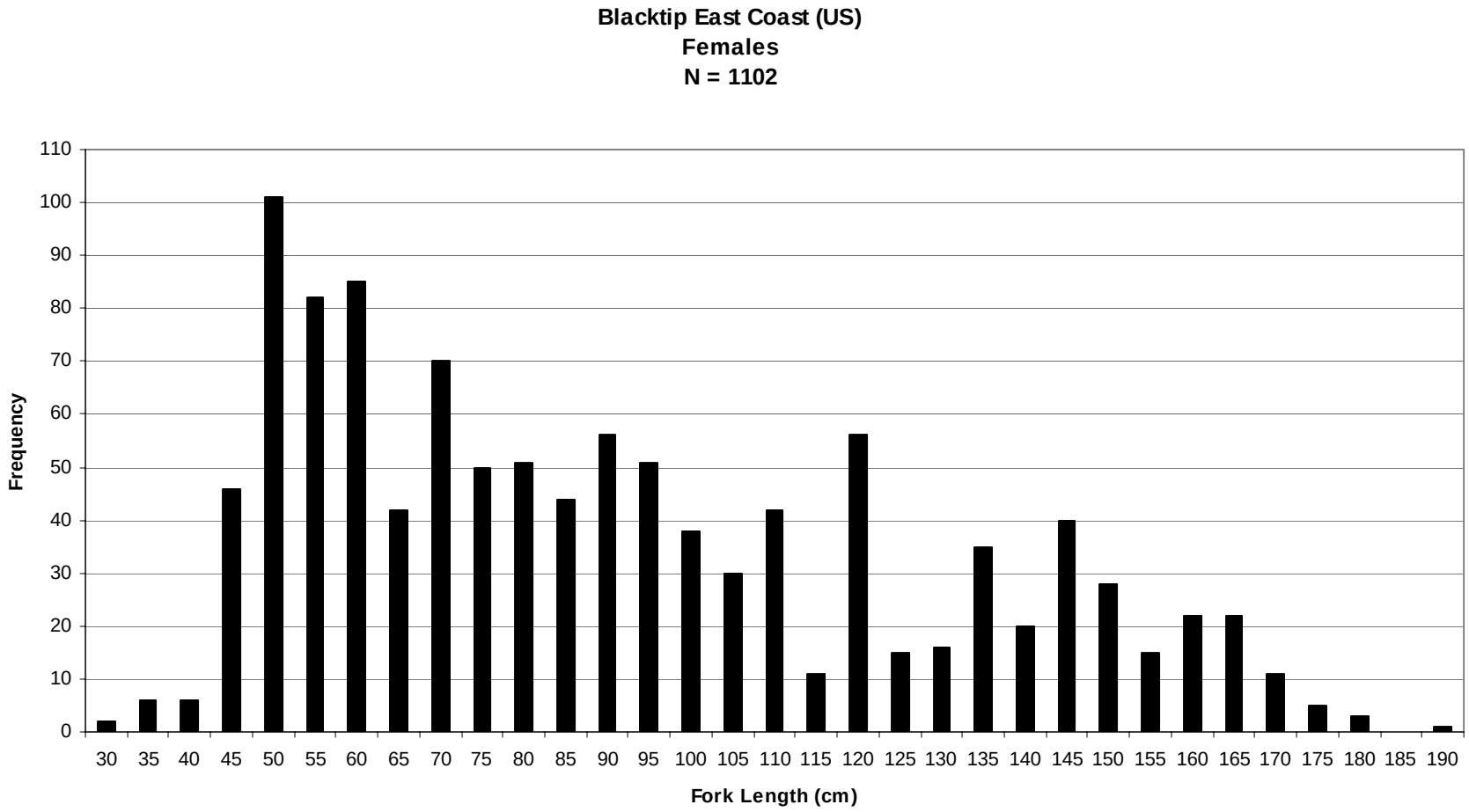
Blacktip East Coast (US)
Females
N = 1102
Frequency
0
10
20
30
40
50
60
70
80
90
100
110
30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190
Fork Length (cm)

