

Deepwater and Other Sharks of the U.S. Atlantic Ocean Exclusive Economic Zone

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Introduction

This paper reviews species descriptions, including primary distribution (where known), of 51 deepwater and other sharks (Table 1) of the U.S. Atlantic Ocean Exclusive Economic Zone (EEZ) which currently are not included in any Federal fishery management plan prepared under the Magnuson-Stevens

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ABSTRACT—Fifty-one deepwater and other shark species of the U.S. Exclusive Economic Zone in the Atlantic Ocean and Gulf of Mexico, which currently are not included in any Federal fishery management plan, are described, with a focus on primary distribution. Many of these shark species are not well known, while others which are more common may be of particular interest. Owing to concerns regarding possible increases in fishing effort for some of these species, as well as possible increases in bycatch rates as other fisheries move farther offshore, it is important that these sharks be considered in marine ecosystem management efforts. This will necessitate a better understanding of their biology and distribution. Primary distribution maps are included, based on geographic information system (GIS) analyses of both published and unpublished data, and a review of the literature. The most recent systematic classification and nomenclature for these species is used.

Fishery Conservation and Management Act. Thirty-three of these species were listed by NOAA's National Marine Fisheries Service (NMFS) as part of the management unit in the Final Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks (HMS FMP) (USDOC, 1999) only in so far as to prohibit finning, as these sharks are sometimes taken incidentally in directed shark, tuna, and swordfish fisheries. Subsequently, in Amendment 1 to the HMS FMP (USDOC, 2003) these species were removed from the management unit because a national ban on finning was instituted under the Shark Finning Prohibition Act.¹ However, NMFS continues to collect available fishing data on these species.

For many of the sharks described here, little is known of either their biology or distribution. Also, at present little information is known on the stock size or reproductive characteristics of many of these species. For species where at least some reproductive information is known, life-history characteristics include slower growth rates and lower reproductive rates, even when compared to shallow-water sharks. When combined with the more limited productivity of cold, deep-sea environments, many of these deepwater sharks are at risk of serious decline before any fishery management scheme can be put into place.

The potential for an increased interest in fishing for these species warrants a better understanding of them, and it is important that they be included in any ecosystem-based analysis pertaining to marine fisheries management. Based

¹H.R. 5461, P.L. 106-557, Shark Finning Prohibition Act, 21 Dec. 2000, 114 Stat. 2772, 4 p.

on what is known regarding their life history characteristics, deep-sea sharks are likely to be highly vulnerable to over exploitation, especially given the rapid boom and bust tendencies of many deep-sea fisheries (Moore, 1999). Also, over exploitation of shallow-water fishery resources has driven some fishermen into deeper fishing grounds, and this can result in an increase in bycatch rates of certain deep-sea sharks in U.S. waters. For example, the monkfish, *Lophius americanus*, fishery off the northeastern United States has ventured to depths of 700 m or more and can frequently capture black dogfish, *Centroscyllium fabricii*, and various lanternsharks, *Etmopterus* spp., as bycatch (co-author J. A. Moore, personal observ.). Ecosystem management of such deepwater fishing grounds will require better knowledge of these deep-sea sharks. Obviously, for those species where little to no information is available on reproduction and stock size, ecosystem management becomes an even more difficult task.

The other, non deepwater sharks covered in this paper are included because they play an important role in their respective ecosystems as middle-to top-level predators. Their inclusion underscores the importance of considering them in addressing marine ecosystem management.

Since publication of the HMS FMP (USDOC, 1999) some of the species listed in that document have been systematically reclassified based on new information. In some cases, there has been confusion when referring to a species by common name. For example, more than one common name may be used for the same species, or two separate species may share a nearly identical

common name. No single standardized reference for common names yet exists, especially for those species found below the 200 m depth zone (which serves as the cut-off point for one published list of fishes) (Robins et al., 1991). In those instances, the most frequently used and/or the United Nations Food and Agriculture Organization (FAO) names are used in this report.

Species Accounts

Primary distribution descriptions for the shark species included here are based on life history information, expert opinion regarding the importance of certain

areas, and presence/absence data, and represent the best available information for these species. To visually illustrate species primary distribution, the data were analyzed using a geographic information system (GIS), and shaded areas marking those boundaries are depicted on the maps (Table 2). Biological and fishing-related information is taken in part from Castro (1983) and Compagno (1984), and updated with supplemental information from more recent literature, personal observations, and personal communications.

The following data sources were used to construct the GIS and associated

primary distribution maps: published literature, unpublished data and photographs from the NMFS Northeast Fisheries Science Center's groundfish surveys, unpublished data from the Northeast Fisheries Science Center's fishery observer program, and catalogued museum specimens from the following institutions: Academy of Natural Science in Philadelphia (ANSP), California Academy of Sciences (CAS), Field Museum of Natural History (FMNH), Florida State Biological Collections (FSBC), Museum of Comparative Zoology at Harvard University (MCZ), Scripps Institution of Oceanography in La Jolla, Calif. (SIO),

Table 1.—Fifty-one deepwater and other sharks of the U.S. Atlantic Ocean Exclusive Economic Zone which currently are not included in any Federal fishery management plan prepared under the Magnuson-Stevens Fishery Conservation and Management Act. Nomenclature note: *Apristurus laurussoni* is the incorrect name for the species commonly found off the U.S. What is in U.S. waters is an undescribed species similar in appearance to *A. laurussoni* (Nakaya¹). The proper designation is *Apristurus* sp. As of yet, there is no common name to apply to this species.

ECHINORHINIDAE (Bramble Sharks) <i>Echinorhinus brucus</i> (Bonnaterre, 1788) Bramble shark	<i>Squaliolus laticaudus</i> Smith and Radcliffe, 1912 Spined pygmy shark, Pygmy shark	<i>Apristurus profundorum</i> (Goode and Bean, 1896) Deepwater catshark
ETMOPTERIDAE (Lanternsharks) <i>Centroscyllium fabricii</i> (Reinhardt, 1825) Black dogfish <i>Etmopterus bigelowi</i> Shirai and Tachikawa, 1993 Blurred lanternshark Often confused with the similar <i>E. pusillus</i> , which does not occur in the western Atlantic. <i>Etmopterus bullisi</i> Bigelow and Schroeder, 1957 Lined lanternshark <i>Etmopterus gracilispinis</i> Krefft, 1968 Broadbanded lanternshark, Broadband dogfish <i>Etmopterus hillianus</i> (Poey, 1861) Caribbean lanternshark, Blackbelly dogfish <i>Etmopterus princeps</i> Collett, 1904 Great lanternshark, Rough sagre <i>Etmopterus robinisi</i> Schofield and Burgess, 1997 West Indian lanternshark <i>Etmopterus schultzi</i> Bigelow, Schroeder, and Springer, 1953 Fringefin lanternshark <i>Etmopterus virens</i> (Bigelow, Schroeder, and Springer, 1953) Green lanternshark	CENTROPHORIDAE (Gulper Sharks) <i>Centrophorus</i> cf. <i>acus</i> Garman, 1906 Undescribed gulper shark #1 An undescribed species similar to the Needle dogfish <i>C. acus</i> from the Pacific (McEachran and Fechhelm, 1998). <i>Centrophorus granulosus</i> (Bloch and Schneider, 1801) Gulper shark <i>Centrophorus</i> cf. <i>harrissoni</i> McCulloch, 1915 Undescribed gulper shark #2 Usually identified as <i>C. uyato</i> , but that species name is now considered invalid (Compagno ²). <i>Centrophorus niaukang</i> Teng, 1959 Taiwan gulper shark <i>Centrophorus</i> cf. <i>tessellatus</i> Garman, 1906 Undescribed gulper shark #3 An undescribed species similar to the Tesellated gulper shark <i>C. tessellatus</i> from the Pacific according to McEachran and Fechhelm (1998). <i>Deania profundorum</i> (Smith and Radcliffe, 1912) Arrowhead gulper shark, Arrowhead dogfish, Flatnose dogfish	<i>Apristurus riveri</i> Bigelow and Schroeder, 1944 Broadgill catshark <i>Apristurus</i> sp. (<i>laurussoni</i> -like) Undescribed carshark #1 An undescribed species similar in appearance to <i>A. laurussoni</i> (Nakaya ¹). <i>Galeus antillensis</i> Springer, 1979 Antillean roughtail catshark <i>Galeus arae</i> (Nichols, 1927) Marbled catshark, Roughtail catshark <i>Galeus springeri</i> Konstantinou and Cozzi, 1998 Striped sawtail catshark <i>Scyliorhinus boa</i> Goode and Bean, 1896 Boa catshark <i>Scyliorhinus meadi</i> Springer, 1966 Blotched catshark <i>Scyliorhinus retifer</i> (Garman, 1881) Chain catshark, Chain dogfish <i>Scyliorhinus torrei</i> Howell-Rivero, 1936 Dwarf catshark
SOMNIOSIDAE (Sleeper Sharks) <i>Centroscyminus coelolepis</i> Bocage and Capello, 1864 Portuguese shark, Portuguese dogfish <i>Centroscyminus owstoni</i> Garman, 1906 Roughskin dogfish <i>C. cryptacanthus</i> is a junior synonym of this species. <i>Somniosus microcephalus</i> (Bloch and Schneider, 1801) Greenland shark <i>Symnodon squamulosus</i> (Günther, 1877) Velvet dogfish <i>S. obscurus</i> is a junior synonym of this species according to Yano and Tanaka (1984) and Wetherbee and Crow (1996).	SQUALIDAE (Spiny Dogfish Sharks) <i>Cirrhitigaleus asper</i> (Merrett, 1973) Roughskin spiny dogfish, Roughskin spurdog This species was recently transferred from <i>Squalus</i> to this genus. <i>Squalus cubensis</i> Howell-Rivero, 1936 Cuban dogfish <i>Squalus mitsukurii</i> Jordan and Snyder, 1903 Shortspine dogfish, Shortspine spurdog Often misidentified as <i>S. blainvillei</i> , which is now considered an invalid name (Compagno ²).	PROSCYLLIDAE (Ribbontail Catsharks) <i>Eridacnis barbouri</i> (Bigelow and Schroeder, 1944) Cuban ribbontail catshark <i>Triakis barbouri</i> is a frequently used synonym.
DALATIIDAE (Kitefin Sharks) <i>Dalatias licha</i> (Bonnaterre, 1788) Kitefin shark <i>Isistius brasiliensis</i> (Quoy and Gaimard, 1824) Cookiecutter shark <i>Isistius plutodus</i> Garrick and Springer, 1964 Bigtooth cookiecutter shark,argetooth cookie-cutter shark	PRSTIOPHORIDAE (Sawsharks) <i>Pristiophorus schoederi</i> Springer and Bullis, 1960 American sawshark, Bahamas sawshark	PSEUDOTRIAKIDAE (False Catsharks) <i>Pseudotriakis microdon</i> Capello, 1867 False catshark <i>Scyliorhinus licha</i> is an older name for this species.
	SCYLIORHINIDAE (Catsharks) <i>Apristurus canutus</i> Springer and Heemstra, 1979 Hoary catshark <i>Apristurus manis</i> (Springer, 1979) Ghost catshark <i>Apristurus microps</i> (Gilchrist, 1922) Smalleye catshark <i>Apristurus parvipinnis</i> Springer and Heemstra, 1979 Smallfin catshark	CHLAMYDOSELACHIDAE (Frill Sharks) <i>Chlamydoselachus anguineus</i> Garman, 1884 Frill shark
		TRIAKIDAE (Smoothhound Sharks) <i>Mustelus canis canis</i> (Mitchill, 1815) Dusky smoothhound, Smooth dogfish <i>Mustelus canis insularis</i> Heemstra, 1997 Antillean smoothhound <i>Mustelus higmani</i> Springer and Lowe, 1963 Smalleye smoothhound <i>Mustelus norrisi</i> Springer, 1940 Florida smoothhound, Narrowfin smoothhound <i>Mustelus sinusmexicanus</i> Heemstra, 1997 Gulf smoothhound
		ODONTASPIDAE (Sand Tiger Sharks) <i>Odontaspis ferox</i> (Risso, 1810) Ragged-tooth shark, Smalltooth sand tiger shark

¹Nakaya, K. 1999. Personal commun., Hokkaido Univ., Japan.

²Compagno, L. 1999. Personal commun., South African Museum, Cape Town.

Texas Cooperative Wildlife Collections at Texas A&M University (TCWC), Texas Natural History Collection (TNHC), Texas University Collections (TU), University of Alabama Ichthyological Collections (UAIC), University of Florida in Gainesville (UF), University of North Carolina Institute of Marine Science (UNCMIS), University of Puerto Rico at Managua (UPRM), National Museum of Natural History (USNM) at the Smithsonian Institution, and Yale University's Peabody Museum of Natural History (YPM).

All length measurements of specimens are given as total length.

Bramble Sharks (Echinorhinidae)

Bramble shark

Echinorhinus brucus

The bramble shark is a large, sluggish, bottom dwelling shark. It is primarily a deepwater species, widely distributed in the deep temperate and tropical waters of continental and insular shelves and upper slopes. Although the species appears to be most abundant at depths of 300–900 m, it is occasionally found in shallower water (<18 m). Bramble shark catches are often reported in the eastern Atlantic and western Indian Oceans, but only five specimens have been reported from the North American east coast in the past century (one off Cape Cod, Mass., one off Virginia, and three near the Mississippi River Delta) (Goode and Bean, 1896; Musick and McEachran, 1969; Schwartz, 1993; McEachran and Fehhelm, 1998).

Biology Very little is known about the habits of the bramble shark. It reportedly feeds on smaller sharks, bony fishes, and crabs. Development is ovoviviparous; i.e. eggs hatch in the uterus before the embryos are fully developed, and the embryos then continue to be nourished by the yolk sac. Litters of 15–24 pups have been reported, with pups approximately 40 cm (16 in) at birth. Males mature at 150–174 cm (60–70 in) and females at 213–230 cm (85–92 in). The species is known to reach a maximum size of 310 cm (124 in).

Fishing The bramble shark is usually caught in water depths >300 m.



Figure 1.—Black dogfish, *Centroscyllium fabricii*, taken at about 915 m depth near Hydrographer Canyon during deep-water monkfish survey aboard F/V *Mary K.* NMFS photo.

Primary Distribution Within the U.S. EEZ (Map 1) In the Gulf of Mexico in water depths of 300–900 m, from the Florida Panhandle east of DeSoto Canyon at 86.5°W to west of Mississippi Canyon at 90.5°W.

Lanternsharks (Etmopteridae)

Black dogfish

Centroscyllium fabricii

The black dogfish (Fig. 1) is a small, bottom-dwelling shark that sometimes forms large schools, which are possibly segregated by sex and size (ICES, 1995). It is a deepwater species found in temperate to boreal waters over the outer continental shelves and slopes of the North Atlantic Ocean. Catches are reported from depths of 180–1,600 m, most usually deeper than 250 m. This species typically occurs at shallower depths in the northern part of its range. It is found off the United States from Georges Bank, off New England, to Cape Hatteras, N.C., and possibly also in the northern Gulf of Mexico.

Biology This species feeds on small crustaceans, cephalopods, bony fishes, and jellyfish (Compagno, 2002a). Development is ovoviviparous and litters of up to 50 pups have been reported (ICES, 1995). Pups are approximately 14 cm (6 in) at birth. Females mature at 58–70 cm (23–28 in) although the species is known to reach a maximum size of 120 cm (48 in) (ICES, 1995).

Fishing Black dogfish are taken as bycatch in deepwater trawl and longline fisheries.

Primary Distribution Within the U.S. EEZ (Map 2) In the Atlantic Ocean in water depths of 180–1,600 m, from the northern extent of the EEZ boundary off

Table 2.—Primary distribution maps.

Map no.	Name	Page no.
1	Bramble Shark	21
2	Black Dogfish	22
3	Blurred Lanternshark	23
4	Lined Lanternshark	24
5	Broadband Dogfish	25
6	Caribbean Lanternshark	26
7	Great Lanternshark	27
8	West Indian Lanternshark	28
9	Fringefin Lanternshark	29
10	Green Lanternshark	30
11	Portuguese Shark	31
12	Roughskin Dogfish	32
13	Greenland Shark	33
14	Velvet Dogfish	34
15	Kitefin Shark	35
16	Cookie-cutter Shark	36
17	Undescribed Gulper Shark #1	37
18	Gulper Shark	38
19	Undescribed Gulper Shark #2	39
20	Taiwan Gulper Shark	40
21	Taiwan Gulper Shark	41
22	Undescribed Gulper Shark #3	42
23	Arrowhead Gulper Shark	43
24	Cuban Dogfish	44
25	Shortspine Dogfish	45
26	American Sawshark	46
27	Hoary Catshark	47
28	Ghost Catshark	48
29	Smallfin Catshark	49
30	Broadgill Catshark	50
31	Undescribed Catshark	51
32	Antillean Roughtail Catshark	52
33	Marbled catshark	53
34	Striped Sawtail Catshark	54
35	Boa Catshark	55
36	Blotched Catshark	56
37	Chain Dogfish	57
38	Dwarf Catshark	58
39	Cuban Ribbontail Catshark	59
40	Smooth Dogfish	60
41	Antillean Smoothhound	61
42	Florida Smoothhound	62
43	Gulf Smoothhound	63

New England, south to Cape Hatteras, N.C., at 35°N.

Blurred lanternshark

Etmopterus bigelowi

The blurred lanternshark is a recently described small, deepwater shark distributed in tropical to temperate waters in the Atlantic, southwestern Indian, and southeastern Pacific Oceans (Shirai

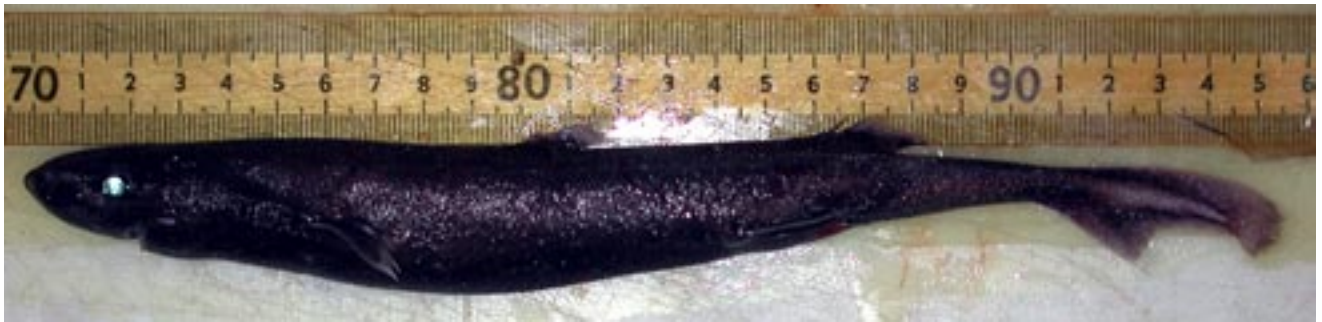


Figure 2.—Broadband dogfish, *Etmopterus gracilispinis*, from 2002 Bear Seamount cruise DE02-06 at depth of 0–1194 m in open water. Photo: Chris Kenaly (Harvard Univ. specimen MCZ 161542).

and Tachikawa, 1993). It formerly was confused with the smooth lanternshark, *Etmopterus pusillus*, which does not occur in the western North Atlantic (Shirai and Tachikawa, 1993). The blurred lanternshark is both mesopelagic and benthopelagic, occurring over the outer continental shelves and slopes at depths ranging from 100 m to below 1,000 m. In U.S. waters it is distributed in the northeastern Gulf of Mexico from Florida to Louisiana.

Biology The blurred lanternshark is known to feed on squid and small fishes. Development is ovoviviparous. Females mature at 50 cm (20 in) and males at 42 cm (17 in). It is known to reach a maximum size of 66 cm (27 in) (Shirai and Tachikawa, 1993). Blurred lanternsharks show a size vs. depth segregation, with smaller individuals occurring at shallower depths and larger ones in deeper waters.

Fishing The blurred lanternshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 3) In the Gulf of Mexico in water depths of 100–1,000 m, from the Florida Keys at 81.3°W, west to the Mississippi River Delta at 89.5°W.

