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ASSESSMENT OF THE STATUS OF SHARK POPULATIONS IN THE UNITED STATES VIRGIN ISLANDS (USVI)

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FINAL REPORT

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Introduction

Shark populations worldwide have undergone decline due to overfishing and the vulnerability of shark populations to withstand elevated levels of fishing pressure (Baum et al. 2003). Shark populations typically have slow rates of increase due to life history characteristics (slow growth, late maturity, few offspring) inherent to these animals (Cortes 1998). Because sharks are important components of coral reef ecosystems there has been concern about the impacts of declining shark populations on coral reef communities. There is recent evidence suggesting that top predators such as sharks play a pivotal role in healthy coral reef ecosystems and that declining shark populations may have dramatic cascading effects on the abundance of other species of fishes and may lead to an overall degradation and instability of entire coral reef ecosystems (Bascompte et al. 2005). These potential problems related to shark populations have a direct economic value because coral reef fisheries represent critical cultural, economic and recreational resources for communities in which they occur. Healthy and flourishing coral reef environments are also paramount to continued successful tourism and recreational operations and their subsequent economic contributions to local communities. Therefore, marine resource managers are entrusted with the responsibility of ensuring that reef fisheries and the health of coral reefs are sustained. However, recreational and commercial overfishing, development, degradation of critical habitat and other human impacts on coral reefs are major problems that threaten the livelihoods of fishers, the culture and way of life of nearby communities, and the integrity of the reef ecosystems as a whole. These threats extend to shark populations and the habitats that are critical for their sustained vigor.

Many species of coastal sharks occupy inshore, shallow bays that serve as nursery areas during the first few years of their lives (Springer 1967, Heupel and Simpfendorfer 2002). Nursery areas provide reduced predation and enhanced survival of the young, which is important for their eventual contribution to sustained populations (Hoese 1962, Castro 1993, Simpfendorfer and Milward 1993, Pratt and Merson 1996). An emphasis has been placed upon identification of nursery areas and delineating their boundaries. These measures are precursors of eventual enhanced protection of young sharks (via fishing regulations) or protection of the habitat itself (against dredging, pollution, development, or other potentially damaging human activities). Thus, identification of species of sharks occupying nursery areas, delineation of these areas, examination of their scale and quality and evaluation of their protection are all important components of an overall goal of maintaining healthy shark populations associated with coral reef ecosystems and policies that benefit coral reefs through enhancement of the role of sharks in the ecological balance of these communities.

The U.S. Virgin Islands (USVI) represent one of the major coral reef habitats within US waters, particularly in the Atlantic Ocean. The coral reef habitat within the USVI provides resources that are utilized by multiple user groups from both recreational and commercial entities. The health of this coral reef environment is subject to a great deal of scrutiny and is managed and monitored under the auspices of multiple local, regional and federal agencies and research groups. Recently, there has been much concern over the health of living corals in the USVI and about vast areas affected by “bleaching” and other problems despite the large amount of effort and funding directed towards their protection. Recognizing that apex predators are one component of the overall health of the coral reef ecosystems in the USVI and that study of this group has lagged far behind many other coral reef organisms, the project described here was

directed at providing information on the occurrence sharks within coral reef habitats in the USVI. The Fishery Management Plan of the United States Caribbean (1998) amendment for Essential Fish Habitat (EFH) states that the waters and substrates that comprise EFHs of the USVI are vulnerable to overexploitation, excess sedimentation, and pollution brought on by shoreline development. The goals of this project were to assess current and past fishing pressure on shark populations in the USVI, identify the species composition of sharks inhabiting the coral reef associated communities in the USVI and to identify nursery areas used by these species.

Methods

Sampling site determination

A total of 95 locations in 25 different bays and shallow water areas off St. Thomas and St. John were sampled during 6 expeditions to the USVI (Figure 1). Following attainment of a fishing permit to fish within the boundaries of the USVI National Park it was possible to sample several additional sites off St. John during 2005 trips. An attempt was made to explore as many coastal areas around the islands as possible and sampling stations were selected based on their potential as nursery areas as well as consultation of habitat maps (NOAA 2001).