Figure 11

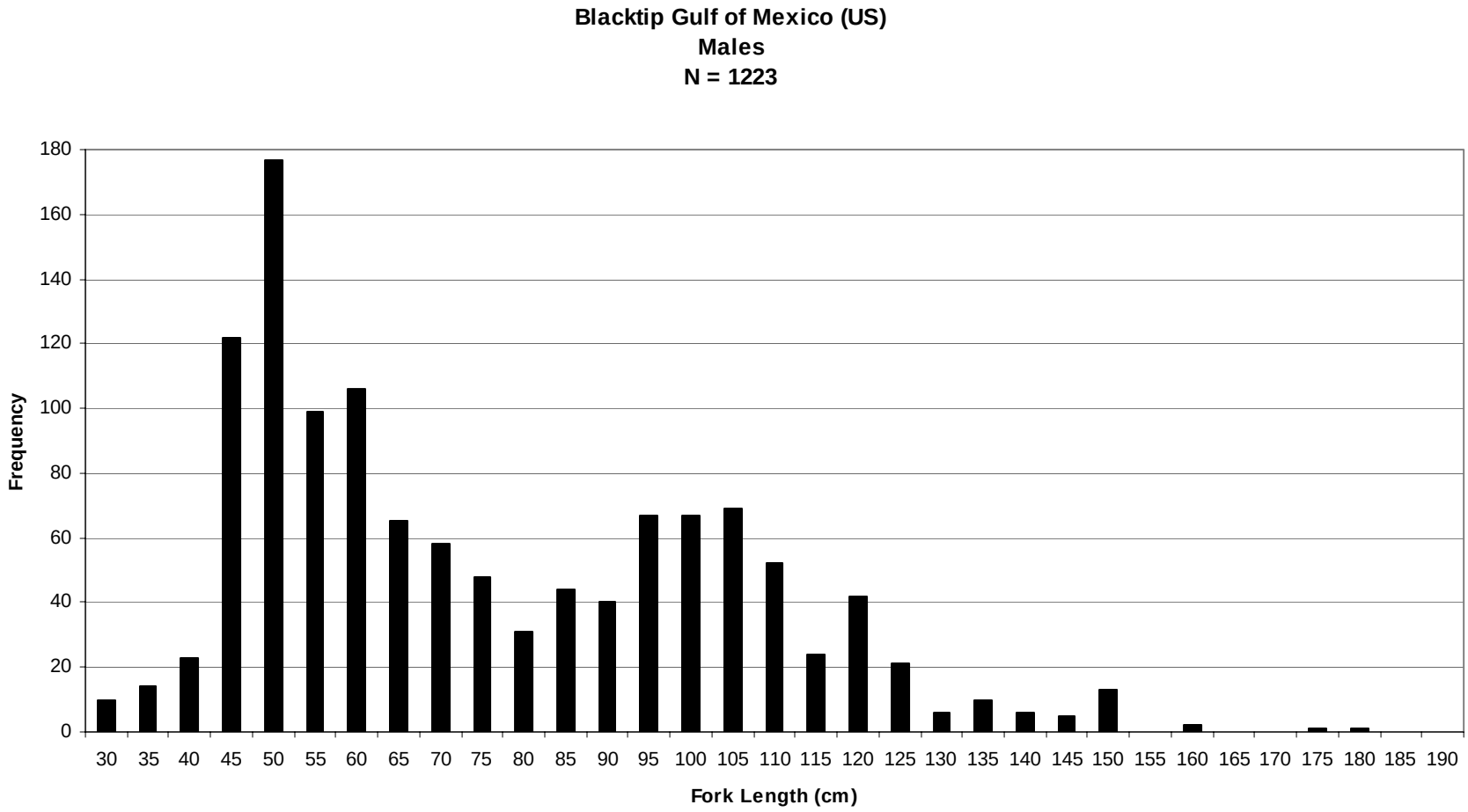
Blacktip Gulf of Mexico (US)
Males
N = 1223
Frequency
0
20
40
60
80
100
120
140
160
180
30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190
Fork Length (cm)