Lined lanternshark

Etmopterus bullisi

The lined lanternshark is a small, slender shark that inhabits the tropical to temperate western Atlantic Ocean. It is a deepwater species, usually found along the continental slope in water depths of 250–850 m. In U.S. waters it is distributed in the northern Gulf of Mexico and



Figure 3.—Head of broadband dogfish, *Etmopterus gracilispinis*, from 2002 Bear Seamount cruise DE02-06 at depth of 1194 m in open water. Photo: Jon Moore (Harvard Univ. specimen MCZ 161542).

in the Atlantic from Florida to North Carolina. This species also most likely occurs off Puerto Rico and the Virgin Islands, given its occurrence off the nearby Leeward Islands.

Biology The lined lanternshark feeds on small crustaceans and squid (McEachran and Fechhelm, 1998). It is capable of swallowing relatively large squid whole, possibly by distending its jaws. Although development is presumed to be ovoviviparous, nothing else is known of its reproduction. The majority of captured specimens have been juveniles measuring 18–26 cm (7–10 in). The maximum size known is 26 cm (10 in) (Compagno, 2002a). The size of an adult lined lanternshark is not yet known.

Fishing The lined lanternshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 4) In the Atlantic Ocean and Gulf of Mexico in water depths of 200–850 m: in the Atlantic extending from Cape Hatteras, N.C., at 35°N, south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Texas/Mexico border.

Broadband dogfish (also referred to as Broadbanded lanternshark)

Etmopterus gracilispinis

Broadband dogfish (Fig. 2, 3) have been reported from the western North Atlantic Ocean and from both sides of the South Atlantic (Compagno, 2002a). It is

widely distributed in the Gulf of Mexico from Florida to Louisiana, and along the east coast from Florida to the southern New England slope south of Nantucket, Mass. (Moore et al., 2003). This species is mesopelagic, occurring at depths of 70–480 m, and benthopelagic along the outer continental shelf and upper slope, where it occurs at depths ranging from 100 to 1,000 m. Similar to several other small, deepwater sharks, it is believed to ascend the water column at night.

Biology Development is ovoviviparous. A newborn specimen measuring 13 cm (5 in) has been reported, while a 26 cm (10 in) male was determined to be immature. Specimens of broadband dogfish have been recorded to 33 cm (13 in).

Fishing The broadband dogfish is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 5) In the Atlantic Ocean and Gulf of Mexico in water depths of 70–1,000 m: in the Atlantic from the northern extent of the EEZ off New England, south to Cape Hatteras, N.C., at 35°N. Also rare individuals are found to occur from Cape Hatteras south to northern Florida to 29°N (Compagno, 2002a; Moore et al., 2003); in the Gulf of Mexico from the Florida Panhandle east of DeSoto Canyon at 86.5°W west to the area of the Mississippi Canyon at 90.5°W.

Caribbean lanternshark
(also referred to as Blackbelly dogfish)
Etmopterus hillianus

The Caribbean lanternshark is a small shark found in the tropical to subtropical Caribbean Sea and the western North Atlantic Ocean. It appears to be confined to deep waters of the upper continental and insular slopes, and has been reported from depths of 300–700 m (Schofield and Burgess, 1997). In U.S. waters it is found from southern Florida to Virginia, in the northern Gulf of Mexico off the Mississippi River Delta, and off Puerto Rico and the Virgin Islands.

Biology Males and females reach maturity at about 20 cm (8 in) and 30 cm (12 in), respectively (Schofield and Burgess, 1997). Development is ovoviparous. Litters consist of up to five pups that are approximately 9 cm (4 in) at birth. The average size is about 25 cm



Figure 4.—Great lanternshark, *Etmopterus princeps*, collected by a commercial fisherman during exploratory fishing at depth of 1464 m in Welker Canyon on Georges Bank. Specimen is 58 cm long. Photo: Jon Moore. (Harvard Univ. specimen YPM 10419).

(10 in), although some individuals have been reported at 28 cm (11 in).

Fishing The Caribbean lanternshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 6) In the Caribbean Sea in water depths of 300–700 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ; in the Atlantic Ocean and Gulf of Mexico in water depths of 300–700 m: in the Atlantic from the Virginia/Maryland border at 38°N, extending south around Florida, including the Straits of Florida, into the Gulf of Mexico west to 83.2°W; in the Gulf of Mexico from the Florida Panhandle east of DeSoto Canyon at 86°W, west to the Mississippi River Delta at 91°W.

Great lanternshark
Etmopterus princeps

The great lanternshark (Fig. 4) is a small, slender shark (although the largest lanternshark species in the western Atlantic Ocean) found throughout the temperate North Atlantic Ocean. Off the United States it is caught from off Georges Bank south to New Jersey (Moore et al., 2003). Confined to deep waters of the continental slopes, the great lanternshark has been reported from depths of 500–2,200 m.

Biology The diet of this shark consists of fish and decapod crustaceans (ICES, 1995). Development is ovoviparous and pups are born at about 18 cm (7 in) (ICES, 1995). A 55 cm (22 in) male was reported as mature, although individuals can grow to a length of about 89 cm (36 in).

Fishing The great lanternshark is caught only in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 7) In the Atlantic Ocean at depths of 500–2,200 m, from the northern extent of the EEZ boundary off New England south to Delaware at 38.7°N.

West Indian lanternshark
Etmopterus robinasi

The West Indian lanternshark is a small, recently described shark found in the tropical western North Atlantic Ocean (Schofield and Burgess, 1997). It appears to be confined to deep waters of the upper continental and insular slopes, and has been reported from depths of 400–800 m, with most reports deeper than 550 m. In U.S. waters it is found off southern Florida and likely occurs off Puerto Rico and the Virgin Islands, given its occurrence off the nearby Leeward Islands.

Biology Very little is known of the biology of this species. Males reach maturity at about 26 cm (10 in) (Schofield and Burgess, 1997). Development is presumably ovoviviparous. The maximum reported size is about 34 cm (14 in) (Schofield and Burgess, 1997).

Fishing The West Indian lanternshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 8) In the Atlantic Ocean and Gulf of Mexico in water depths of 400–800 m: in the South Atlantic beginning at 30°N out to the EEZ boundary, including the Blake Plateau, extending south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to 83.8°W.

Fringefin lanternshark
Etmopterus schultzi

The fringefin lanternshark is a small, deepwater shark found in the tropical



Figure 5.—Portuguese shark, *Centroscymsus coelolepis*, (top, specimen no. YMP 10137) and black dogfish, *Centroscyllium fabricii*, (bottom, specimen no. YPM 10134) caught by exploratory deepwater fisherman near Block Canyon at depth of 1006 m. Photo: Jon Moore.

and subtropical western North Atlantic Ocean. It appears to be common along upper continental slopes at depths ranging from 200 to 1,000 m. In U.S. waters it is distributed in the northern Gulf of Mexico from Florida to Texas, and in the Atlantic from Florida to South Carolina (although it may possibly extend north to Cape Hatteras).

Biology The species is known to feed on squid. No data on its reproductive development are available. Males mature at 27 cm (11 in) and females at 28–30 cm (11–12 in). The maximum reported size of a fringefin lanternshark is 30 cm (12 in) (Compagno, 2002a).

Fishing The fringefin lanternshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 9) In the Atlantic Ocean and Gulf of Mexico in water depths of 200–1,000 m: in the Atlantic extending from the North Carolina/South Carolina border at 33°N, south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Texas/Mexico border.

Green lanternshark *Etmopterus virens*

The green lanternshark is found in the western North Atlantic Ocean, from

the Caribbean Sea and Gulf of Mexico to the Bahamas and off the east coast of Florida. It appears to live in dense schools confined to moderately deep waters, typically 100–1,000 m. In U.S. waters it is relatively common in the northern Gulf of Mexico from Texas to Florida, and off Puerto Rico and the Virgin Islands.

Biology The green lanternshark feeds primarily on squid. The cephalopod beaks and eyes commonly found in stomach contents are large enough to indicate that the shark's jaws must have been greatly stretched at the time of swallowing. It has been suggested that dense schools of these sharks attack prey much larger than themselves, biting off chunks with their sharp lower teeth. Development is ovoviviparous and the gestation period is believed to last around one year. Litters consist of 1–3 pups, which measure nearly 9 cm (4 in) at birth. Maturity is reached at about 20–23 cm (8–9 in) and the average size is 20–25 cm (8–10 in). The maximum size observed is 26 cm (10 in) (Compagno, 2002a).

Fishing The green lanternshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 10) In the Caribbean Sea in water depths of 100–1,000 m surrounding

Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ; in the Atlantic Ocean and Gulf of Mexico in water depths of 100–1000 m: in the Atlantic beginning at 30°N out to the EEZ boundary, including the Blake Plateau, extending south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Texas/Mexico border.

Sleeper Sharks (Somniosidae)

Portuguese shark *Centroscymsus coelolepis*

The Portuguese shark (Fig. 5) inhabits very deep waters along the continental slope and rise nearly worldwide. This shark is found at depths of 150–3,700 m, with most captures occurring in water depths >600 m (Compagno, 2002b) and at temperatures of 5–6°C (41–43°F). Due to its preferred depth range, few catches have been reported in North American waters. Sporadic captures off the United States range from the Straits of Florida to Georges Bank.

Biology Stomach contents of Portuguese sharks have consisted of small fishes, squid, and cetacean flesh. Development is ovoviviparous, with average litters of 13–16 pups measuring 27–30

cm (11–12 in) at birth. Japanese studies indicate that Portuguese sharks may have a tri-annual reproductive cycle. The average size is 90–107 cm (35–42 in), although the maximum reported size is 128 cm (51 in) (ICES, 1995).

Fishing The majority of Portuguese shark specimens are caught on longlines set at depths >350 m, but this species is also occasionally taken in trawls. The species is commercially fished in the eastern Atlantic Ocean.

Primary Distribution Within the U.S. EEZ (Map 11) In the Atlantic Ocean and Gulf of Mexico in water depths of 160–3,700 m: in the Atlantic from the northern extent of the EEZ boundary off New England extending south around Florida, including the Straits of Florida, west to the Dry Tortugas at 83.4°W.

Roughskin dogfish *Centroscymnus owstoni*

The roughskin dogfish inhabits deep waters along the continental and seamount slopes nearly worldwide at depths of 400–1,500 m. Rare captures of this species in U.S. waters are from the northern Gulf of Mexico from the vicinity of the Mississippi River Delta to Pensacola, Fla., and the Florida Keys. *Centroscymnus cryptacanthus* is a commonly used junior synonym for this species (Compagno, 2002b).

Biology The diet of roughskin dogfish consists of small fishes. Very little is known about development in the species. Males mature at 72–84 cm (29–34 in) and females at 102 cm (41 in). The maximum reported size is 104 cm (42 in).

Fishing Roughskin dogfish are occasionally caught in trawls or longlines set at depths greater than 400 m.

Primary Distribution Within the U.S. EEZ (Map 12) In the Gulf of Mexico in water depths of 400–1,500 m, from the Straits of Florida at 80.3°W, west to Key West at 82.4°W, and from the Florida Panhandle east of DeSoto Canyon at 88.5°W, west to the Mississippi River Delta at 86.4°W.

Greenland shark *Somniosus microcephalus*

The Greenland shark is a large, wide-bodied shark commonly found in temper-

ate to polar North Atlantic waters. This is the only shark species regularly encountered in the polar waters of the Atlantic Ocean. Individuals have been reported in the Gulf of Maine and as far south as Georgia (Herdendorf and Berra, 1995). This species has been found in water temperatures ranging from 0.6 to 16°C (33–61°F), with most specimens taken in temperatures of 2–7°C (36–45°F). In the summer, the Greenland shark tends to reside at depths of 200–750 m, although some have occurred as deep as 2,200 m (Herdendorf and Berra, 1995). During the winter months individuals ascend the water column, often approaching the surface at the edge of the ice.

Biology The Greenland shark feeds on bony fishes (e.g. capelin, char, halibut, herring, lumpfish, and salmon), seals, seabirds, squid, crabs, and other benthic invertebrates. Stomach content analyses reveal fast-moving fishes often found with their tails bitten off. This species often gathers in large numbers around sealing or whaling operations, feeding on offal or carrion. Size at maturity is 240 cm (96 in) (Scott and Scott, 1988). Development is ovoviviparous. Pups measure about 38 cm (15 in) at birth, and up to 10 pups have been reported in one litter. Tagging studies have shown the Greenland shark to be a very slow-growing fish—medium-size specimens appear to grow only 1 cm (0.4 in) or less per year. The average size is 340 cm (11.1 ft) and 285 kilograms (kg) (627 lb), whereas the largest specimen on record measured 640 cm (21.0 ft) and weighed 1,022 kg (2,250 lb).

Fishing The Greenland shark has been fished along the coasts of Norway, Iceland, and Greenland for its liver oil. In Greenland it is targeted using longlines at 250–550 m depths. In the winter fishermen often use light to lure sharks to the surface where they tend to be extremely sluggish and offer little resistance. Individuals are occasionally caught as bycatch in squid trawl fisheries off the northeastern United States.

Primary Distribution Within the U.S. EEZ (Map 13) In the Atlantic Ocean from inshore coastal waters and embayments, except estuaries, out to 2,200 m, from the northern extent of the EEZ

boundary off New England south to Cape Cod, Mass., including the Gulf of Maine and Cape Cod Bay. Rare individuals have been found off New Jersey and Georgia.

Velvet dogfish *Scymnodon squamulosus*

The velvet dogfish is a little-known deepwater shark found in tropical to subtropical waters of the Atlantic, southwest Indian, and western Pacific Oceans. It is mesopelagic and benthopelagic over continental slopes at depths ranging from 39 to 2,200 m, but usually at depths between 400 m and 900 m (Yano and Tanaka, 1984; Wetherbee and Crow, 1996). In U.S. waters this species is found in the northern Gulf of Mexico in the vicinity of the Mississippi River Delta, and possibly off Puerto Rico and the Virgin Islands. *Scymnodon obscurus* is a frequently used synonym for this species (Yano and Tanaka, 1984; Wetherbee and Crow, 1996).

Biology Velvet dogfish feed on fishes and bottom invertebrates. Type of development is unknown. Males mature at 52 cm (21 in) and females at 75 cm (30 in) (Yano and Tanaka, 1984). The maximum reported size is 84 cm (34 in).

Fishing Velvet dogfish are infrequent bycatch in longline and trawl fisheries.

Primary Distribution Within the U.S. EEZ (Map 14) In the Gulf of Mexico in water depths of 400–900 m, from the Florida Panhandle east of DeSoto Canyon at 88.5°W, west to the Mississippi River Delta at 86.4°W.

Kitefin Sharks (Dalatiidae)

Kitefin shark *Dalatias licha*

The kitefin shark is a small, deepwater shark found worldwide, usually over the outer continental and insular shelf and slope at depths of 37–1,800 m, but mostly at depths below 200 m. This species is rarely found in U.S. waters—catches have been reported on Georges Bank, the Blake Plateau off Florida, the northern Gulf of Mexico off the Mississippi River Delta, and off Puerto Rico and the Virgin Islands. Catch records in the Mediterranean suggest that the kitefin is



Figure 6.—Cookie-cutter shark, *Isistius brasiliensis*. Photo: Karsten Hartel (Harvard Univ. specimen MCZ 60365).

primarily a solitary shark that does not exhibit schooling behavior.

Biology The kitefin shark is a versatile deep-sea predator that feeds on numerous bony fishes, rays, crabs, and squid. Adults tend to consume more crustaceans and sharks and fewer cephalopods than do juveniles, and in the spring and winter rely heavily on sharks as an alternative food source. Submersible observations indicate that this species is also likely to be a scavenger (Clark and Kristof, 1990). Development is ovoviviparous, with litters consisting of 10–16 pups. The gestation period is estimated to be two years (Silva, 1988), with pups measuring 42–45 cm (17–18 in) at birth (Silva, 1988). In the Azores, von Bertalanffy growth parameters were calculated as $L_{\infty} = 127$, $k = .198$, and $t_0 = -1.949$; Holden's method gave $L_{\infty} = 130$, $k = .195$, and $t_0 = -2.000$ for males and $L_{\infty} = 165$, $k = .147$, and $t_0 = -2.000$ for females (Silva, 1988). Males reach maturity at 77–121 cm (31–48 in) and females at 120 cm (47 in). Studies in the Azores indicate that there may be depth segregation by sex, with females peaking in abundance at a depth of 230 m and males peaking at 412–448 m (Silva,



Figure 7.—Cookie-cutter shark, *Isistius brasiliensis*. Photo: Karsten Hartel (Harvard Univ. specimen MCZ 60365).

1988). Average size and weight for the species is about 120 cm (47 in) and 8 kg (18 lb), respectively, with the largest specimen on record measuring 182 cm (72 in) (ICES, 1995).

Fishing The kitefin shark is usually taken in deepwater trawls or on longlines.

Primary Distribution Within the U.S. EEZ (Map 15) In the Atlantic Ocean and Gulf of Mexico in water depths of 200–1,800 m: in the Atlantic off Florida at 30.4°N, east out to the EEZ boundary, including the Blake Plateau, and south to the EEZ boundary; in the Gulf of Mexico from the Florida Panhandle east of DeSoto Canyon at 85.5°W, west to the Mississippi River Delta at 89°W; in the Caribbean Sea at depths of 200–1,800 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ.

Cookie-cutter shark *Isistius brasiliensis*

The cookie-cutter shark (Fig. 6, 7) inhabits deep waters of the tropical and subtropical belts of the Atlantic, Pacific, and Indian Oceans. It is a very small shark species, usually characterized as epipelagic to bathypelagic (caught anywhere from the surface down to 3,700 m) (Retzer, 1990; Compagno, 2002c). The reported captures come from the northern Gulf of Mexico (from Texas to

Alabama) and the area north of the Bahamas. However, it is also likely found off Puerto Rico and the Virgin Islands. Most catches occur after dark between the surface and 550 m, indicating a possible nighttime vertical migration from deeper water (Compagno, 2002c). The species is also thought to exhibit schooling behavior.

Biology The cookie-cutter shark has very powerful jaws and large teeth. It feeds extensively on large squid, but may also attack even larger prey. Evidence indicates that it feeds by taking bites from large pelagic fishes (tunas, wahoo, dolphin, marlins, etc.) as well as porpoises and whales. It has been suggested that the shark is able to grab a quick bite after being approached, and subsequently rejected, by larger animals in search of prey. The ventral surfaces of the head and body (except for the dark collar around the gill area), as well as the ventral fin surfaces, are luminescent and emit a bright greenish glow. The number of light organs is highly variable—some specimens may have very few or emit no light at all. Cookie-cutter shark development is presumed to be ovoviviparous. Six or seven large eggs have been reported from females, but embryos have not yet been reported. Females mature at 38–44 cm (15–18 in) and males are thought to reach maturity around 31–37 cm (12–15 in). The cookie-cutter shark ranges in size

from 14 to 50 cm (6–20 in); the largest on record is 50 cm (20 in).

Fishing The cookie-cutter shark is caught at the surface and in mid-water trawls after dark. It does not appear to be attracted to lights.

Primary Distribution Within the U.S. EEZ (Map 16) In the Atlantic Ocean and Gulf of Mexico in water depths of 200–3,700 m or out to the EEZ boundary, whichever is closer, extending from Cape Canaveral, Fla., at 28°N, south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Texas/Mexico border.

Bigtooth cookie-cutter shark
(also referred to as Largetooth
cookie-cutter shark)

Isistius plutodus

The bigtooth cookie-cutter shark is a very rare, small shark characterized as epipelagic to bathypelagic, caught at depths of 880–6,440 m. Only a few specimens are presently known, from Okinawa, Brazil, Australia, Sahara Republic, and the holotype caught in the Gulf of Mexico near the Mississippi River Delta (Compagno, 2002c).

Biology The habits of the bigtooth cookie-cutter shark are presumed to be similar to those of the cookie-cutter shark. However, its more powerful jaws, bigger mouth, and gigantic lower teeth (proportionately the largest of any living shark) enable it to take larger bites out of its prey. The holotype had a plug of fish flesh in its stomach. In addition, its short snout and anteriorly positioned eyes allow for binocular vision, and may be useful in locating prey. There are no data available on reproduction. The maximum known size of this species is 42 cm (17 in).