Fishing

A 50-gangion (12/0 hooks), 305 m, 0.64 cm, braided nylon bottom longline was used to fish for sharks in most locations. Occasionally, the line was halved to two 25-hook sections in areas that were too small for the entire 50 hooks and also within the St. Thomas territorial reserve at Cas Cay. The gear and sampling procedures were modeled after methodology of the

Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) Survey (Pratt et al. 1998). Gangions consisted of Mustad circle hooks with barbs depressed, 50 cm, 0.16 cm stainless steel cable fastened to 1 m, 0.64 cm braided nylon line ending with a 4/0 swivel snap for attachment to the mainline. Hooks were baited with Atlantic mackerel (*Scomber scombrus).* Soak time was one hour for the 50 hook lines and three hours for the 25 hook lines.

Locations of sampling sites were recorded for each end of the longline (Figure 1). Depth, salinity (by refractometer) and temperature were measured at each site and wind speed, wind direction and cloud cover were also noted. Bottom type was recorded and classified into eleven different categories: degree (low, moderate, high) of reef development, degree of macro-algal cover, degree of sea-grass (*Thalasia. testudinum*) cover, and substrate type: sand or mud.

Elasmobranchs captured

For each shark or ray captured, gender, weight, precaudal length (PCL), fork length (FL) and total length (TL), (disk width for rays) were recorded. For newborn or juvenile sharks the condition of the umbilical scar was grouped into six categories: umbilical remains, fresh open, partially healed, mostly healed, well healed, and none (UR, FO, PH, MH, WH respectively). The species and TL of the few teleosts captured on longlines were also recorded. There were few mortalities on longlines and with the exception of a few sharks that died, all sharks were tagged with either a Rototag (Dalton-Henly, Nettlebed, Oxford, England) clipped into a hole punched in the first dorsal fin, or in the case of larger sharks with an M-tag (Droitcor, Warwick, Rhode Island) anchored with a stainless steel dart in the musculature near the first dorsal fin. Both types of tags contained reward information and were provided by the National Marine

Fisheries Service, Northeast Fishery Science Center (NOAA/NMFS/NEFSC), Narragansett, Rhode Island, Apex Predator Program.

Nursery area identification

Nursery areas were identified based on the presence of newborn or juvenile sharks. Nurseries may be classified as primary nurseries – where sharks are born, or secondary nursery areas – occupied by juvenile sharks during the first few months or years of their lives (Castro 1993). Each location sampled was evaluated in terms of its function as a nursery area and data summarized in terms of species composition and abundance for sharks utilizing the area as a nursery as well as habitat type and environmental characteristics. Sampling locations, major nurseries and habitat characteristics were plotted using GIS software. Locations identified as nursery areas were also classified according to the level of protection afforded through management policies under the jurisdiction of local or federal agencies.

Results

I. Assessment of past and present elasmobranch exploitation in the USVI

The commercial reef fishery in the USVI is a multi-species, multi-gear fishery, with long-line fishing being second only to trap fishing in gear use (Tobias 1997). According to the USVI Department of Natural Resources (DPNR 1994) fishermen often augment their fish harvest of inshore species with offshore pelagics, due to the proximity of deep water close to shore. The USVI shark fishery, like others in the West Indies, traditionally has been and remains artisanal, landing whatever species happen to be seasonally abundant. Prior to the 1970s sharks in the

archipelago were far more abundant than their current levels (personal communication, William Tobias, USVI DPNR). Five decades ago shark populations in the USVI were considered viable for a directed fishing industry (USFWS 1945). Shark flesh is consumed locally on an opportunistic basis. Often, shark is used to 'pay' crew members for their services, especially so with the nurse shark (*Ginglymostoma cirratum*) and the trap fishery. Some species were actively targeted three decades ago because fishermen considered them a nuisance on account of them feeding on hooked bony fishes (personal communication, Robert McAuliffe, President, Fishermen's United Services Cooperative of St. Croix). This practice continues presently, especially at particular locations some distance from shore that are popular for tuna and billfish fishing and where sharks are often encountered. There has also been interest in the development of chartered shark fishing trips and shark dives to take advantage of these local areas of high shark abundance.