Figure 12

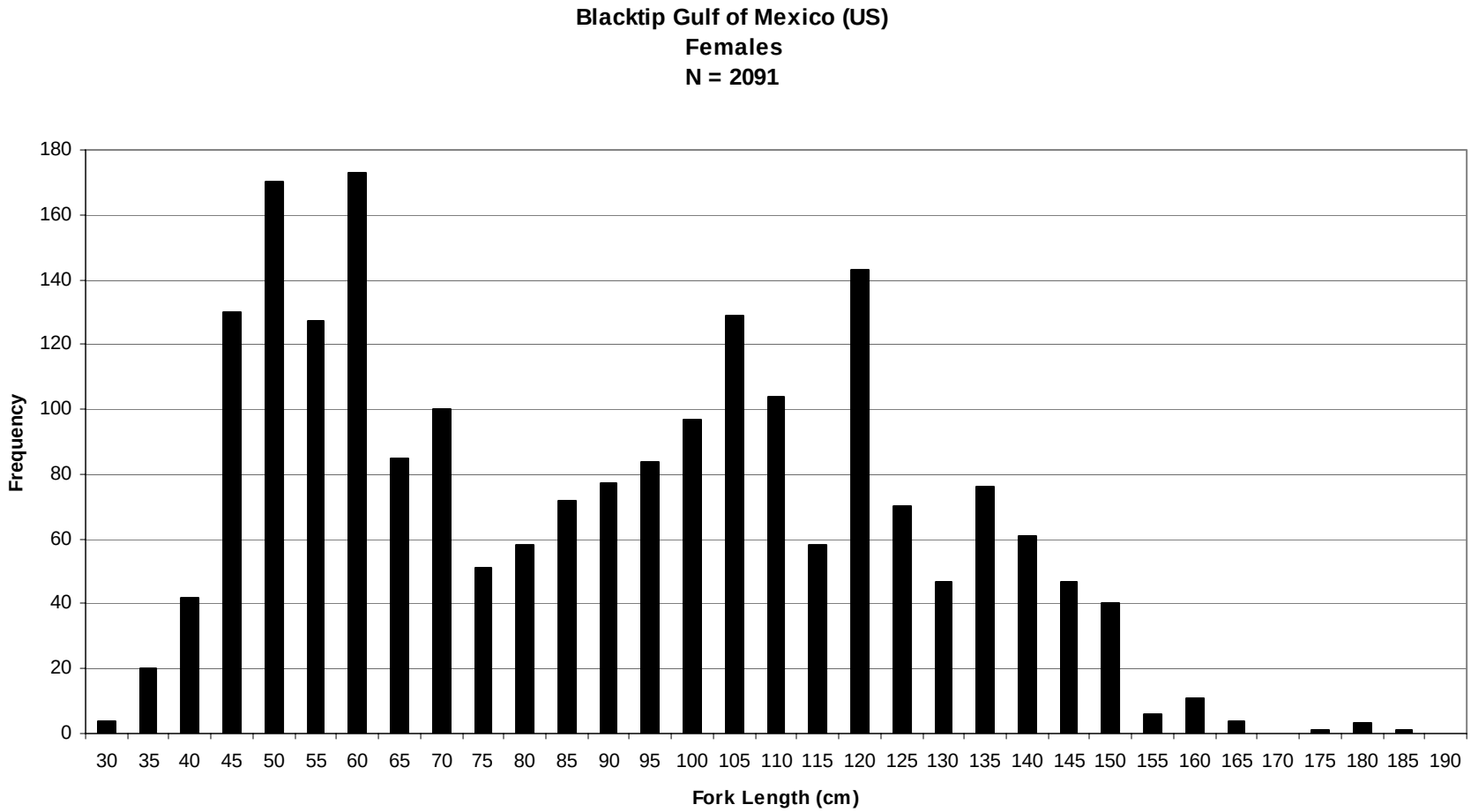
Blacktip Gulf of Mexico (US)
Females
N = 2091
Frequency
0
20
40
60
80
100
120
140
160
180
30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190
Fork Length (cm)