Fishing A bigtooth cookie-cutter shark specimen was caught in a mid-water trawl.

Primary Distribution Within the U.S. EEZ Available information is insufficient to determine primary distribution at this time.

Spined pygmy shark
(also referred to as Pygmy shark)
Squaliolus laticaudus

The spined pygmy shark is a minute, cigar-shaped shark. The species is wide

ranging worldwide, inhabiting temperate and tropical mesopelagic waters at depths ranging from 200 to 800 m (Glukhov and Kuzmichev, 1984). Pygmy sharks tend to undergo diurnal vertical migrations, migrating upward to depths of 200 m at night to feed. This species is known to occur in U.S. waters off Virginia, and in the northern Gulf of Mexico (McEachran and Fechhelm, 1998; Moore et al., 2003).

Biology The spined pygmy shark is known to feed on squid, lanternfishes, and lightfishes. Although embryos have not been observed, development is presumed to be ovoviviparous. Males reach maturity at 15–22 cm (6–9 in), while females mature at 17–20 cm (7–8 in). This shark is the smallest on record, with an average size of 15–22 cm (6–9 in) and a maximum size of about 27 cm (11 in).

Fishing The spined pygmy shark is caught in mid-water trawls at depths of 200–800 m.

Primary Distribution Within the U.S. EEZ Available information is insufficient to determine primary distribution at this time.

Gulper Sharks (Centrophoridae)

Gulper sharks are moderately sized sharks, on the order of 1–1.7 m (40–68 in) in length. This is a group in need of further taxonomic work. With potentially three undescribed species in U.S. waters, it is best for management purposes to lump all species of *Centrophorus* together until further information is available to aid in distinguishing all these species. The distributions appear to be similar enough so that four areas of concentration are found in U.S. waters: in the mid Atlantic Ocean, Gulf of Mexico, and Caribbean Sea, and off southern Florida.

Undescribed gulper shark #1
Centrophorus cf. acus

A possible new species of gulper shark similar to the Japanese gulper shark from the Pacific Ocean, *Centrophorus acus*, is found in the Caribbean Sea and Gulf of Mexico (McEachran and Fechhelm, 1998). At least two specimens are known from the Dry Tortugas. It is presumed to occur at depths below 200 m; specimens

in the Smithsonian are from depths of 732–915 m.

Biology No biological information is available until this species is distinguished from the Japanese gulper shark.

Fishery This species is taken with either trawls or longlines.

Primary Distribution Within the U.S. EEZ (Map 17) In the Caribbean Sea in water depths of 200–900 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ; in the Atlantic Ocean and Gulf of Mexico in water depths of 200–900 m: in the Atlantic off Virginia and North Carolina from 37.5°N extending south to 34.5°N, off southern Florida from 26.5°N extending south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Dry Tortugas at 83.8°W; in the Gulf of Mexico from the Florida Panhandle east of DeSoto Canyon at 85.3°W, extending west to the Mississippi River Delta at 90.5°W.

Gulper shark

Centrophorus granulosus

The gulper shark is a deepwater species found along the outermost continental shelves and upper slopes in the Atlantic, western Indian, and western Pacific Oceans. Specimens have been caught at depths of 100–1,200 m from the Carolinas in the Atlantic, to the Mississippi River Delta region in the northern Gulf of Mexico. This species is also abundant off Puerto Rico and the Virgin Islands (Russell et al., 1988). In the past, a number of other larger gulper shark species have been confused with this species.

Biology Development is ovoviviparous, with litters consisting of 4–6 pups that measure approximately 35 cm (14 in) at birth. Males mature at 85–92 cm (34–37 in) (Yano and Kugai, 1993). The maximum reported size is about 96 cm (38 in).

Fishing The gulper shark is usually caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 18) In the Caribbean Sea in water depths of 100–1,200 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ; in the Atlantic Ocean



Figure 8.—Large female Taiwan gulper shark, *Centrophorus niaukang*, from fishery survey catch at Norfolk Canyon in 1998. NMFS photo.

and Gulf of Mexico in water depths of 100–1,200 m: in the Atlantic off Virginia and North Carolina from 37.5°N, extending south to 34.5°N, off southern Florida from 26.5°N, extending south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Dry Tortugas at 83.8°W; in the Gulf of Mexico from the Florida Panhandle east of DeSoto Canyon at 85.3°W, extending west to the Mississippi River Delta at 90.5°W.

Undescribed gulper shark #2
(also referred to as Little gulper shark)
Centrophorus cf. harrissoni

The little gulper shark is a small, slender shark that inhabits waters of the continental slopes in the Gulf of Mexico and Caribbean Sea. Individuals have been collected in U.S. waters from the northeastern Gulf of Mexico (off northwestern Florida to Louisiana), in the Straits of Florida, and around Puerto Rico and the Virgin Islands. The typical depth range for this species is 200–800 m, although individuals have been reported in waters as shallow as 50 m and as deep as 1,400 m. This long-snouted species is most similar to the Australian dumb gulper shark, *Centrophorus harrissoni*, and has previously been reported as *Centrophorus uyato*, although this latter name is now considered invalid (Compagno²).

²Compagno, L. 1999. Personal commun., South African Museum, Cape Town.

Biology Given the present difficulty in defining the species, very little biological information is available. Diet consists of squid and bony fishes. Males mature at 81–94 cm (32–38 in) and females at 75–89 cm (30–36 in) (Yano and Kugai, 1993). The largest recorded length for a little gulper shark is 100 cm (39 in) (McEachran and Fechhelm, 1998).

Fishing The little gulper shark is caught with deepwater trawls and longlines.

Primary Distribution Within the U.S. EEZ (Map 19) In the Caribbean Sea in water depths of 200–800 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ; in the Atlantic Ocean and Gulf of Mexico in water depths of 200–800 m: in the Atlantic off Virginia and North Carolina from 37.5°N, extending south to 34.5°N, off southern Florida from 26.5°N, extending south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Dry Tortugas at 83.8°W; in the Gulf of Mexico from the Florida Panhandle east of DeSoto Canyon at 85.3°W, extending west to the Mississippi River Delta at 90.5°W.

Taiwan gulper shark
Centrophorus niaukang

The Taiwan gulper shark (Fig. 8–10) is a larger-bodied gulper shark distributed over the outer continental shelf and slope in the South China Sea, southwestern

Indian Ocean, and North Atlantic Ocean (Munoz-Chapuli and Ramos, 1989), typically occurring at depths of 200–900 m. In U.S. waters it has been caught at depths of 145–660 m within an area extending from Cape Hatteras, N.C., to just north of Norfolk Canyon off Virginia (Moore et al., 2003).

Biology Taiwan gulper sharks feed on bony fishes, skates, and squid. Development is ovoviviparous, with pups measuring 35–40 cm (14–16 in) at birth. Males mature at 110 cm (44 in) and females at 146 cm (58 in). The maximum reported size is 169 cm (68 in) (co-author J. A. Moore, personal observ.). Two records for U.S. waters involved captures of multiple individuals, 8 sharks just north of Cape Hatteras and 40 near the head of Norfolk Canyon. These appeared to be feeding aggregations in shallower water at night. One unique aspect to the U.S. captures of this species is that all 50 specimens have been mature, gravid females. Those captured in February and March contained eggs and very small embryos and those captured in September had embryos at various stages of development (17–40 cm, 8–16 in), including near-term pups (co-author J. A. Moore, personal observ.). Given that these groups are segregated by sex and all examined individuals were both large—no less than 149 cm (60 in)—and gravid, it may be that these groups represent breeding aggregations.



Figure 9.—Male near-term pup of Taiwan gulper shark, *Centrophorus niaukang*, from fishery survey catch at Norfolk Canyon in 1999. Photo: Jon Moore.

Fishing The Taiwan gulper shark is caught with deepwater trawls and long-lines. The large size of this species makes it an attractive fishery target in the eastern Atlantic and South China Sea.

Primary Distribution Within the U.S. EEZ (Map 20) In the Caribbean Sea in water depths of 150–700 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ; in the Atlantic Ocean and Gulf of Mexico in water depths of 150–700 m; in the Atlantic off Virginia and North Carolina from 37.5°N extending south to 34.5°N, off southern Florida from 26.5°N extending south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Dry Tortugas at 83.8°W; in the Gulf of Mexico from the Florida Panhandle east of DeSoto Canyon at 85.3°W extending west to the Mississippi River Delta at 90.5°W. Particularly important feeding and potential pupping grounds have been identified along the outer continental shelf and upper slope in the Atlantic in water depths of 150–700 m off Cape Hatteras, N.C., beginning at 36°N and extending to north of Norfolk Canyon to 37.3°N (Map 21).

Undescribed gulper shark #3
Centrophorus cf. tessellatus

A possible new species of gulper shark similar to the Pacific mosaic gulper shark, *Centrophorus tessellatus*, this species is found in the Caribbean Sea and Atlantic Ocean, and also in the Gulf of Mexico (McEachran and Fehhelm, 1998), where specimens are known from northwestern



Figure 10.—Female Taiwan gulper shark, *Centrophorus niaukang*, 158 cm long, from Norfolk Canyon at a depth of 460–660 m, captured off Virginia during NMFS cruise AL98-04. Photo: Jon Moore.

Florida to the Mississippi River Delta. It occurs at depths of 200–750 m.

Biology The maximum reported size is 89 cm (36 in). Virtually no other biological information is available until this species is distinguished from the Pacific mosaic gulper shark.

Fishery This species is taken with either trawls or longlines.

Primary Distribution Within the U.S. EEZ (Map 22) In the Caribbean Sea in water depths of 200–750 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ; in the Atlantic Ocean and Gulf of Mexico in water depths of 200–750 m; in the Atlantic off Virginia and North Carolina from 37.5°N, extending south to 34.5°N, off southern Florida from 26.5°N, extending south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Dry Tortugas at 83.8°W; in the Gulf of Mexico from the Florida Panhandle east of DeSoto Canyon at 85.3°W, extending west to the Mississippi River Delta at 90.5°W.

Arrowhead gulper shark
(also referred to as Dogfish,
flatnose dogfish)
Deania profundorum

The arrowhead gulper shark is a poorly known deepwater species, widely distributed in bottom waters of the upper continental slopes worldwide. In U.S. waters this species is caught off Virginia and North Carolina and also in the vicinity of the Mississippi River Delta. It has been reported at depths of 300–1,800 m (Compagno, 2002d).

Biology This species is known to feed on crustaceans, squid, and lanternfishes. Development is ovoviviparous, with 5–7 pups per litter. Males reach maturity at 43 cm (17 in) and females at about 70 cm (28 in). The average size is about 50 cm (20 in), although individuals can reach a maximum size of 76 cm (30 in).

Fishing The arrowhead gulper shark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 23) In the Atlantic Ocean

and Gulf of Mexico in water depths of 300–1,800 m: in the Atlantic off Virginia and North Carolina from 37.5°N, south to 34.5°N; in the Gulf of Mexico from the Florida Panhandle east of DeSoto Canyon at 85.3°W, extending west to the Mississippi River Delta at 90.5°W.

Spiny Dogfish Sharks (Squalidae)

Roughskin spiny dogfish
(also referred to as
Roughskin spurdog)
Cirrhigaleus asper

The roughskin spiny dogfish is widely distributed in tropical to subtropical waters 200–650 m deep over the upper continental slope (Compagno, 2002e). Most specimens have been isolated captures off North Carolina south to Florida, in the northern Gulf of Mexico, or around Puerto Rico and the Virgin Islands.

Biology The roughskin spiny dogfish is a poorly known species. Its diet includes squid and small fishes. Development is ovoviviparous, with litters of 10–22 pups reported. Although size at maturity has not been determined, specimens 85 cm (33 in) long have been reported as mature. The average size is around 90 cm (35 in), although individuals can reach at least 118 cm (46 in) (Compagno, 2002e).

Fishing The roughskin spiny dogfish has been caught with both hook and line and trawling gear in deep waters.

Primary Distribution Within the U.S. EEZ Available information is insufficient to determine primary distribution at this time.

Cuban dogfish
Squalus cubensis

The Cuban dogfish inhabits tropical to subtropical waters of the western Atlantic Ocean. In U.S. waters it is very abundant throughout the Gulf of Mexico, along the Atlantic coast from Florida to North Carolina, and around Puerto Rico and the Virgin Islands (Russell et al, 1988). It is a bottom-dwelling species found along the continental shelf and uppermost slopes, forming dense schools at depths of 100–400 m (Compagno, 2002e).

Biology The habits and diet of this shark have not yet been reported. Some

depth segregation by size has been reported, with smaller, younger individuals found in shallower water than were the adults. Development is ovoviviparous, with observed litters of 10 embryos. Maturity is reached at 50 cm (20 in). The average size is 75 cm (30 in), although individuals can reach 110 cm (43 in) (Compagno, 2002e).

Fishing The Cuban dogfish is caught in bottom trawls at depths greater than 50 m. It is harvested for its liver, which is used in the production of oil and vitamins.

Primary Distribution Within the U.S. EEZ (Map 24) In the Caribbean Sea in water depths of 100–400 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ; in the Atlantic Ocean and Gulf of Mexico in water depths of 100–400 m: in the Atlantic extending from Cape Hatteras, N.C., south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Texas/Mexico border.

Shortspine dogfish (also referred to as Shortspine spurdog)
Squalus mitsukurii

Shortspine dogfish are found throughout deep tropical and temperate waters along the continental shelves and upper slopes. Catches have been reported from North Carolina to Florida, throughout the Gulf of Mexico, and off Puerto Rico and the Virgin Islands. This species is taken typically by bottom trawls at depths ranging from 100–750 m. It is often misidentified as *Squalus blainvillei*, which is now considered an invalid name (Compagno, 2002e). There is some question, however, as to whether *Squalus mitsukurii* represents a single widespread species or a complex of several species.

Biology The diet of the shortspine dogfish includes crustaceans, squid, and small fishes. Development is ovoviviparous with a two-year gestation period. Litters typically consist of 2–15 pups that measure 22–26 cm (9–10 in) at birth and reach maturity at 60–70 cm (24–28 in). The average size is about 75 cm (30 in), although individuals can reach 125 cm (50 in) (Compagno, 2002e).

Fishing Shortspine dogfish are usually caught in mid-water or bottom trawls.

Primary Distribution Within the U.S. EEZ (Map 25) In the Caribbean Sea in water depths of 100–750 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ; in the Atlantic Ocean and Gulf of Mexico in water depths of 100–750 m: in the Atlantic extending from Cape Hatteras, N.C., at 35°N, south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Texas/Mexico border.

Sawsharks (Pristiophoridae)

American sawshark (also referred to as Bahama sawshark)
Pristiophorus schroederi

The American sawshark is a poorly known deepwater species, inhabiting waters of the continental and insular slopes. It is known only from waters off southeast Florida, Cuba, and the Bahamas (Compagno, 2002f). Catches have occurred at water depths of 400–1,000 m.

Biology The American sawshark is easily recognized by its snout, which is prolonged into a long flat blade. The snout is equipped with teeth, actually enlarged dermal denticles, on each side and two long barbels on the underside. The American sawshark is not to be confused with the sawfish, the latter being a shark-like ray of the batoid family Pristidae. However, the sawshark may use its saw to stun and disable prey just as sawfishes do. Development is assumed to be ovoviviparous and newborns measure 30 cm (12 in). The largest American sawshark specimen was recorded at 81 cm (32 in).

Fishing The American sawshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 26) In the Atlantic Ocean and Gulf of Mexico in water depths of 400–1,000 m: in the South Atlantic extending from Jupiter Inlet, Fla., at 27°N, south around Florida, including the Straits of Florida, and west to the Dry Tortugas at 83.4°W.



Figure 11.—Live shot of an *Apristurus* catshark, most likely the ghost catshark, *Apristurus manis*, taken at Manning Seamount. Video frame-grab from the 2003 Mountains in the Sea cruise. Photo: Mountains in the Sea research group.

Catsharks (Scyliorhinidae)

Hoary catshark

Apristurus canutus

This poorly known deepwater shark was not described until 1979. The species is benthic, occurring along continental and insular slopes in the Caribbean Sea and in the Straits of Florida. Most specimens have been accidental captures from West Indian waters 500–1,000 m deep. Captures of this species in U.S. waters are limited to the Straits of Florida and around Puerto Rico and the Virgin Islands.

Biology Males mature at 39 cm (16 in), while the maximum size is 46 cm (18 in). No other information is available.

Fishing The hoary catshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 27) In the Atlantic Ocean and Gulf of Mexico in water depths of 500–1,000 m: in the Atlantic extending from Jupiter Inlet, Fla., at 27°N, south around Florida, including the Straits of Florida, and west to the Dry Tortugas at 83.4°W.

Ghost catshark

Apristurus manis

This poorly known deepwater shark (Fig. 11, 12) was not described until 1979. It is a benthic dweller on the continental slopes of Britain and New England. Most specimens have been accidental captures in waters 600–1,900 m



Figure 12.—Ghost catshark pup, *Apristurus manis*, from seamount top at depth of 1128–1804 m 2000. Bear Seamount cruise DE00-11. Photo: Jon Moore (Harvard Univ. specimen MCZ 158897).

deep. Captures of this species in U.S. waters are limited to the continental slope between Block Canyon off southern New England and the northern boundary of the EEZ, and also on Bear Seamount (Moore et al., 2003). Very little biological information is available for this species.

Biology Development is oviparous, i.e. eggs are laid enclosed in leathery cases. Size at maturity is estimated at 70 cm (28 in) (Nakaya and Stehmann, 1998), while the maximum size is 88 cm (35 in) (co-author J. A. Moore, pers. observ.). No other information is available for this species.

Fishing The ghost catshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 28) In the Atlantic Ocean in water depths of 600–1,900 m off southern New England and Long Island, along the continental slope from Block Canyon to Veatch Canyon. However, specimens have been found up to the northern boundary of the EEZ, and also on Bear Seamount. In the future, what is considered primary distribution for the species may be extended to the EEZ boundary.

Smalleye catshark

Apristurus microps

This deepwater shark was previously known from Newfoundland and the temperate eastern Atlantic Ocean. Most specimens have been accidental captures in waters 1,000–2,200 m deep off Great Britain and South Africa (Nakaya and Stehmann, 1998). Capture of this species in U.S. waters is limited to a single specimen taken

near Veatch Canyon, off Massachusetts (Nakaya and Stehmann, 1998; Moore et al., 2003).

Biology Development is presumably oviparous. Size at maturity is estimated at 70 cm (28 in) although the maximum reported size is 73 cm (29 in) (Nakaya and Stehmann, 1998). No other information is available for this species.

Fishing The smalleye catshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ Available information is insufficient to determine primary distribution at this time.

Smallfin catshark

Apristurus parvipinnis

The smallfin catshark is benthic along the upper continental and insular slopes of the Gulf of Mexico and the Caribbean Sea. In U.S. waters it is commonly found in deep waters of the Straits of Florida and Gulf of Mexico where specimens have been collected at depths ranging from 600 to 1,200 m. It may possibly be present around Puerto Rico and the Virgin Islands.

Biology Development is oviparous. The average size is 45–50 cm (18–20 in), although the maximum known size is 52 cm (21 in). No other information is available.

Fishing The smallfin catshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 29) In the Atlantic Ocean and Gulf of Mexico in water depths of 600–1,200 m: in the Atlantic extending from Ft. Lauderdale, Fla., at 26.6°N, south around Florida, including the Straits



Figure 13.—Deepwater catshark, *Apristurus profundorum*, (top) compared to ghost catshark, *Apristurus manis* (bottom) taken on 2004 Bear Seamount cruise DE04-09 from seamount top at depth of 1110–1284 m. Photo: Jon Moore.

of Florida, and into the Gulf of Mexico west to the Texas/Mexico border.