From 1974 to 1996, fisheries data compiled by local fisheries managers were recorded by total landings by gear type and did not distinguish between fish species. After 1996, catch report forms were implemented to record commercial catch by family or species groups (Tobias et al. 2000). Sharks and rays however, are not listed on the forms. Traditionally, commercial data collection of all commercially important species, including sharks, has been problematic for quantification of catch by marine managers of the USVI (Tobias 2000). Often, landings go unreported, or larger fish are sold to the public before they can be sampled (Barshinger et al. 1998). However, there is currently no directed shark fishery in the USVI and past direct targeting of sharks occurred on a small scale for short durations. The occurrence of sharks in USVI fisheries is most often as by-catch in traps or other fisheries or in recreational fisheries for

pelagic fish, where small numbers of sharks may be targeted in an attempt to reduce shark damage to the targeted tuna or billfish.

II. Species composition and abundance of elasmobranchs in the USVI

A total of 10 elasmobranch species and 4 species of teleost were captured in longline sampling of nearshore locations, bays and mangrove-sea grass beds. The two most common species of sharks captured in these shallow areas were blacktip (*Carcharhinus limbatus*) and lemon (*Negaprion brevirostris*) sharks, which combined to account for 48% of elasmobranchs captured (Table 1). Southern stingrays (*Dasyatis americana*) were also common in these areas and represented the third elasmobranch species for which more than 40 individuals were captured in 225 longline sets. Two species of shark were captured regularly at a variety of locations, but in small numbers: blacknose (*Carcharhinus acronotus,* n = 23) and nurse (*Ginglymostoma cirratum,* n = 19). Multiple juveniles of several hammerhead species were captured within a short time frame in Megans Bay, but were not captured at other locations: scalloped hammerhead (*Sphyrna lewini*, n = 16), great hammerhead (*Sphyrna mokarran,* n = 4). There were also a number of shark species that were captured almost exclusively in deeper water, at the entrance of bays, or near offshore islands: Caribbean reef (*Carcharhinus perezi*, n = 10), tiger (*Galeocerdo cuvier*, n = 7) and Caribbean sharpnose (*Rhizoprionodon porosus,* n = 6). With the exception of a small number of locations, most 50 hook longline sets resulted in the capture of one or two elasmobranchs at most, and on many sets no sharks were captured. Sampling efforts indicate that sharks are common inhabitants of the near-shore areas of the USVI, but are not particularly abundant other than at selected locations. At several sites large numbers of newborn and juvenile sharks were captured, this was especially true for blacktip and

lemon sharks captured in Fish Bay, St. John, a site that produced nearly 40% of all elasmobranchs captured in this study. At several other locations (Mary's Creek, Cas Cay) smaller numbers of lemon and blacktip sharks were regularly captured. Outside of shallow, sea grass and sandy bottom habitats, lemon and blacktip sharks were captured infrequently and the species composition tended to shift to species associated with slightly deeper water such as blacknose, tiger, sharpnose, nurse and Caribbean reef sharks. The Caribbean reef shark is not common in the nearshore areas and bays where the majority of fishing was conducted, but it is apparently fairly abundant in reef areas in deeper water. Because the Caribbean reef shark is listed as a prohibited species in the NMFS fishery management plan for Atlantic sharks there is concern about the vulnerability of this species to overfishing. This species was placed in the prohibited category partly as a result of lack of information on its life history and basic biology, and partly to discourage the development of fisheries for this species. Insular populations of sharks are generally poor at withstanding direct fishing pressure and the vast majority of such fisheries are short-lived. One notable exception in all fishing to date is the bull shark (*Carcharhinus leucas*), which is a common inhabitant of similar insular areas throughout the Bahamas and Caribbean. Since bull sharks have been implicated in numerous attacks on humans and are considered along with the white shark (*Carcharodon carcharias*) and tiger shark as among the most dangerous sharks to humans worldwide, their apparent absence (or rarity) in the USVI may result in reduced risk of negative human-shark interactions in the USVI.