Figure 13

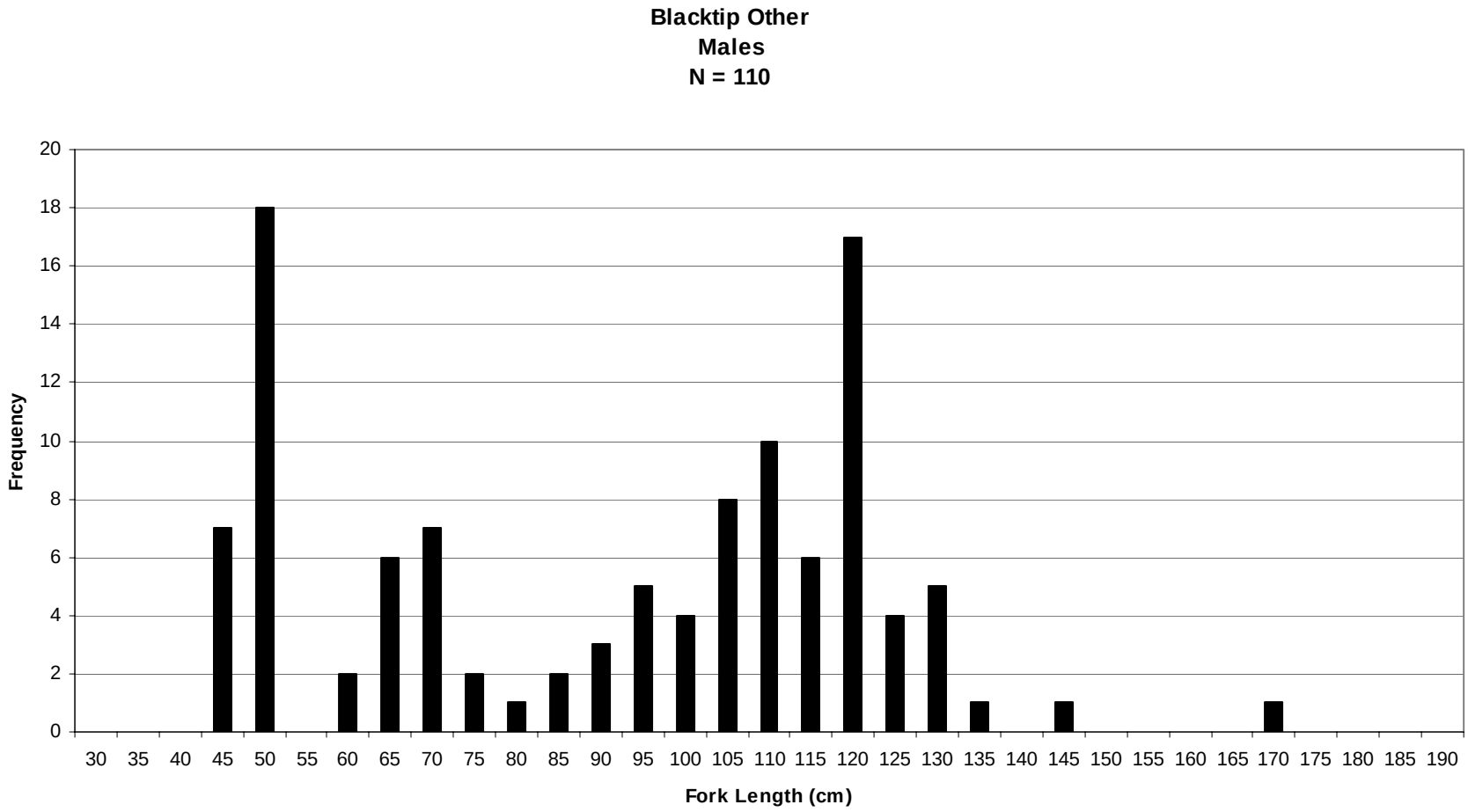
Blacktip Other
Males
N = 110
Frequency
0
2
4
6
8
10
12
14
16
18
20
30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190
Fork Length (cm)