Deepwater catshark
Apristurus profundorum

This poorly known, but not uncommon, deepwater shark (Fig. 13) is in need of re-description to aid in distinguishing it from other species within this genus. Several features, such as velvety texture to the denticles, no enlarged denticles at the base of the anal and second dorsal fins, wider and shorter snout, smaller dorsal fins, and squared off posterior edges to the pectoral and anal fins, all help distinguish this species from the ghost cat shark, *Apristurus manis*, the more common *Apristurus* species off New England. Capture of this species in U.S. waters is limited to the holotype taken near Hudson Canyon, a specimen from Block Canyon, and several individuals taken from Bear Seamount (Moore et al., 2003). It is caught in water depths of 1,100–1,750 m.

Biology Virtually no biological information is available for this species. The holotype is a subadult male 51 cm (20 in) long and maximum size known is 59 cm.

Fishing The deepwater catshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ In the Atlantic Ocean in water depths of 1,100–1,750 m, in Hudson Canyon, along the continental slope to Block Canyon, and also on Bear Seamount.

Broadgill catshark
Apristurus riveri

This is another poorly known deepwater shark. It is a benthic species, occurring along continental and insular slopes in water depths of 700–1,500 m. The species ranges from Florida, Cuba, and Hispaniola to the northern Gulf of Mexico and along the Central American coast south to Venezuela (Compagno, 2002g). Captures of this species in U.S. waters are limited to the Straits of Florida and eastern Gulf of Mexico west to the Mississippi River Delta. This species is also likely to be present around Puerto Rico and the Virgin Islands.

Biology Little is known of the habits of the broadgill catshark. Development is oviparous and egg cases are smooth-surfaced, translucent, greenish with indistinct bands of lighter color, measuring about 5.5 cm (2 in) long by 1.3 cm (0.5 in) wide. Females are believed to mature at 40 cm (16 in) and males at a slightly

larger size. The average adult size is 42 cm (17 in), with the largest recorded specimen measuring 48 cm (19 in).

Fishing The broadgill catshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 30) In the Gulf of Mexico in water depths of 700–1,500 m, from the Straits of Florida at 79.8°W, extending west to the Mississippi River Delta at 89.4°W.

Undescribed catshark
Apristurus cf. laurussoni

Although this species is commonly caught off the United States, many authors have incorrectly identified this undescribed species of deepwater shark as the Iceland catshark, *Apristurus laurussoni*, which it closely resembles (Nakaya³). This undescribed species is found along the U.S. east coast, in the Gulf of Mexico, and in the Caribbean Sea off the coasts of Honduras and Venezuela (Nakaya and Sato, 1998). It currently is under study by K. Nakaya. This species is benthic, usually over mud or other soft bottoms, along the continental slopes in

³Nakaya, K. 1999. Personal commun., Hokkaido Univ., Lab. Mar. Zoology, Japan.

water depths of 700–1,500 m. Captures of this species in U.S. waters occur off Massachusetts and Delaware, and throughout the entire northern Gulf of Mexico from Florida to Texas (Compagno, 2002g; Moore et al., 2003).

Biology Very little biological information is available for this species. Development is oviparous (Nakaya and Sato, 1998). The maximum reported size is 68 cm (27 in).

Fishing This species of catshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 31) In the Atlantic Ocean and Gulf of Mexico in water depths of 700–1,500 m throughout the entire EEZ, from the northern extent of the EEZ boundary off New England, south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Texas/Mexico border.

Antillean roughtail catshark *Galeus antillensis*

This small shark was formerly considered a subspecies of the marbled catshark, *Galeus arae*, but has recently been elevated to full species status. The species is benthic on West Indian insular slopes at depths of 150–700 m. Captures in U.S. waters are limited to areas off Puerto Rico and the Virgin Islands.

Biology Very little biological information is available. Development is oviparous. Size at maturity is greater than 35 cm (14 in), the maximum reported size being 46 cm (18 in) (Konstantinou and Cozzi, 1998).

Fishing The Antillean roughtail catshark is caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 32) In the Caribbean Sea in water depths of 150–700 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ.

Marbled catshark (also referred to as Roughtail catshark) *Galeus arae*

The marbled catshark is a small, slender shark that is benthic along the continental slope from North Carolina southward through the northeastern Gulf of Mexico and along the Central American

coast from Belize to Nicaragua (Compagno, 2002g). It is common throughout its range, although distribution is irregular, and inhabits waters 250–750 m deep with a temperature range of 6–11°C (43–52°F) (Springer, 1979). Adults have been found to reside in deeper water than do juveniles. The occurrence of this species in U.S. waters is in the Atlantic Ocean from North Carolina south to Florida, along the Gulf coast of Florida, and, rarely, west of Pensacola to the Mississippi River Delta (Compagno, 2002g).

Biology The marbled catshark feeds on various species of deepwater shrimp. Type of development has not yet been determined, but is believed to be ovoviparous due to the presence of eggs without cases found inside a female. Gravid females are very seldom seen, although large numbers of females have been caught. Maturity is reached at about 27 cm (11 in), with the average size approximately 35 cm (14 in). The maximum size is estimated at 40 cm (16 in).

Fishing The marbled catshark is usually caught in deepwater shrimp trawls.

Primary Distribution Within the U.S. EEZ (Map 33) In the Atlantic Ocean and the Gulf of Mexico in water depths of 250–750 m: in the Atlantic from Cape Hatteras, N.C., at 36°N, extending south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Mississippi River Delta at 90°W.

Striped sawtail catshark *Galeus springeri*

This recently described, small shark was formerly confused with the Antillean roughtail catshark, *Galeus antillensis*, with which it co-occurs (Konstantinou and Cozzi, 1998). The species is a benthic dweller on West Indian insular slopes in water depths of 450–700 m (Konstantinou and Cozzi, 1998). Captures of this species in U.S. waters are limited to Puerto Rico, although it most likely also occurs off the Virgin Islands.

Biology Development is oviparous. All captured males have been immature; one female, at 43 cm (17 in), was gravid. The maximum reported size is 44 cm (18 in) (Konstantinou and Cozzi, 1998). Little else is known about its biology.

Fishing The striped sawtail catshark is usually caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 34) In the Caribbean Sea in water depths of 450–700 m surrounding Puerto Rico and probably the U.S. Virgin Islands, extending east and west to the limits of the EEZ

Boa catshark *Scyliorhinus boa*

Even though this deepwater shark was described over 100 years ago, less than two dozen specimens exist, and the biology of this species is still very poorly known. This species is a benthic dweller in water depths of 200–700 m in the Caribbean Sea along the continental slope from Honduras south to Surinam, and also off the West Indian islands (Hispaniola, Jamaica, Puerto Rico, Lesser Antilles, and Barbados). Captures of this species in U.S. waters are limited to Puerto Rico, although it most likely also occurs off the Virgin Islands.

Biology A male was reportedly mature at 35 cm (14 in) (Springer, 1966). Development is probably oviparous, but little is known about the reproduction and biology of this species. The maximum size is 54 cm (22 in).

Fishing The boa catshark is usually caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 35) In the Caribbean Sea in water depths of 200–700 m surrounding Puerto Rico and probably the U.S. Virgin Islands, extending east and west to the limits of the EEZ.

Blotched catshark *Scyliorhinus meadi*

This small benthic shark is taken from upper continental slope waters at depths of 300–600 m, ranging from offshore of North Carolina to Florida, the Santaren Channel, and the Bahamas (Burgess et al., 1979). In U.S. waters, captures of this species occur off North Carolina south to the Straits of Florida.

Biology The few specimens collected have all been immature, ranging from 18 to 49 cm (7–19 in). Diet consists of cephalopods, shrimps, euphausiids, and bony fishes (Burgess et al., 1979; Parsons, 1985). Development is prob-

ably oviparous, but little is known about the reproduction and biology of this species.

Fishing The blotched catshark is usually caught in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 36) In the Atlantic Ocean and Gulf of Mexico in water depths of 300–600 m: in the Atlantic extending from Cape Fear, N.C., south around Florida, including the Straits of Florida, and west to the Dry Tortugas at 83.5°W.

Chain dogfish

(also referred to as Chain catshark)

Scyliorhinus retifer

The chain dogfish is a small, slender catshark that ranges from Georges Bank, off New England, to Nicaragua, including the entire Gulf of Mexico. It is a benthic species found along the continental shelf and slope at depths of 50–750 m (Sminkey and Tabit, 1992), usually in temperatures near 8.5–11°C (47–52°F), although nursery areas can be as cold as 7.4°C (Castro et al., 1988). The species appears to be most abundant in deep waters off Virginia and North Carolina. It is often taken in shallower water (50–220 m) in the northern parts of the range, but more often inhabits deeper waters (230–450 m or more) south of Cape Hatteras (Able and Flescher, 1991; Castro et al., 1988). Submersible observations have found individuals in contact with bottom structures (e.g. cerianthid anemones, boulders, and coils of cable) (Able and Flescher, 1991).

Biology Diet consists of (in descending order) crustaceans, annelid worms, squid, and bony fishes, which make up 90% of the food ingested (NMFS⁴). There may be geographic differences in size at maturity: sharks off Virginia and north were found to mature at 38–39 cm (15–16 in) (Able and Flescher, 1991; Sminkey and Tabit, 1992), while sharks off Florida and South Carolina matured at 50–52 cm (20–21 in) (Castro et al., 1988). Development is oviparous. Egg cases are 5–6 cm (2 in) long by 2 cm (0.9 in) wide,

brownish/amber in color, and possess a long tendril at each corner, which wraps around bottom structures (e.g. hydroid colonies, soft corals, lost fishing nets). These bottom structures are utilized by a number of egg-laying individuals—a hydroid colony from Washington Canyon was found with as many as 300 eggs attached, and an abandoned trawl recovered from Hudson Canyon similarly had many eggs attached (Able and Flescher, 1991). Eggs are laid in pairs at the rate of one pair every 14–17 days (Castro et al., 1988). Incubation time is estimated at about one year (Castro et al., 1988). One trawl off Nags Head, N.C., produced a large number of newly hatched or small chain dogfish, suggesting that nursery areas may be highly localized. The pups measure about 10 cm (3.9 in) at hatching, and (in the laboratory) grow 0.18–0.22 mm/day during the first two years (Castro et al., 1988). The average size is about 38 cm (15 in). The largest recorded chain dogfish measured 59 cm (24 in) (Castro et al., 1988).

Fishing The chain dogfish is taken by trawling in water depths greater than 75 m and at temperatures around 10°C (50°F).

Primary Distribution Within the U.S. EEZ (Map 37) In the Atlantic Ocean and Gulf of Mexico in water depths of 50–750 m throughout the entire EEZ, from the northern extent of the EEZ boundary off New England south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Texas/Mexico border.

Dwarf catshark

Scyliorhinus torrei

The dwarf catshark is a small, slender shark known from off the southeast coast of Florida, the Bahamas, Cuba, Puerto Rico, and the Virgin Islands. It is a benthic species along the upper continental slope, and has been caught at depths of 200–600 m. Captures in U.S. waters are limited to southeastern Florida, Puerto Rico, and the Virgin Islands.

Biology Analysis of stomach contents indicates a diet of squid and possibly cuttlefish. Nothing else is known about its habits and reproduction, as neither eggs nor newly hatched pups have been

observed. Size at maturity is 26 cm (10 in), while the largest recorded dwarf catshark measured 32 cm (13 in).

Fishing The dwarf catshark is caught only in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 38) In the Caribbean Sea in water depths of 200–600 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the EEZ; in the Atlantic Ocean and Gulf of Mexico in water depths of 200–600 m: extending from Jupiter Inlet, Fla., at 27°N, south around Florida, including the Straits of Florida, and west to the Dry Tortugas at 83.4°W.

Ribbontail Catsharks (Proscyllidae)

Cuban ribbontail catshark

Eridacnis barbouri

This species is taken as accidental captures from the upper continental slope in water depths of 400–650 m, off southern Florida, the Bahamas, and Cuba (Compagno, 2002h). This is one of the smallest shark species known and rivals the minute size of the spined pygmy shark. *Triakis barbouri* is a frequently used synonym of this species.

Biology Size at maturity is 27–28 cm (11 in). Development is ovoviviparous with two pups (one per oviduct), which are 10 cm (4 in) at birth. The maximum reported size is 34 cm (14 in). Almost nothing else is known about the biology of this species.

Fishing The Cuban ribbontail catshark is caught only in deepwater trawls.

Primary Distribution Within the U.S. EEZ (Map 39) In the Atlantic Ocean and Gulf of Mexico in water depths of 400–650 m: in the South Atlantic extending from Cape Canaveral, Fla., at 28°N, south around Florida, including the Straits of Florida, into the Gulf of Mexico to 81.5°W.

False Catsharks (Pseudotriakidae)

False catshark

Pseudotriakis microdon

This large deepwater shark is apparently wide-ranging in the Atlantic, Pacific, and Indian Oceans, but records

⁴Unpublished data on file at the Food Web Dynamics Program, NOAA, NMFS, NEFSC, Woods Hole Lab., 166 Water St., Woods Hole, MA 02543.



Figure 14.—Frill shark, *Chlamydoselachus anguineus*, specimen cited in Moore et al. (2003) checklist, from southern New England slope. Photo: Rob Nawojchik (Harvard Univ. specimen MCZ 153745).

of captures are sparsely distributed and it is uncommon to rare where it does occur (Compagno, 1988). This species is usually taken as accidental captures on the upper continental slope in water depths of 200–1,500 m, although it occasionally ventures inshore (Compagno, 1988). It typically is benthic over continental and insular slopes. The only records of this species in U.S. waters are single specimens—one that washed ashore at Amagansett, Long Island, N.Y., in 1883 (Goode and Bean, 1896) and another that swam into a nearshore pound net in Manasquam, N.J., in 1936 (Bigelow and Schroeder, 1953). *Scyliorhinus licha* is an older name for this species.

Biology The diet of this species consists of mostly bony fishes and cephalopods (Yano and Musick, 1992). Males mature at 260 cm (104 in) (Yano, 1992), and females at 212 cm (85 in). Development is ovoviviparous, with two embryos produced. Pups are 120 cm (48 in) at birth (Yano, 1992). The maximum recorded size is 296 cm (118 in) (Yano and Musick, 1992).

Fishing The false catshark is usually caught on longlines, but occasionally swims into pound nets.

Primary Distribution Within the U.S. EEZ Available information is insufficient to determine primary distribution at this time.

Frill Sharks (Chlamydoselachidae)

Frill shark

Chlamydoselachus anguineus

The frill shark (Fig. 14, 15) is a relatively rare deepwater shark, usually benthopelagic, occurring in water depths

of 100–1,300 m, but sometimes in shallower, inshore waters (Compagno, 2002i). It is widely distributed but sparsely occurring in the eastern Atlantic Ocean from Norway to Mauritania and from Angola to South Africa, and in the Pacific Ocean from Chile, southern California, Japan, New South Wales, and New Zealand. In the western Atlantic it is found off Suriname and French Guiana and south of Massachusetts. The sole capture in U.S. waters is the specimen from the continental slope south of Martha's Vineyard, Mass. (Moore et al., 2003).

Biology The diet of this shark consists of cephalopods, other sharks, and bony fishes (Kubota et al., 1991; Compagno, 2002i). Males mature at 97 cm (39 in) and females at 135 cm (54 in). Development is ovoviviparous, with 2–12 embryos produced (Tanaka et al., 1990; Compagno, 2002i). The gestation period may be 3.5 years (Tanaka et al., 1990), with the pups measuring 55 cm (22 in) at birth (Tanaka et al., 1990). The maximum recorded size is 196 cm (78 in) (Compagno, 2002i).

Fishing The frill shark is usually caught on longlines.

Primary Distribution Within the U.S. EEZ Available information is insufficient to determine primary distribution at this time.

Smoothhound Sharks (Triakidae)

Smooth dogfish (also referred to as Dusky smoothhound)

Mustelus canis canis

In North American waters the range of the smooth dogfish encompasses the



Figure 15.—Frill shark head, *Chlamydoselachus anguineus*, specimen cited in Moore et al. (2003) checklist, from southern New England slope. Photo: Rob Nawojchik (Harvard Univ. specimen MCZ 153745).

Bay of Fundy (only the occasional rare stray) to Florida as well as the Gulf of Mexico. This is a common shark in bays and inshore waters, usually found at depths of less than 20 m. It is frequently encountered from Cape Cod, Mass., to Charleston, S.C., where it is the second most abundant shark after the spiny dogfish, *Squalus acanthias*. This subspecies prefers muddy or sandy bottoms. There is some evidence that this species is divided into several discrete populations. The most well known population ranges from the Carolinas north along the coast to New England and southern Canada. The species is relatively uncommon between North Carolina and Florida but can be found in abundance off the Florida coast. In addition, smooth dogfish catches occur frequently in many areas of the Gulf of Mexico and the Caribbean Sea. Off the Atlantic coast the species migrates in response to changes in water temperature, moving from north to south and inshore to offshore with the seasons. Its range of bottom temperatures in the Mid-

Atlantic Bight is 5.3–27.7°C, with most captures from waters with temperatures of 10–22°C (NMFS⁵). Individuals winter primarily in the area between southern North Carolina and the Chesapeake Bay, moving up the coast to New England in the spring. Unpublished NMFS data⁵ also show that some individuals are in deeper waters (80–460 m) off New York and New England during the winter.

Biology The smooth dogfish has a very slender body and a prominent spiracle behind the eye. The species feeds primarily on crustaceans (72%), including crabs, lobsters, and shrimp (NMFS⁴). Other prey includes molluscs (7%), fishes (4%), squid (3%), and worms (2%) (NMFS⁴). However, the smooth dogfish is both an opportunistic feeder and a scavenger and will consume whatever prey is easily available. It is primarily nocturnal and tends to be a very active shark, constantly patrolling the bottom for food. Development is viviparous; i.e. embryos develop in the uterus, initially dependent on stored yolk, and are later nourished by the mother through a placental connection. This species enters bays and estuaries, which serve as nursery grounds for young of the year (Rountree and Able, 1996). Pups measure 34–39 cm (13–15 in) at birth, with litters usually consisting of 4–20 pups (Heemstra, 1997). The gestation period lasts about ten months and most births occur in early summer. The growth rate of this species is believed to be very fast, with maturation occurring after only one or two years and at a size of 82–90 cm (33–36 in). Although the average size is about 122 cm (48 in), individuals as large as 155 cm (62 in) have been reported.

Fishing The smooth dogfish is easily taken with hook and line using squid or shrimp bait. Because of its abundance, it interferes with shrimp trawling operations and affects crab and lobster stocks. It is often caught in large numbers by shrimp trawlers. The species is extensively used as a laboratory animal and often displayed in aquaria.

⁵Unpublished data on file at the Ecosystems Surveys Branch, NOAA, NMFS, NEFSC, Woods Hole Lab., 166 Water St., Woods Hole, MA 02543.

Primary Distribution Within the U.S. EEZ (Map 40) In the Atlantic Ocean and Gulf of Mexico in waters ranging from shallow estuaries and inshore areas out to a depth of 450 m, throughout the entire EEZ, from the northern extent of the EEZ boundary off New England south around Florida, including the Straits of Florida, and into the Gulf of Mexico west to the Texas/Mexico border.

Antillean smoothhound *Mustelus canis insularis*

This is a relatively common deepwater shark found around islands in the Caribbean Sea. The subspecies is found from Barbados to Cuba, the Bahamas, and Bermuda in water depths of 100–800 m (Heemstra, 1997). Captures in U.S. waters are limited to Puerto Rico and the Virgin Islands, where it is abundant (Russell et al., 1988). This subspecies prefers rugged bottoms, in contrast to the continental subspecies (Heemstra, 1997).

Biology Development is viviparous, with pups measuring 34 cm (13 in) at birth (Heemstra, 1997). Maturation occurs at a size of 80–90 cm (32–36 in). The maximum reported size is 117 cm (47 in) (Heemstra, 1997).

Fishing The Antillean smoothhound is easily taken with hook and line using squid or shrimp bait. It is often caught in large numbers by trawlers. A fishery exists for this subspecies off Cuba.

Primary Distribution Within the U.S. EEZ (Map 41) In the Caribbean Sea in water depths of 100–800 m surrounding Puerto Rico and the U.S. Virgin Islands, extending east and west to the limits of the U.S. EEZ.