III. Identification of nursery areas and critical habitat for young sharks in the USVI

Sampling in this study revealed only one major shark nursery area, Fish Bay, St. John. Catch data indicate that there may be more than 40 blacktip and over 30 lemon sharks born in

Fish Bay each year. Although this probably corresponds to fewer than 10 pregnant blacktip and three pregnant lemon sharks giving birth in Fish Bay in early summer each year, Fish Bay remains one of the few locations that serves as a nursery area for substantial numbers of newborn sharks, and appears to be a perpetual nursery area for these species. Mary's Creek, also off St. John and the Cas Cay territorial marine refuge area are other locations where newborn blacktip and lemon sharks are found, although the smaller number of newborn sharks were captured at these sites and may have resulted from parturition of a handful of pregnant females for each species. These blacktip and lemon shark nurseries are characterized by shallow turtle grass and sand flat substrate with mangrove-lined shores. Lemon sharks in particular are associated with the mangroves, often swimming next to or among mangrove roots in very shallow water. Blacktip sharks tended to occur in slightly deeper water and slightly farther from shore and from mangroves. Megans Bay, St. Thomas, is also a nursery area where a limited number of blacktip and scalloped hammerhead sharks are born each summer. The second highest number of sharks was captured in Megans Bay, resulting from capture of newborn blacktip and scalloped hammerheads as well as a number of other larger and deeper water species.

Blacktip and lemon sharks appear to reside in Fish Bay for approximately one year following their birth and reduced catch rates over time suggest a relatively high level of mortality during this first year, although individuals probably also emigrate from the bay. Once the young blacktip and lemon sharks leave Fish Bay, or similar mangrove-lined shores and sea grass beds, they appear to expand their movements and range along shorelines in shallow water until they reach a larger size, when they move to deeper water and range over more varied habitat including coral covered bottom. Although blacktip and lemon shark nursery areas do not contain large amounts of coral, these bays and shallow water environments serve as essential habitat

during the early life stages of these sharks, similar to the nursery function of bays and estuaries for early life stages of many species of fish.

Scalloped hammerhead sharks may occupy similar non-coral type of nurseries early in life, although Megans Bay is apparently one of the few, if not the only, location where young scalloped hammerheads occur near St. Thomas or St. John. The majority of other elasmobranch species are more directly reef-associated than young blacktip, lemon and scalloped hammerhead sharks and were captured near or over coral substrate. Few newborn or small juvenile individuals of other species were captured, although the presence of several small Caribbean reef, Caribbean sharpnose and great hammerhead sharks suggest that nursery areas may exist in nearby areas outside of the survey sites.

The modest shark populations found in the USVI have most likely declined over the past several decades as a result of a combination of factors such as fishing pressure directly on sharks, reduced availability of prey due to fishing pressure as well as destruction of habitat critical to some life history stage of sharks. Since mangrove-lined bays appear to be of particular importance in the habitat characteristics for blacktip and lemon shark nurseries, destruction of this type of habitat probably affected these shark populations by limiting the availability of suitable nursery habitat. Development at locations throughout the tropics is typified by removal of mangroves and elimination of the mangal community during replacement of mangrove-lined shores with docks, shoreline hotels, resorts, beaches, or other development. Fish Bay has apparently been an important nursery area for blacktip and lemon sharks for the past few decades, however, its importance as a nursery historically is unknown. Other similar locations in the USVI have certainly been lost to development and along with these alterations, long-time nursery areas for these species were lost. This development has dramatically increased the

importance of Fish Bay as the single major nursery location for blacktip and lemon sharks. Fish Bay remains relatively undeveloped with much of the mangrove-lined shoreline intact.