Figure 14

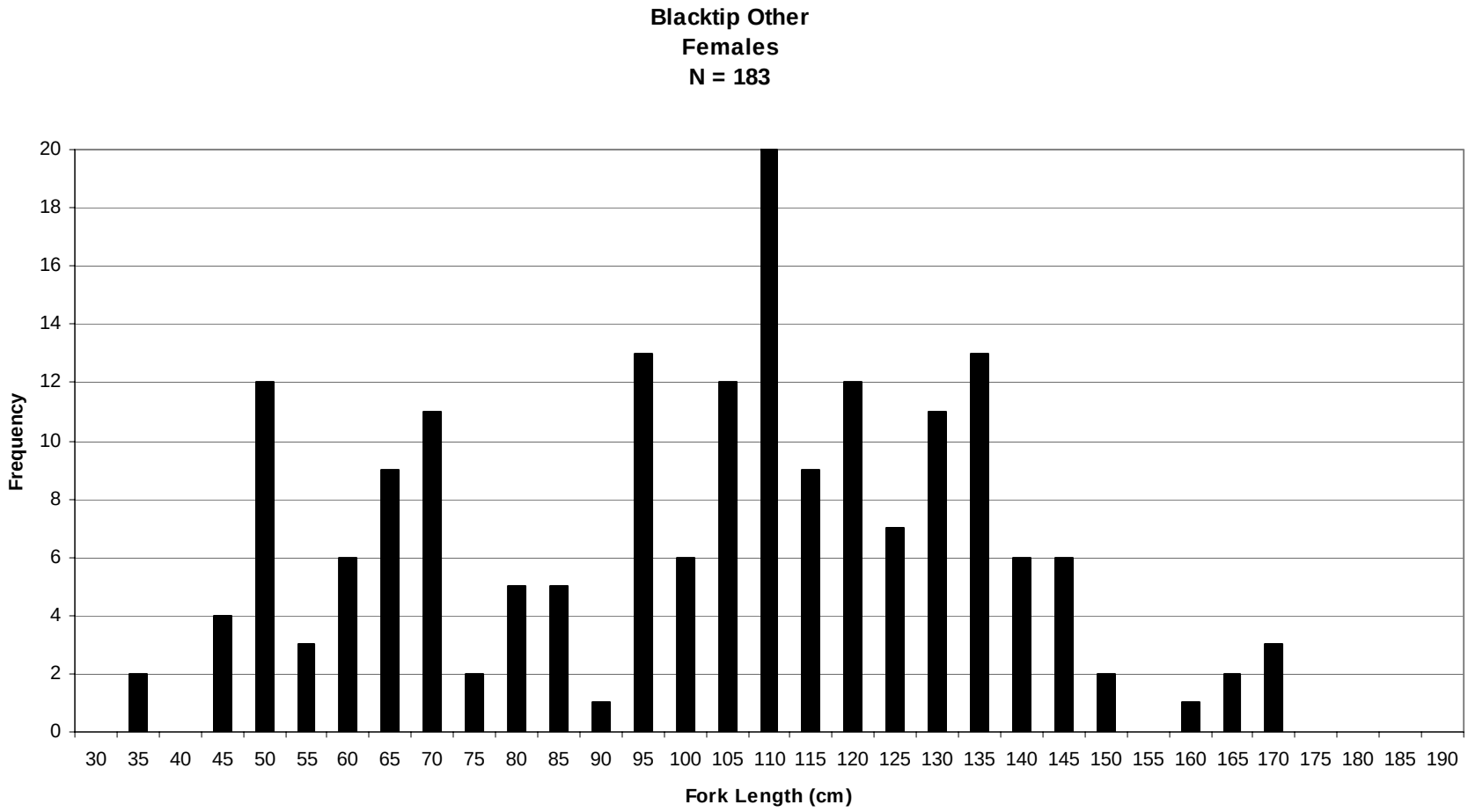
Blacktip Other
Females
N = 183
Frequency
0
2
4
6
8
10
12
14
16
18
20
30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190
Fork Length (cm)