Smalleye smoothhound *Mustelus higmani*

A small, active shark (the smallest smoothhound species in U.S. waters), the smalleye smoothhound is found mainly off northern South America, occurring from close inshore to a depth of 900 m (Heemstra, 1997). The species also enters brackish estuaries and lagoons (Compagno, 2002j). Capture in U.S. waters is limited to one specimen taken in the northern Gulf of Mexico off Florida.

Biology The diet of this shark consists mainly of crustaceans, but also cephalopods and fishes (Compagno, 2002j). Development is viviparous, with litters of 1–7 pups, which measure 21–24 cm (8–10 in) at birth. Maturation occurs at a size of 43–48 cm (17–19 in) (Heemstra, 1997). The maximum reported size is 64 cm (26 in) (Heemstra, 1997).

Fishing The smalleye smoothhound is easily taken with hook and line using squid or shrimp bait. It is also caught by trawlers.

Primary Distribution Within the U.S. EEZ Available information is insufficient to determine primary distribution at this time.

Florida smoothhound (also referred to as Narrowfin smoothhound)
Mustelus norrisi

The very slender Florida smoothhound is usually found in shallow coastal waters with sand or mud bottoms. The species typically moves inshore to waters 5–7 m deep or less during the winter months, although specimens have been caught in waters as deep as 100 m. Off Florida this species moves offshore (>55 m) between May and October (Heemstra, 1997). The Florida smoothhound is common along the west coast of Florida, off Texas, and also in the southern Caribbean Sea and the western Atlantic Ocean south to Brazil (Heemstra, 1997).

Biology This smoothhound feeds on crabs, shrimp, and small fishes. Development is viviparous, with litters in late winter or early spring usually consisting of 7–14 pups that measure 30 cm (12 in) at birth. Males reach maturity at about 58 cm (23 in) and females at 65 cm (26 in). The average size is 75 cm (30 in) for males and 90 cm (35 in) for females, although individuals exceeding 100 cm (39 in) have been reported (Heemstra, 1997).

Fishing The Florida smoothhound is often taken in nets, usually very close to shore.

Primary Distribution Within the U.S. EEZ (Map 42) In the Gulf of Mexico in waters ranging from shallow estuaries and inshore areas out to a depth of 100 m throughout the EEZ from and including

the Straits of Florida, west to the Texas/Mexico border.

Gulf smoothhound *Mustelus sinuatus*

This is an active offshore shark found along the Gulf of Mexico coast on the outer shelf. The species is known to occur at water depths of 30–250 m (Heemstra, 1997), although most records are from waters 42–91 m deep (Compagno, 2002j). Captures in U.S. waters occur from Panama City, Fla., to Texas.

Biology Development is viviparous, with litters of 8 pups, which measure 39–43 cm (16–17 in) at birth. Maturation occurs at a size of 80 cm (32 in), although the maximum reported size is 140 cm (56 in).

Fishing The gulf smoothhound is easily taken with hook and line using squid or shrimp bait. It is also caught by trawlers.

Primary Distribution Within the U.S. EEZ (Map 43) In the Gulf of Mexico in waters ranging from shallow estuaries and inshore areas out to a depth of 100 m: from Panama City, Fla., at 86°W, west to the Texas/Mexico border.

Sand Tiger Sharks (Odontaspidae)

Ragged-tooth shark (also referred to as Smalltooth sand tiger shark)
Odontaspis ferox

This is a large deepwater shark found over continental and insular shelves and upper slopes in water depths of 13–420 m. Although it is widely distributed and nearly cosmopolitan, it is rarely captured. The one U.S. record is a single specimen taken off North Carolina (Sheehan, 1998).

Biology Very little biological information is available for this species. Its diet consists of small bony fishes, squid, and shrimp. Young measure 105 cm (42 in) at birth. Males mature at 275 cm (110 in), although the maximum reported size is 360 cm (144 in).

Fishing Ragged-tooth sharks are caught with hook and line and in trawls.

Primary Distribution Within the U.S. EEZ Available information is insufficient to determine primary distribution at this time.

Acknowledgments

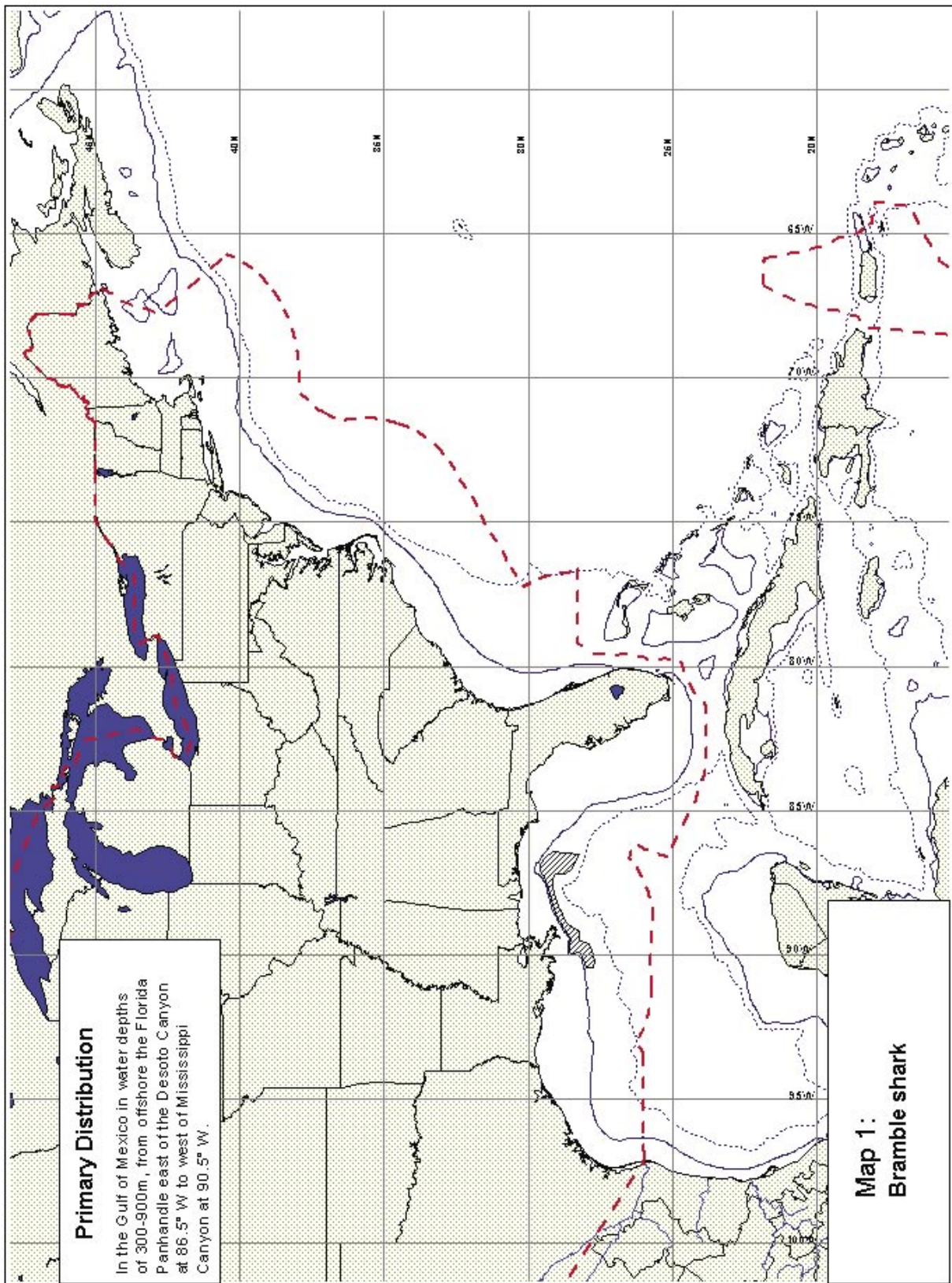
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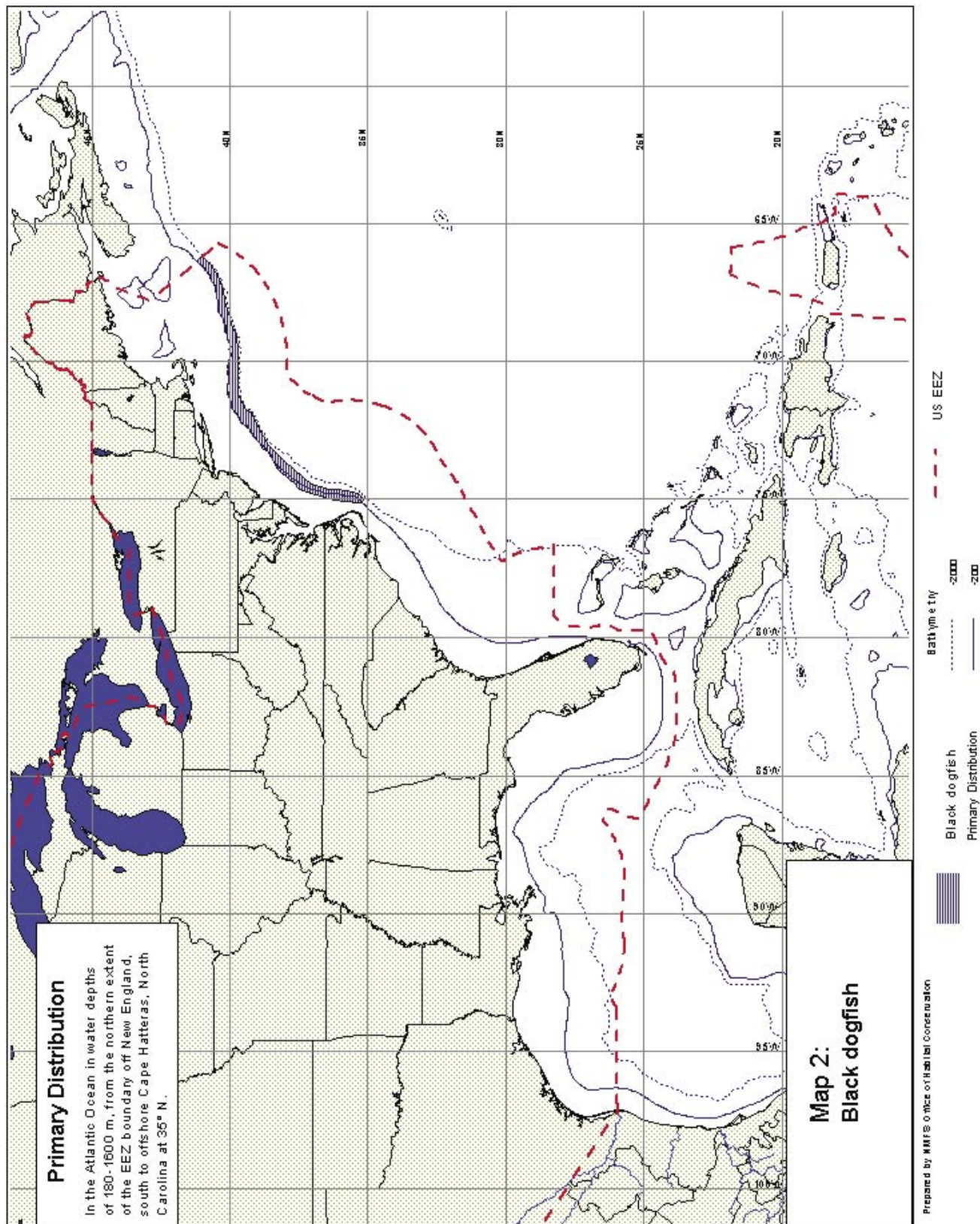
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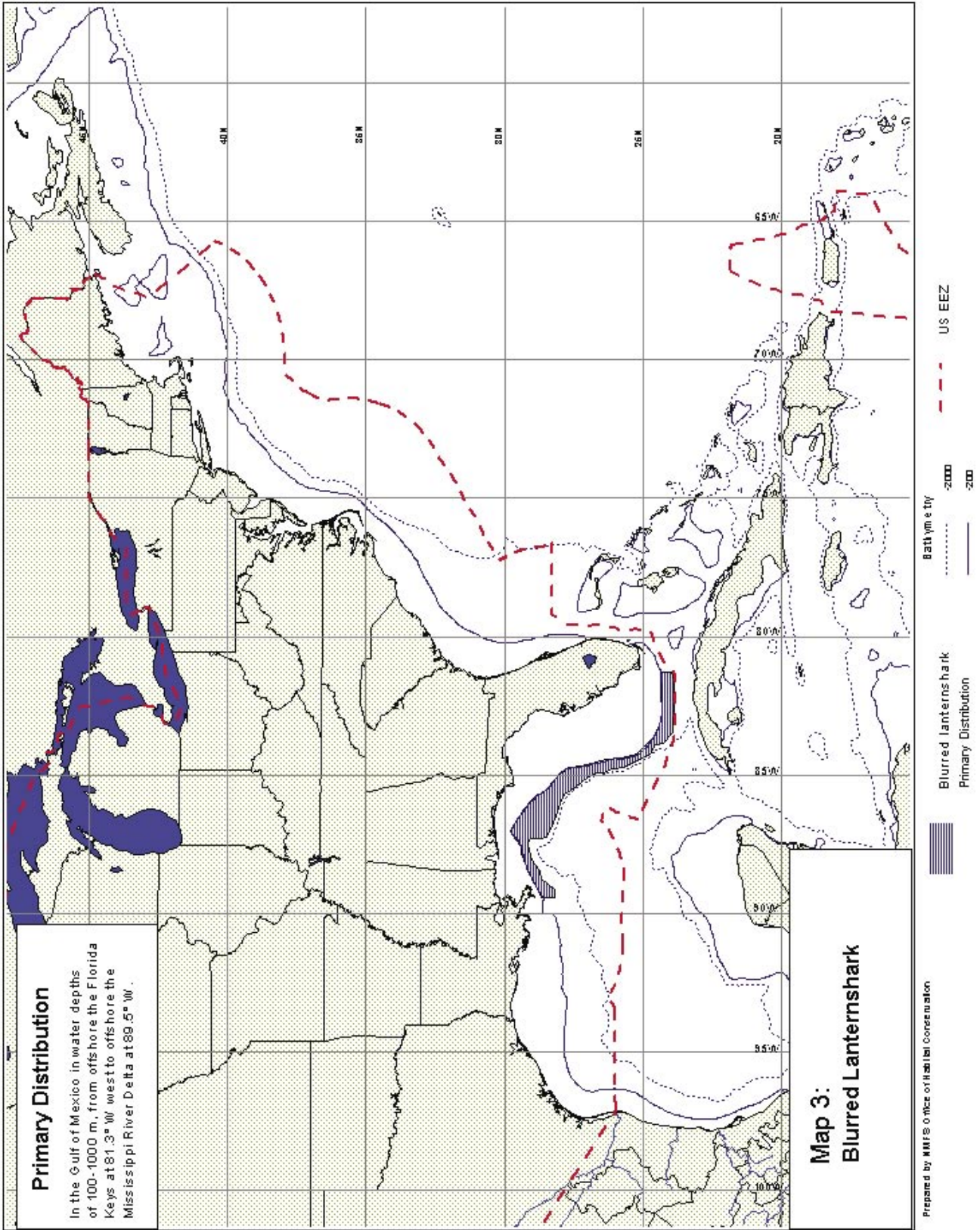
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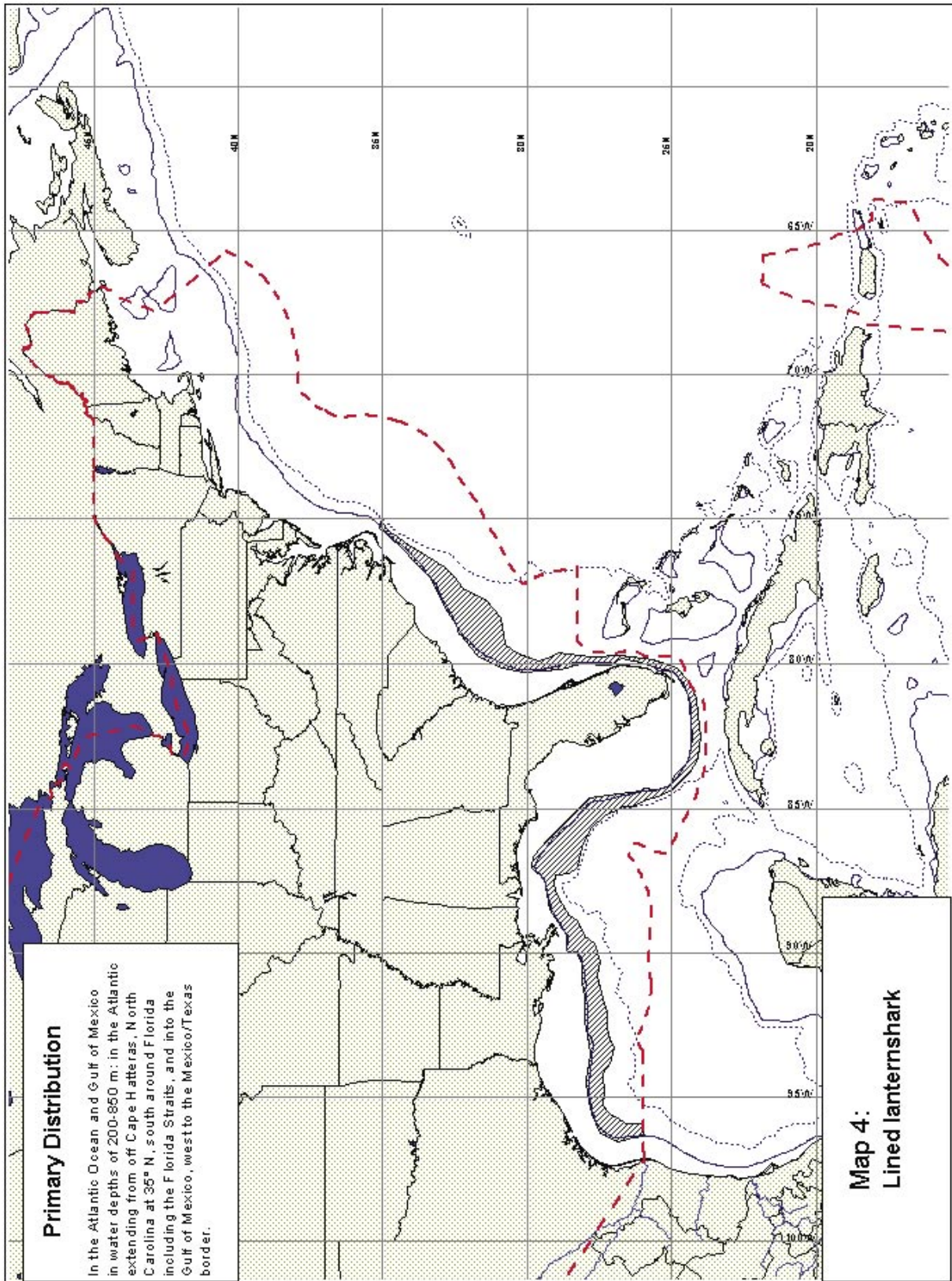
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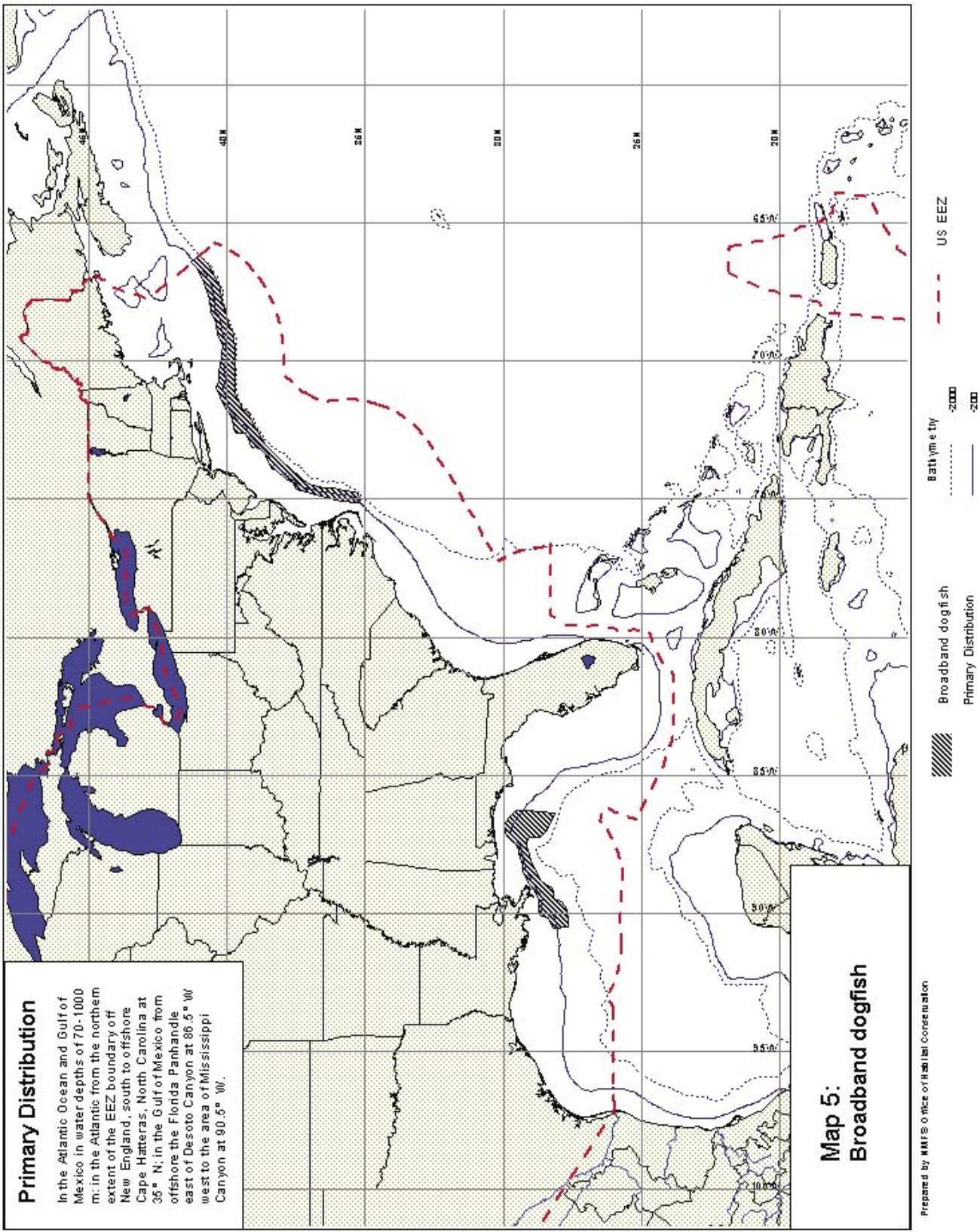
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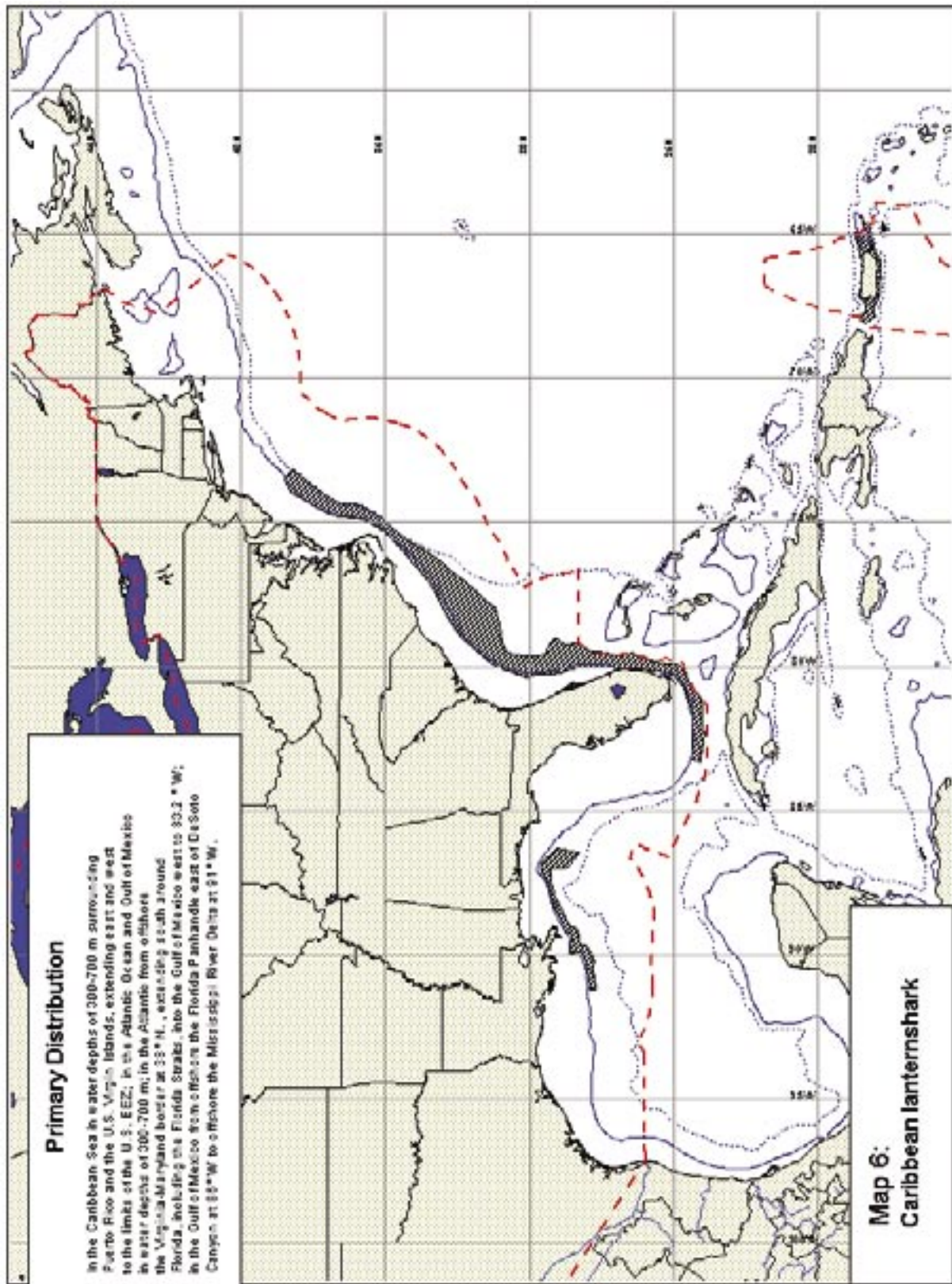