The fact that a small portion of Fish Bay is encompassed within the boundary of the USVI National Park offers optimism for continued protection of this habitat through regulations discouraging extensive development in the park. However, the majority of Fish Bay does not fall within the boundaries of the park and remains vulnerable to perturbations that could severely affect the shark populations that rely on this area as nursery habitat. Even a very minor extension of the park boundary to include Fish Bay or a larger portion of the bay would increase the level of protection indirectly afforded to this habitat. Mary's Creek, the more limited nursery area on St. John, is located within the boundary of the national park and therefore protected to a greater extent than Fish Bay. However, because fishing and capture of sharks is allowed in the park, the primary form of protection for shark populations occurs indirectly through containment of habitat degradation. Management of the coral reef resources within the USVI National Park such as monitoring of the health of coral and fish populations as well as prohibition of anchoring and other activities damaging to coral also benefit shark populations by easing habitat destruction. Cas Cay, St. Thomas is another nursery area utilized by newborn blacktip and lemon sharks and this location is well protected via strict restrictions on development and fishing as part of the management policy within the territorial marine reserve. Megans Bay, St. Thomas serves as a nursery for blacktip and scalloped hammerhead sharks and as habitat occupied by all 10 of the species captured in these surveys. Megans Bay is one of the most popular tourist sites in the USVI and is of tremendous economic importance to the local community. The role of Megans Bay in the tourism industry has produced a premium on maintaining the environmental quality of the area, close scrutiny of commercial and recreational activities that take place within

the bay and establishment of a quasi-government, grassroots organization (Megans Bay Authority) that oversees these activities. This combination of factors is likely to provide some level of protection for the environmental quality of this area even though conservation regulations and their enforcement are less stringent in Megans Bay than in areas found within the national park or territorial marine reserves.

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Table 1. Species of elasmobranchs captured in longline surveys at St. Thomas and St. John, USVI during 2004 and 2005.

Species	2004 Total	Jan-05	Mar-05	May-05	2005 Total	Total
Blacktip (*Carcharhinus limbatus*)	56	4	2	8	14	70
Lemon (*Negaprion brevirostris*)	34	6	3	8	17	51
Southern Stingray (*Dasyatis americana*)	19	11	7	12	30	49
Blacknose (*Carcharhinus acronotus*)	7	9	1	6	16	23
Nurse (*Ginglymostoma cirratum*)	8	6	1	4	11	19
Scalloped Hammerhead (*Sphyrna lewini*)	9	1	2	4	7	16
Caribbean Reef (*Carcharhinus perezi*)	2	0	5	3	8	10
Tiger (*Galeocerdo cuvier*)	1	2	2	2	6	7
Caribbean Sharpnose (*Rhizoprionodon porosus*)	3	0	2	1	3	6
Great Hammerhead (*Sphyrna mokarran*)	1	0	1	2	3	4
Total	140	39	26	50	115	255

Table 2. Number of individuals, size ranges and condition of umbilicus as an indicator of the existence of primary nursery areas - where parturition occurs - for elasmobranchs captured at locations sampled off St. Thomas and St. John in this study.

Species	n	Size Range (cm TL)	Visible Umbilical Scar
Blacktip (*Carcharhinus limbatus*)	70	48-135	yes
Lemon (*Negaprion brevirostris*)	51	59-167	yes
Southern Stingray (*Dasyatis americana*)	49	41-102*	no
Blacknose (*Carcharhinus acronotus*)	23	72-126.2	no
Scalloped Hammerhead (*Sphyrna lewini*)	16	45.3-82.5	yes
Nurse (*Ginglymostoma cirratum*)	19	117-234	no
Caribbean Reef (*Carcharhinus perezi*)	10	68-160	no
Tiger (*Galeocerdo cuvier*)	7	119-221	no
Caribbean Sharpnose (*Rhizoprionodon porosus*)	6	51-98	yes
Great Hammerhead (*Sphyrna mokarran*)	4	67-112	yes

*disk width (cm)