Figure 15

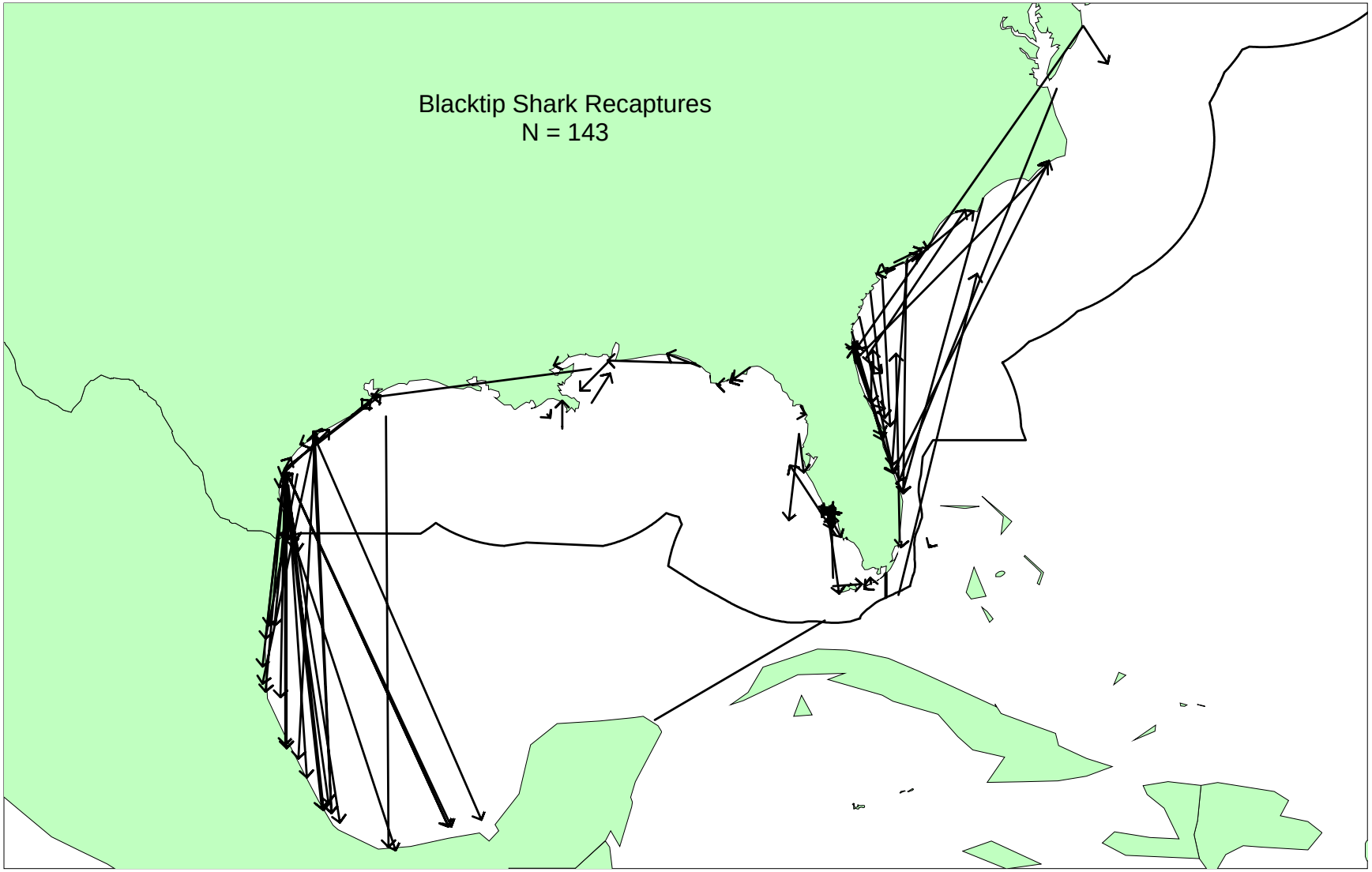

Figure 16

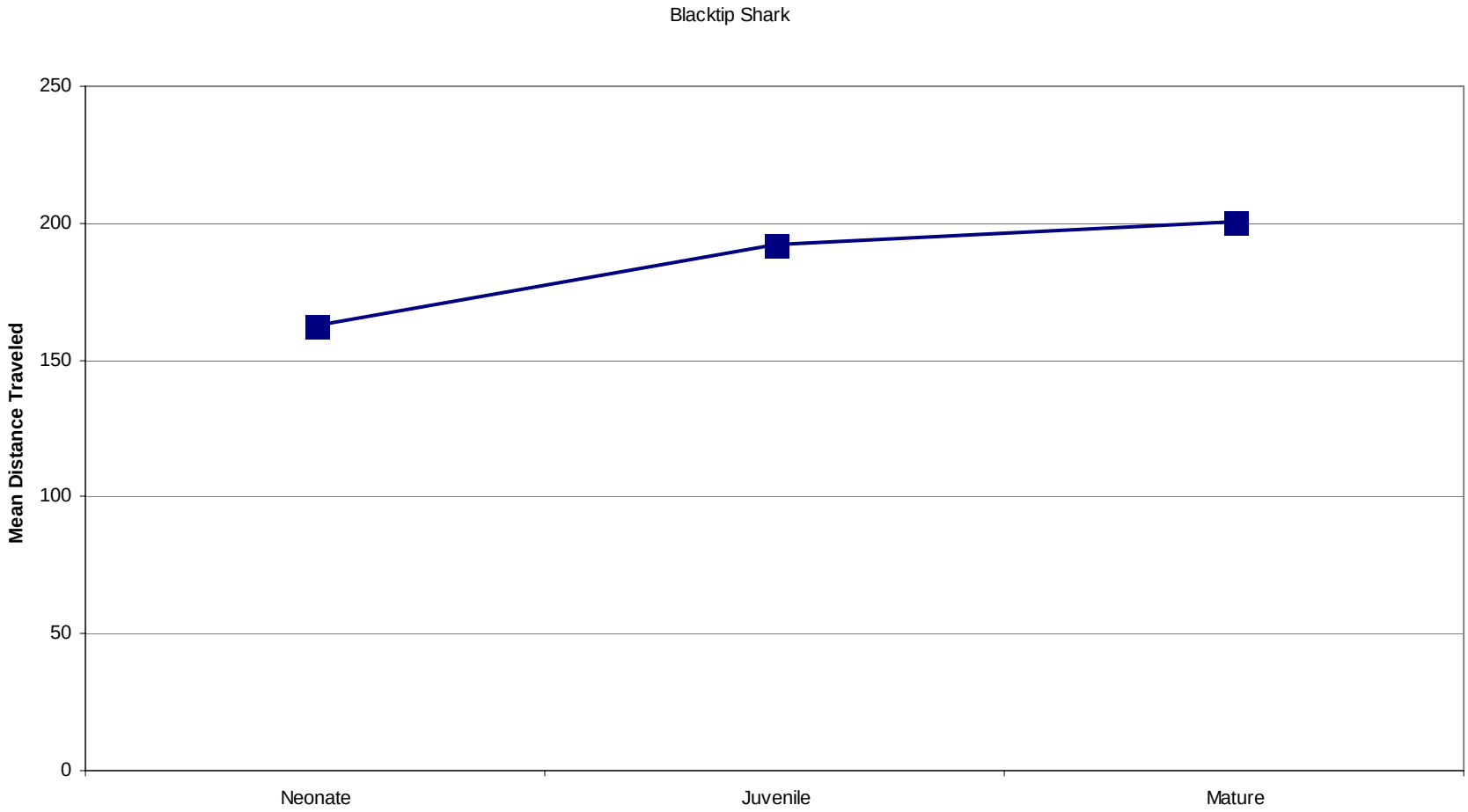
Blacktip Shark
Mean Distance Traveled
250
200
150
100
50
0
Neonate
Juvenile
Mature

Figure 17