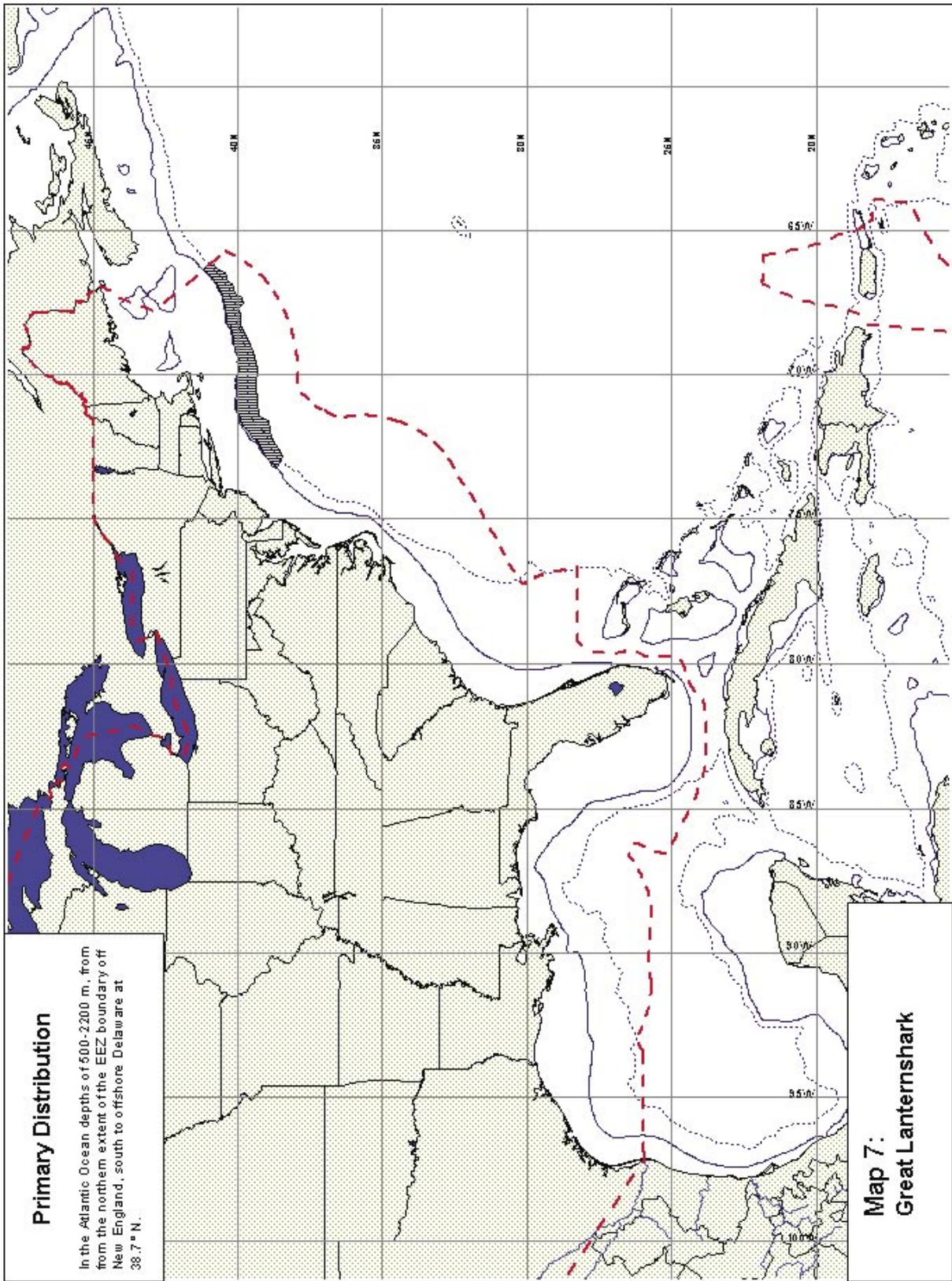


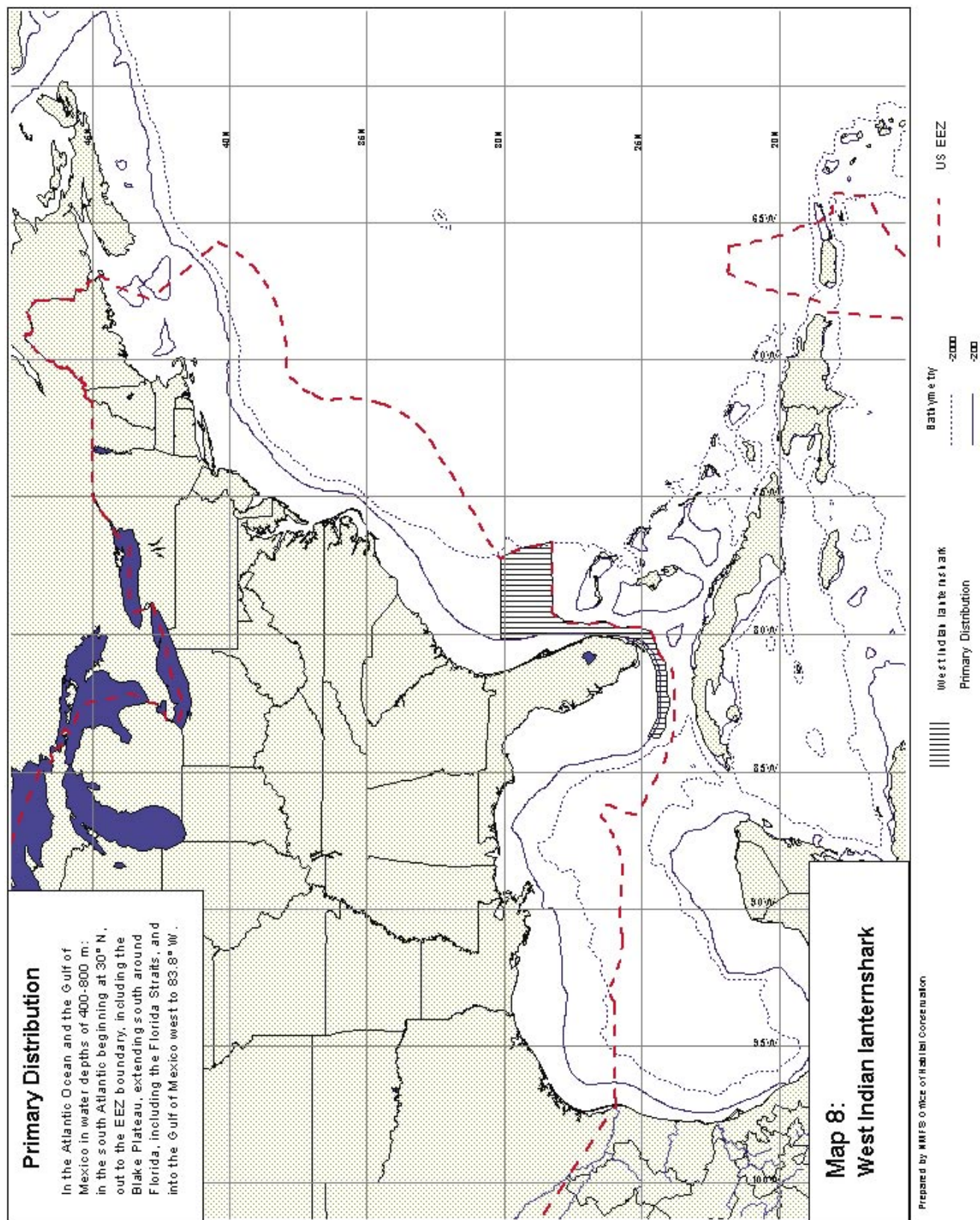


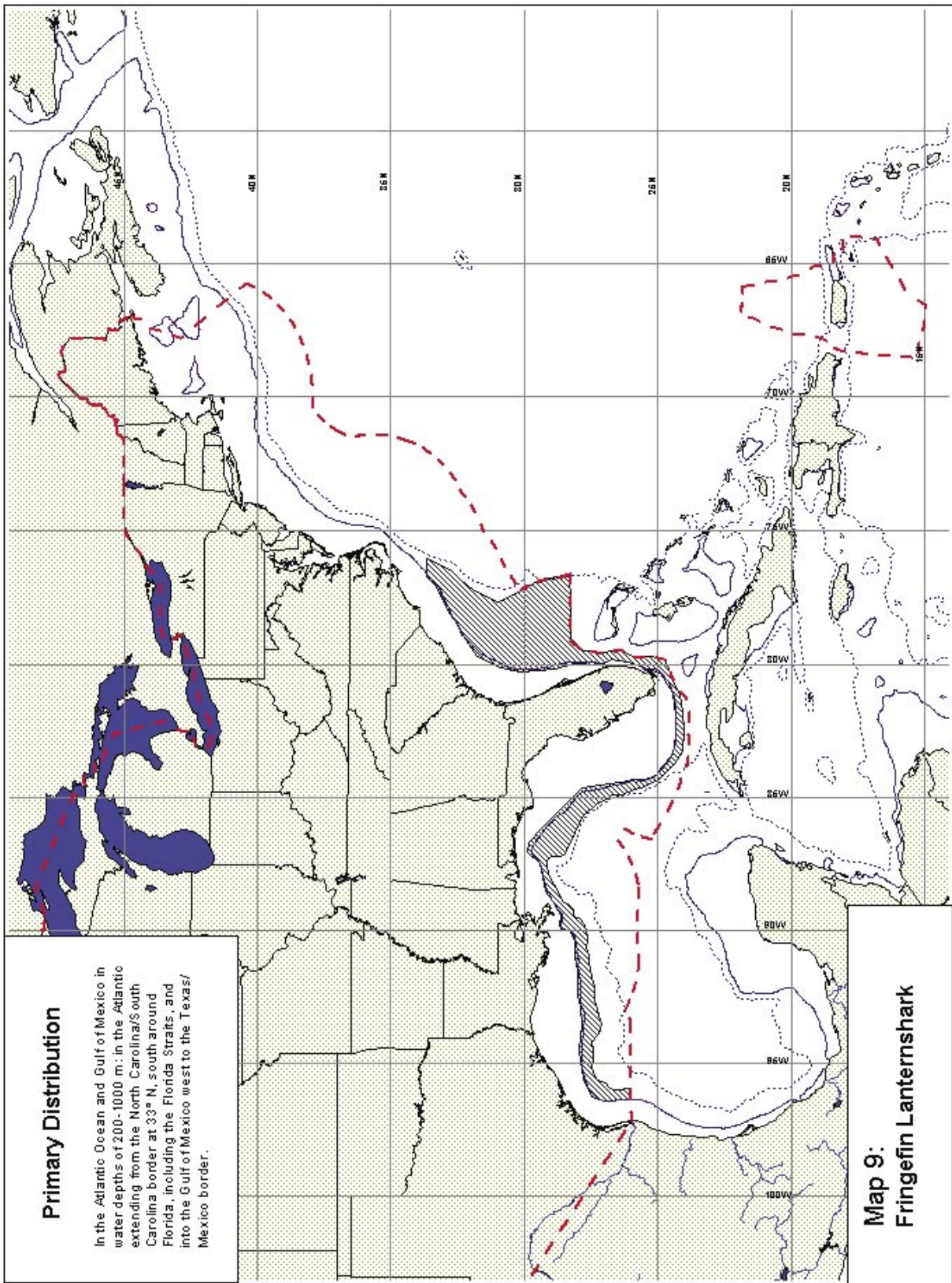










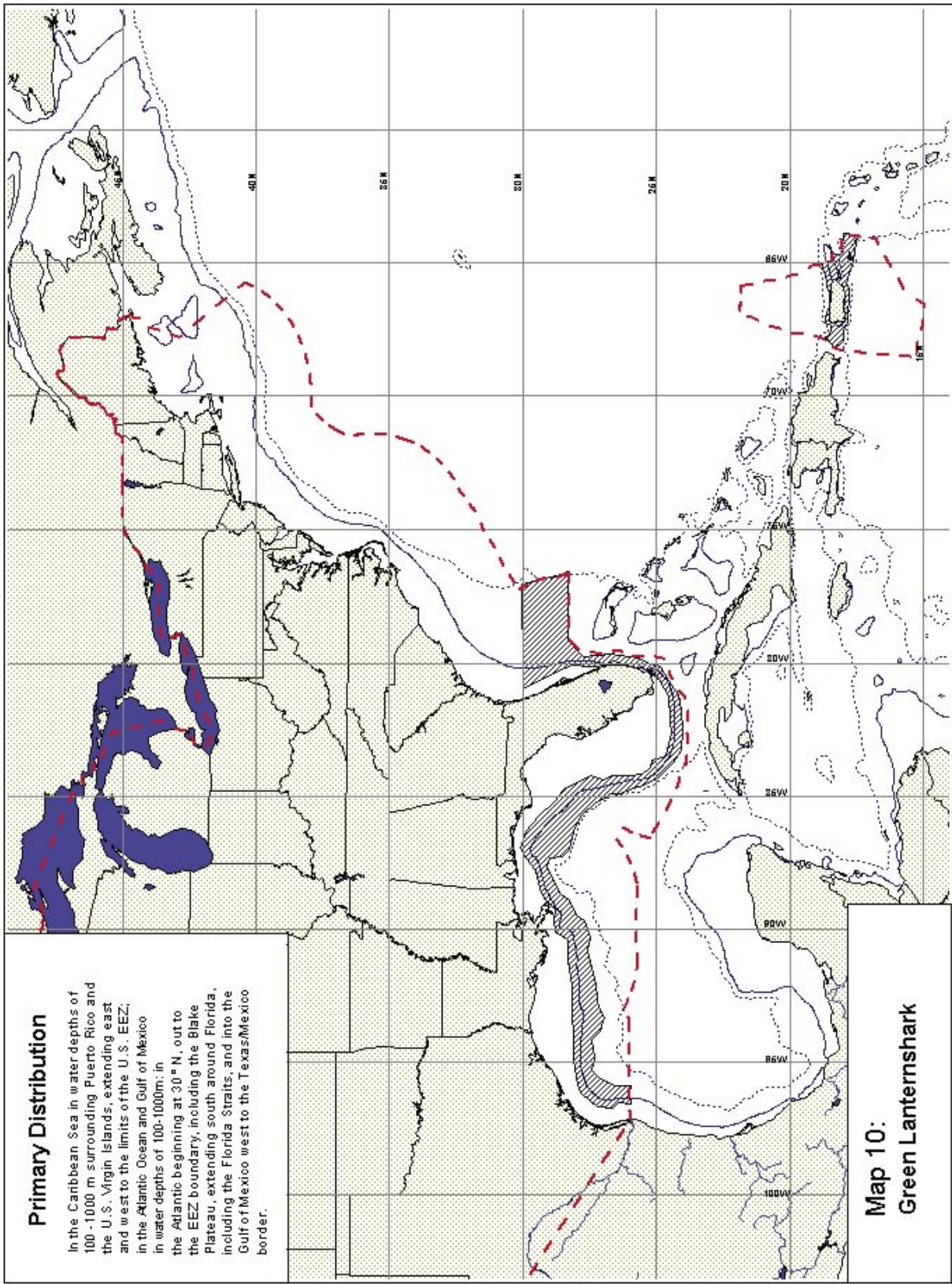


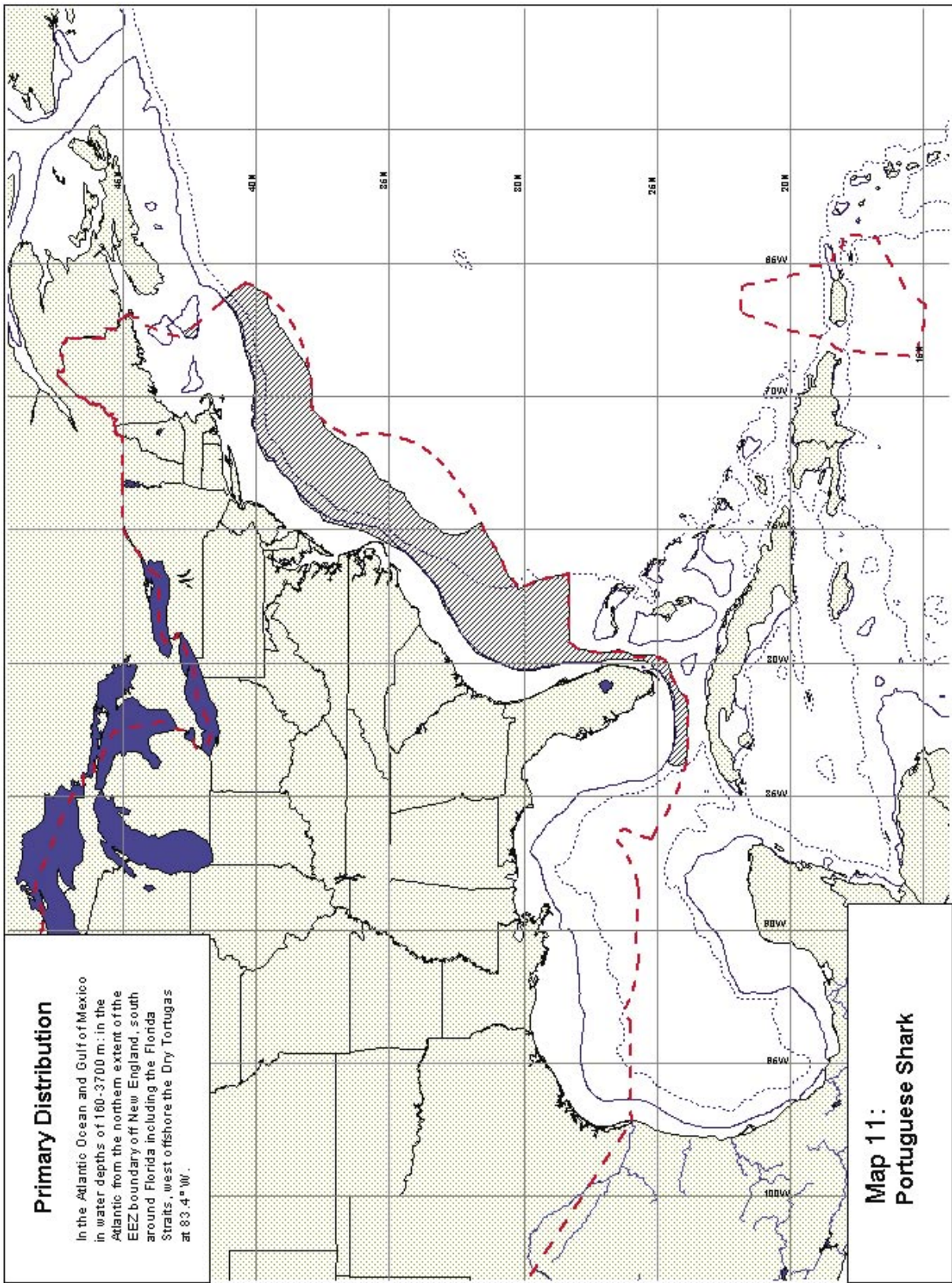
Primary Distribution

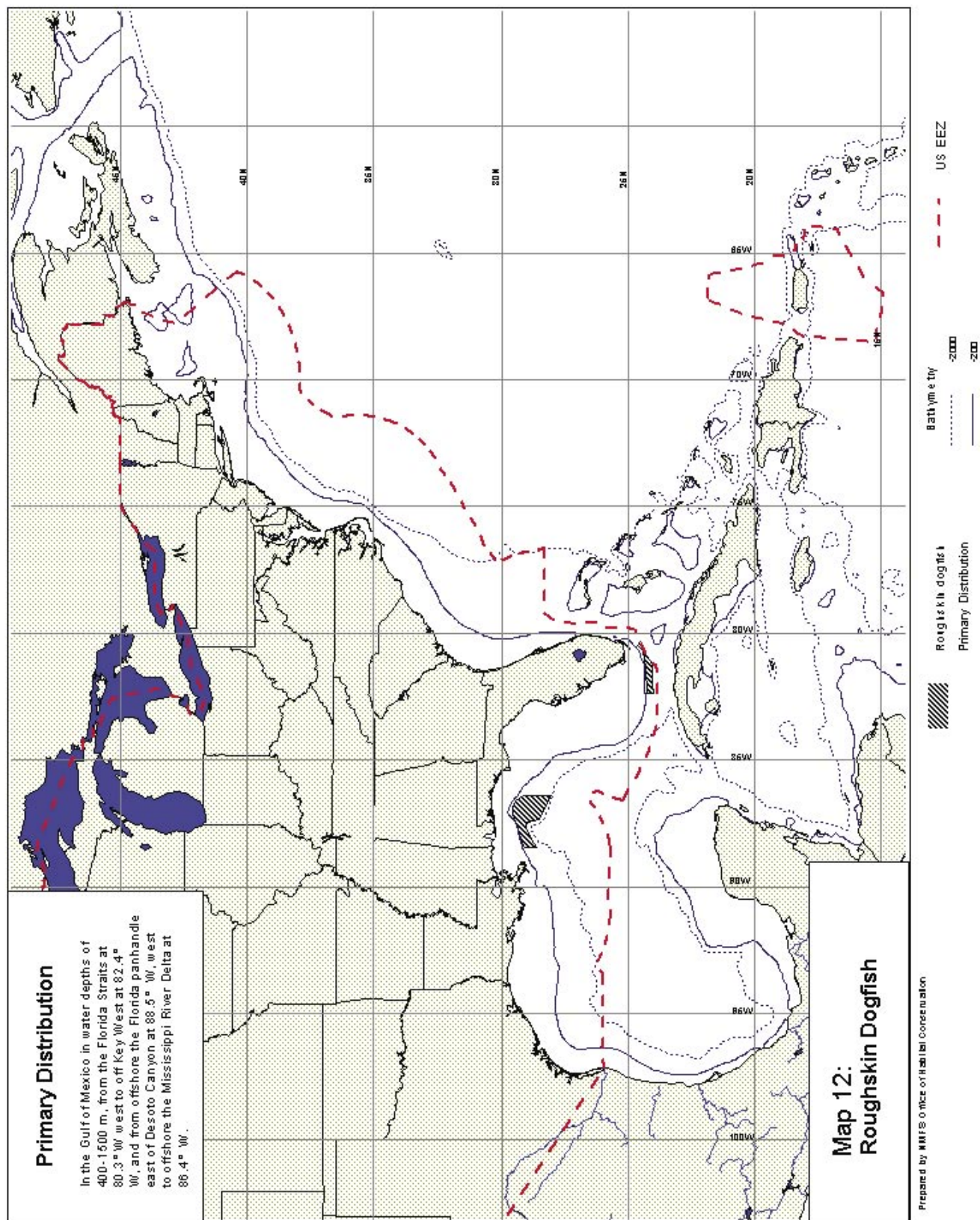
In the Atlantic Ocean and Gulf of Mexico in water depths of 200-1000 m; in the Atlantic extending