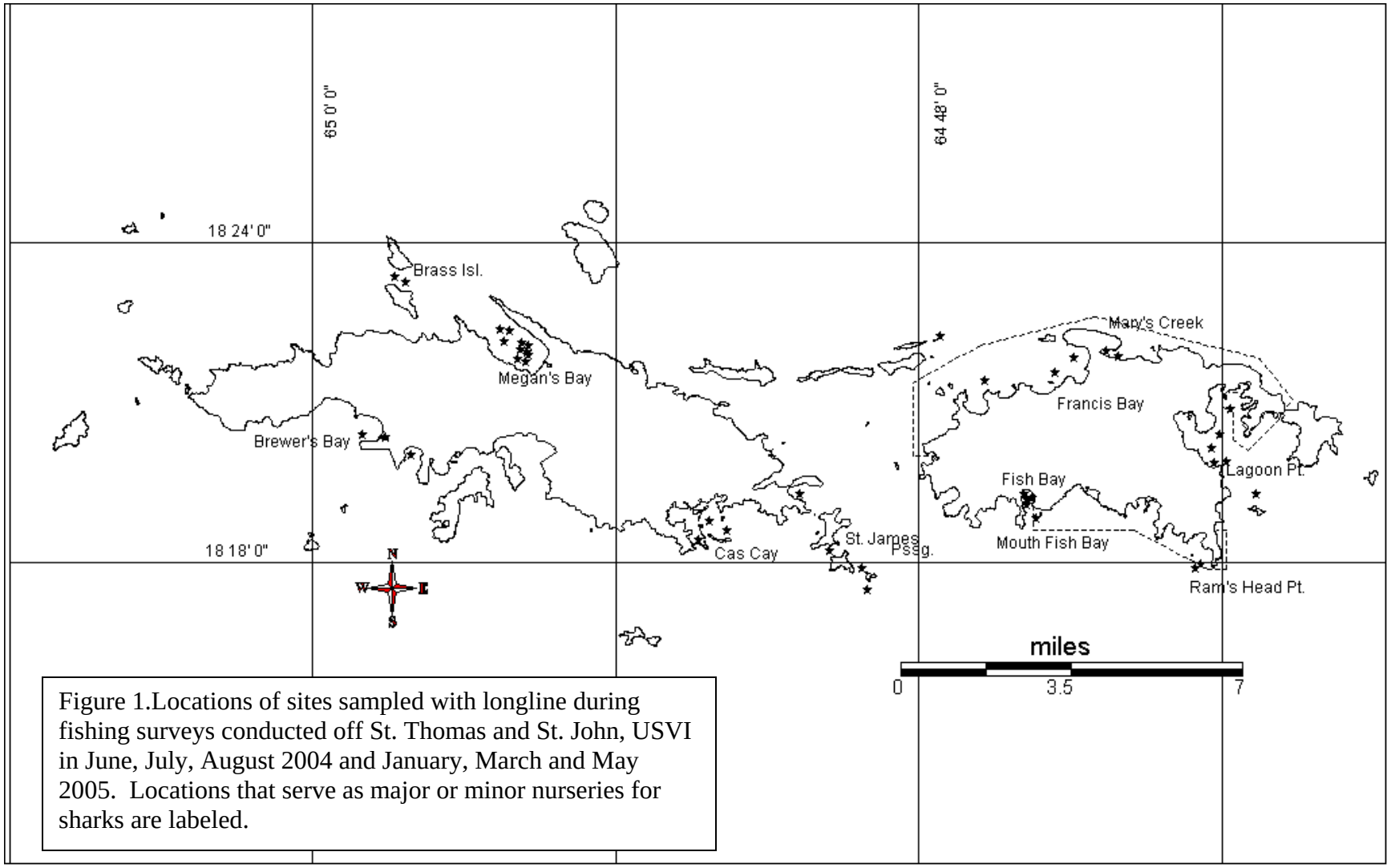

Figure 1.Locations of sites sampled with longline during fishing surveys conducted off St. Thomas and St. John, USVI in June, July, August 2004 and January, March and May 2005. Locations that serve as major or minor nurseries for sharks are labeled.