from the North Carolina/South Carolina border at 33° N, south around Florida, including the Florida Straits, and into the Gulf of Mexico west to the Texas/Mexico border.

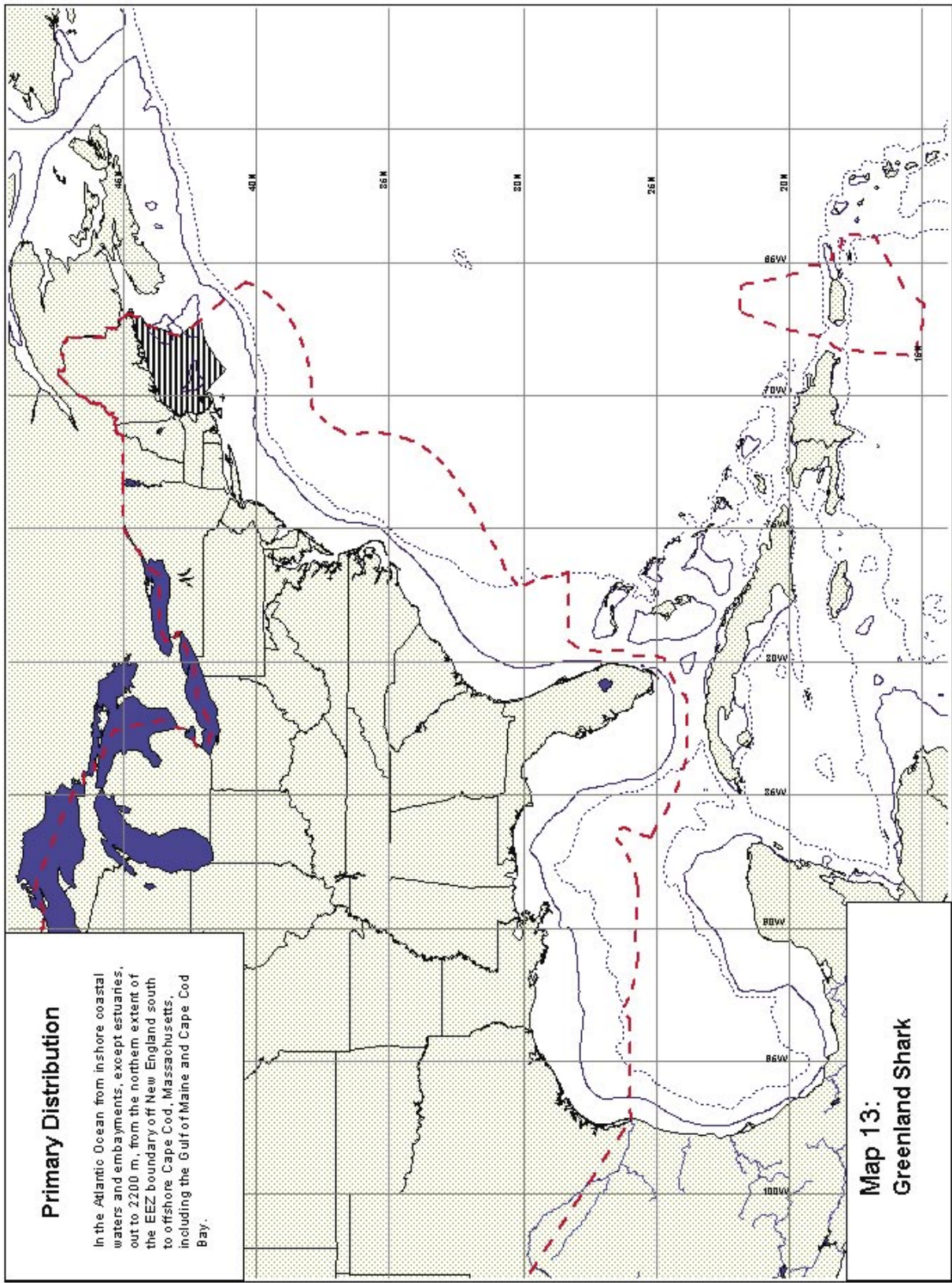
**Map 9:
Fringing Lanternshark**

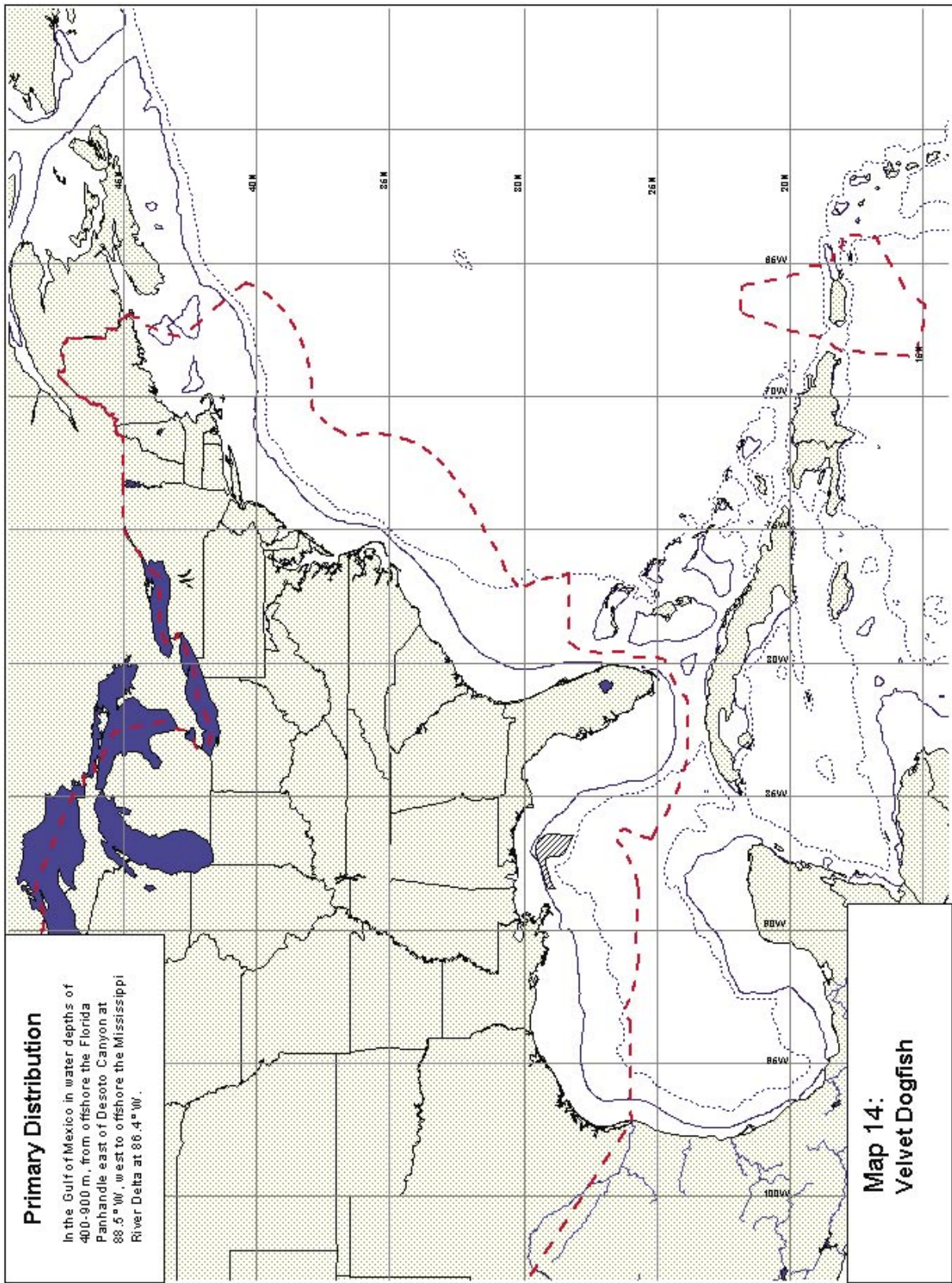
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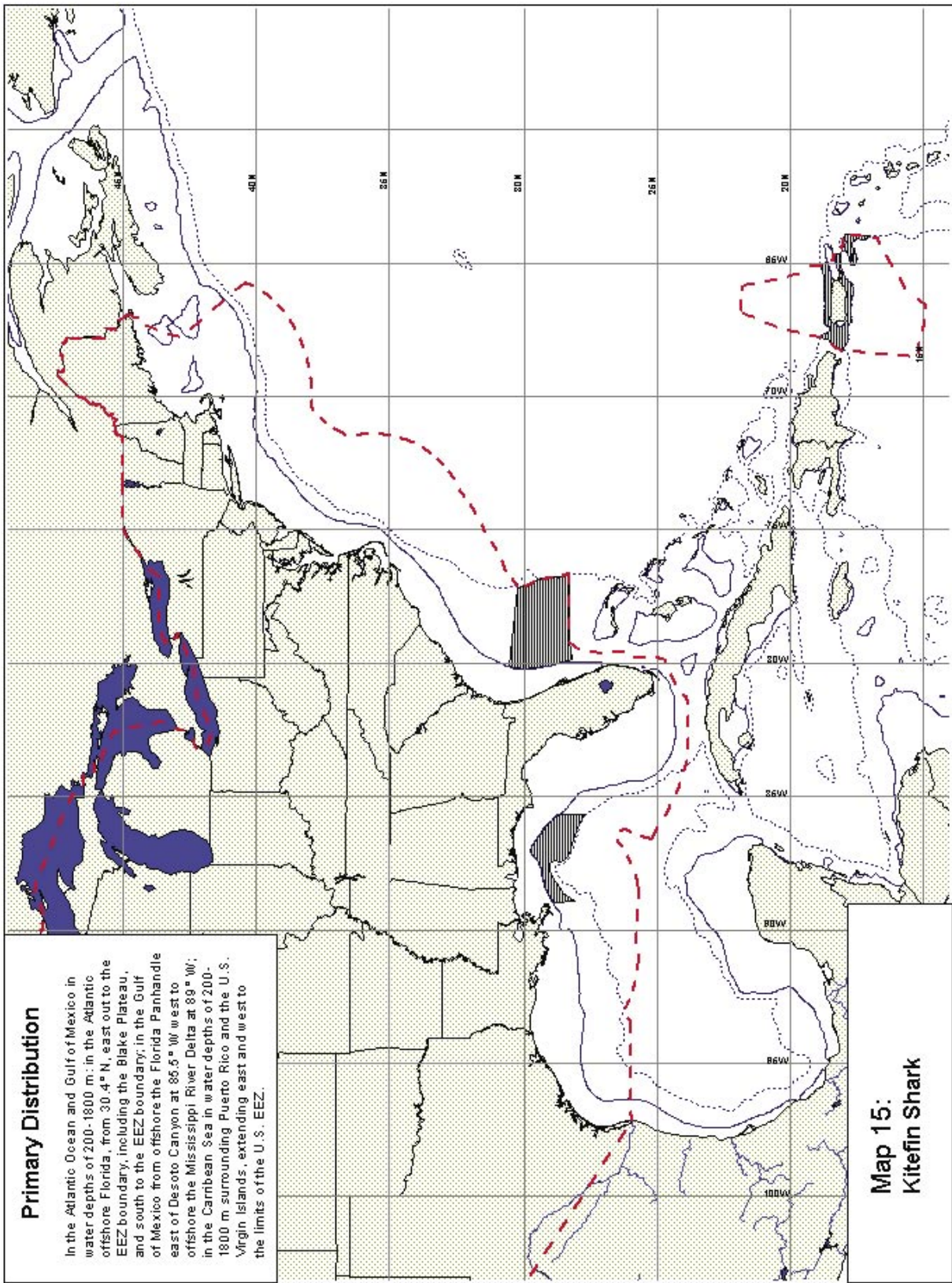


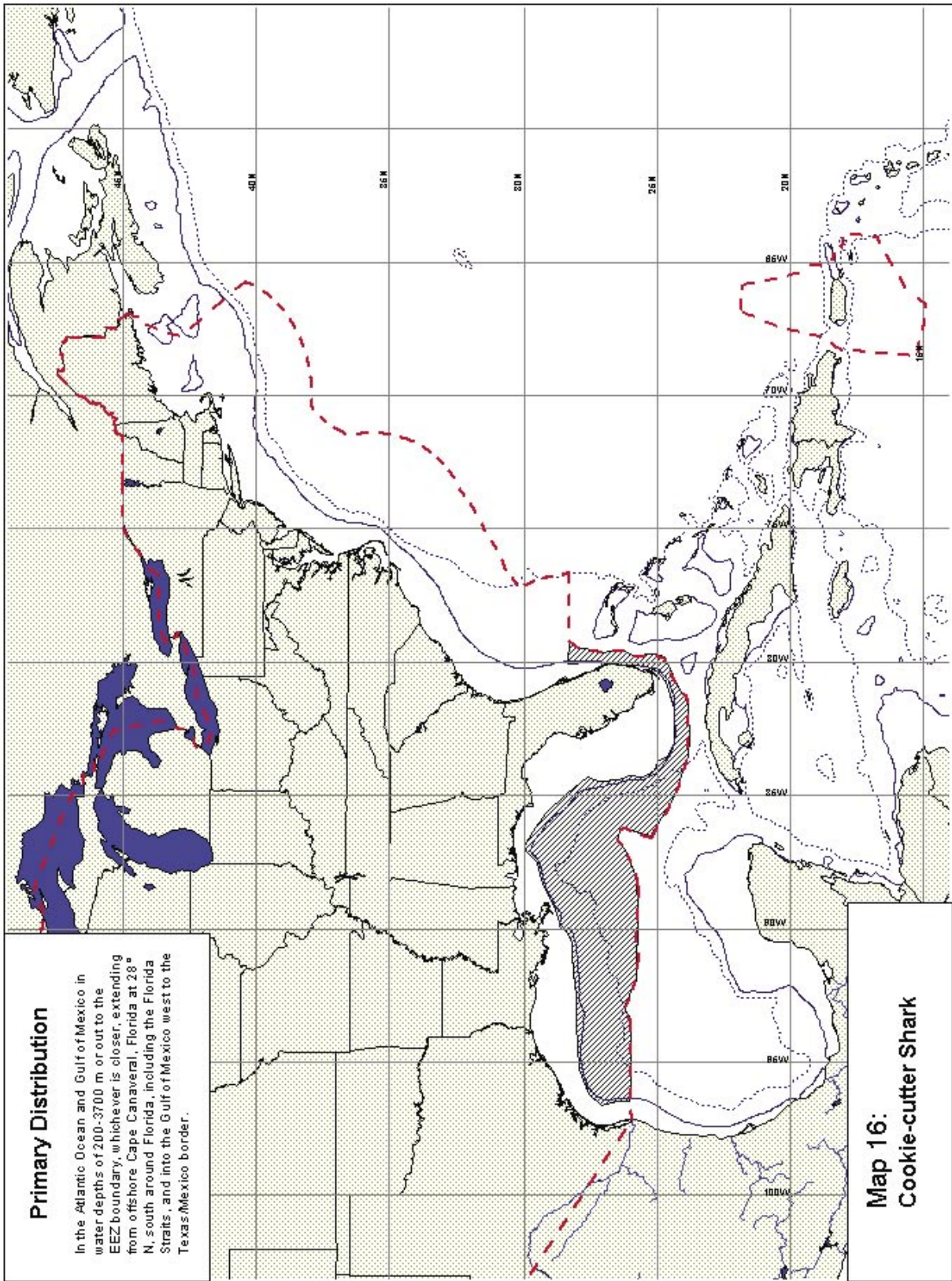


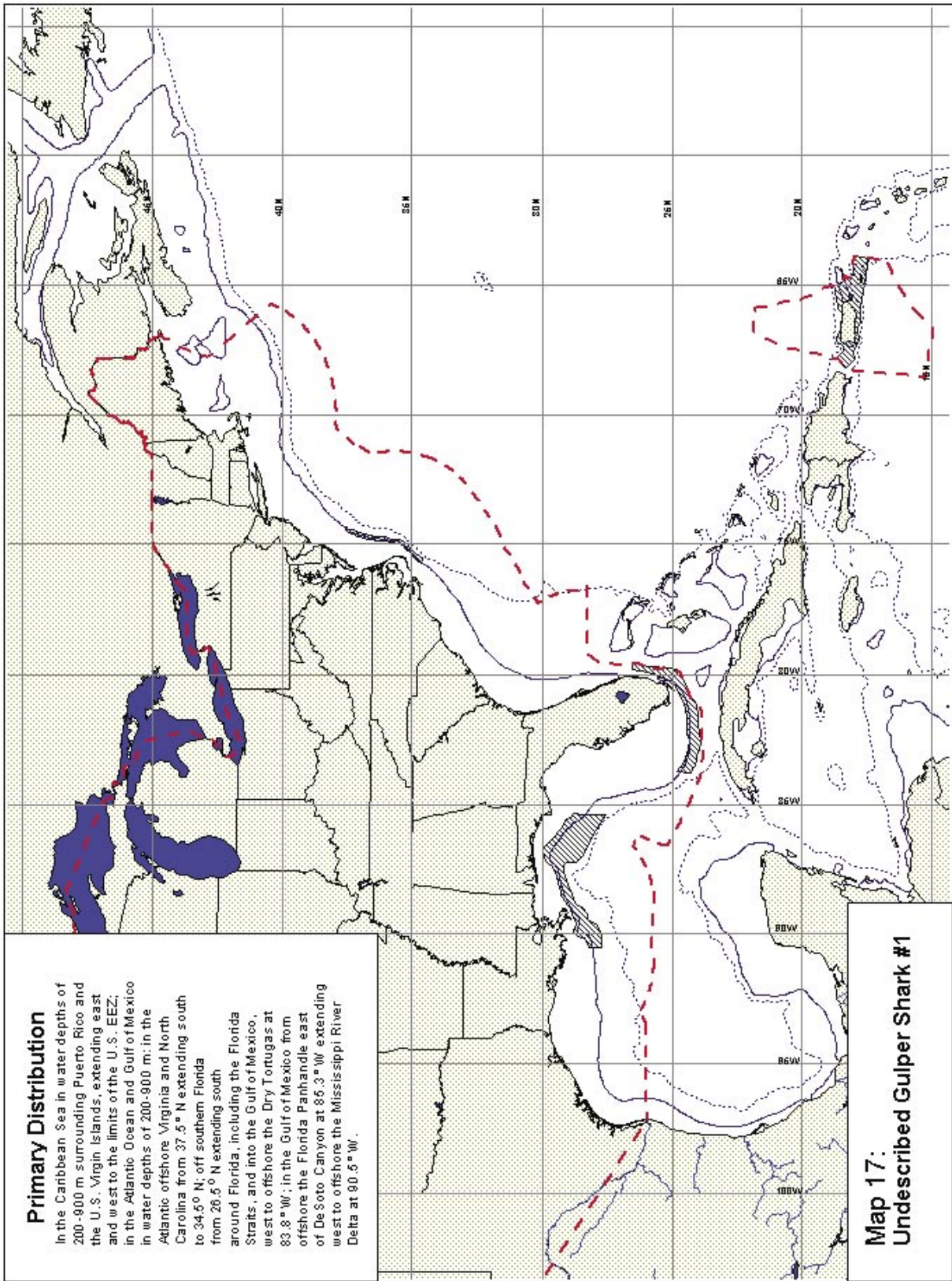


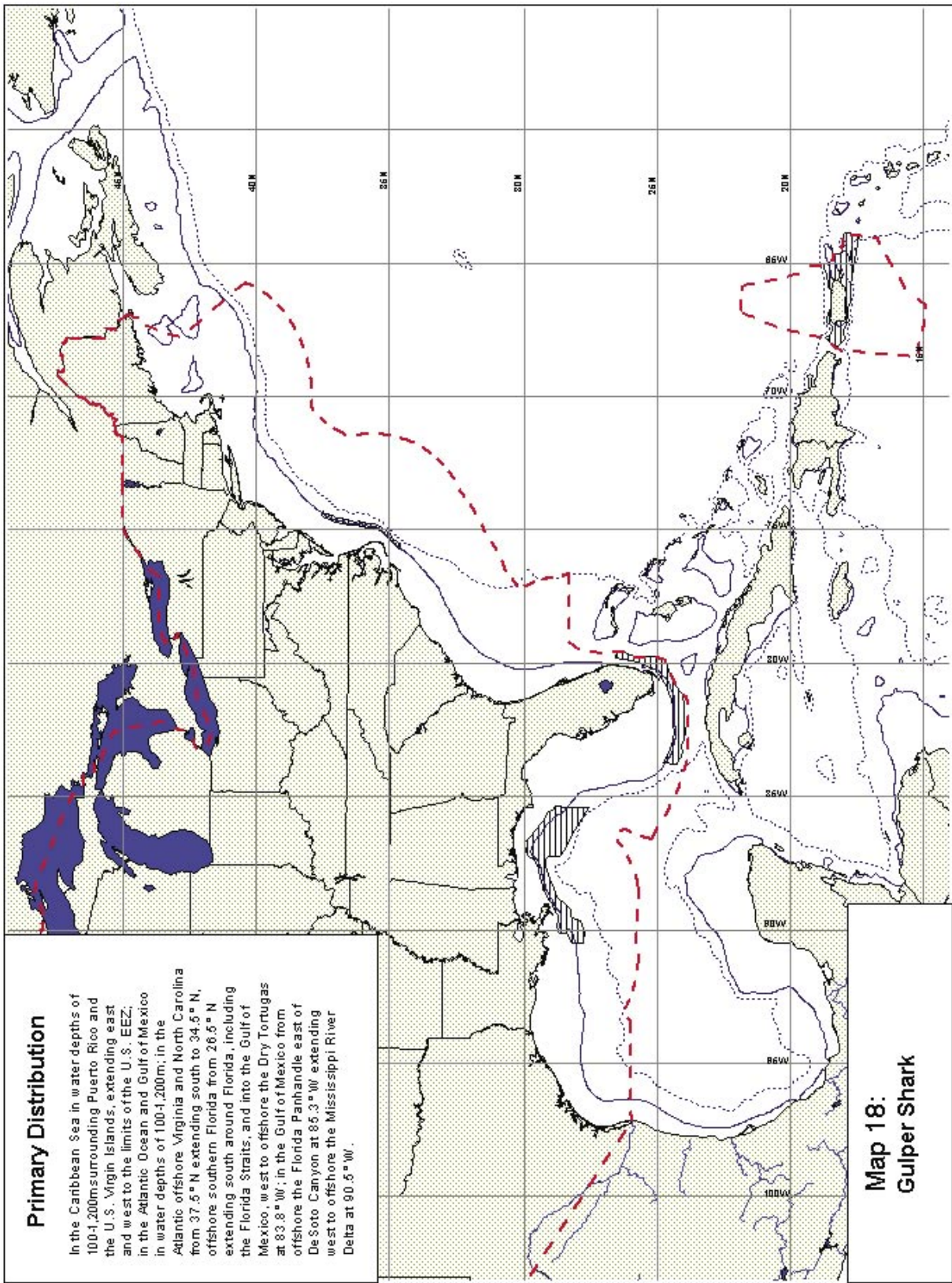


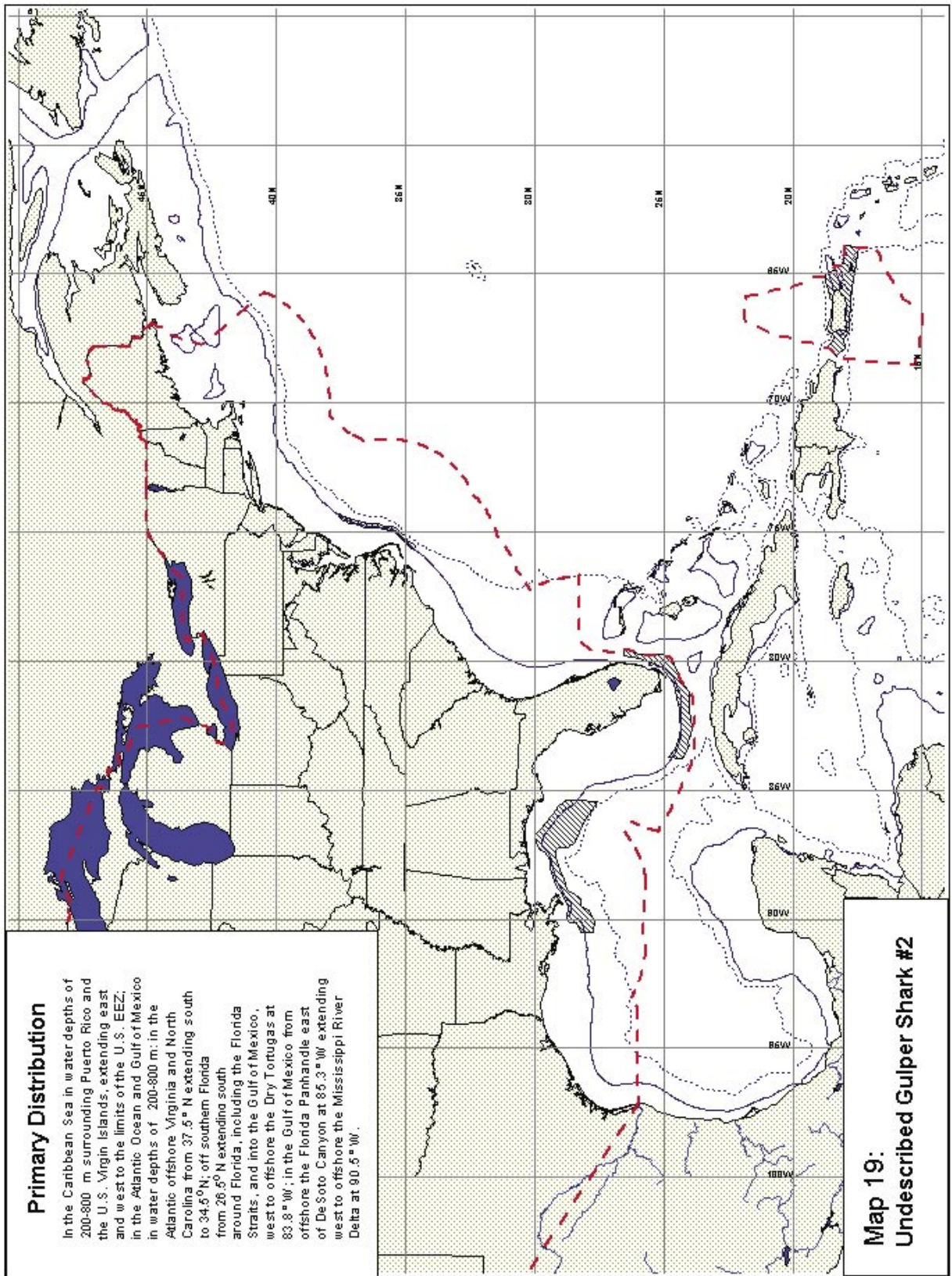


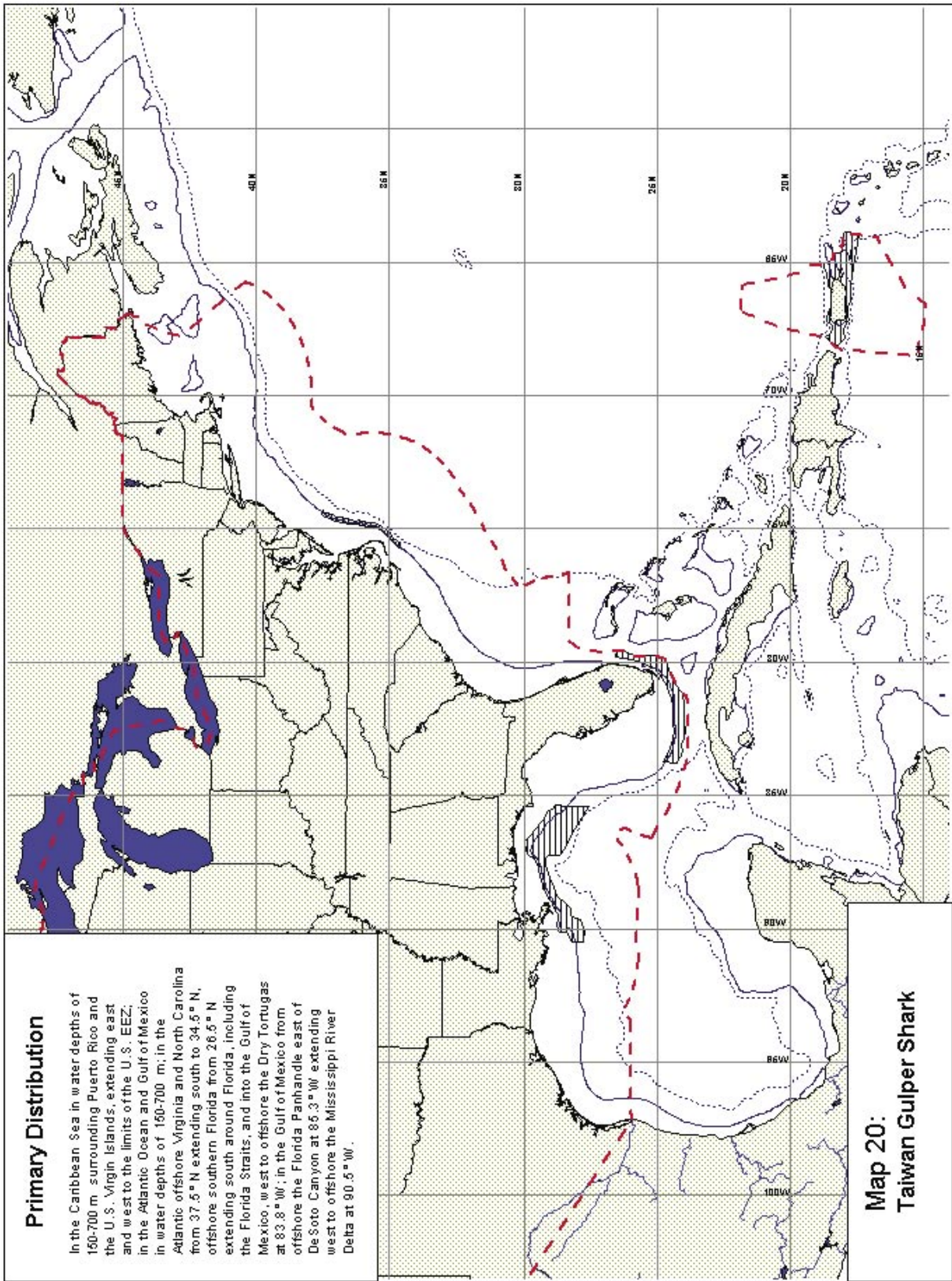


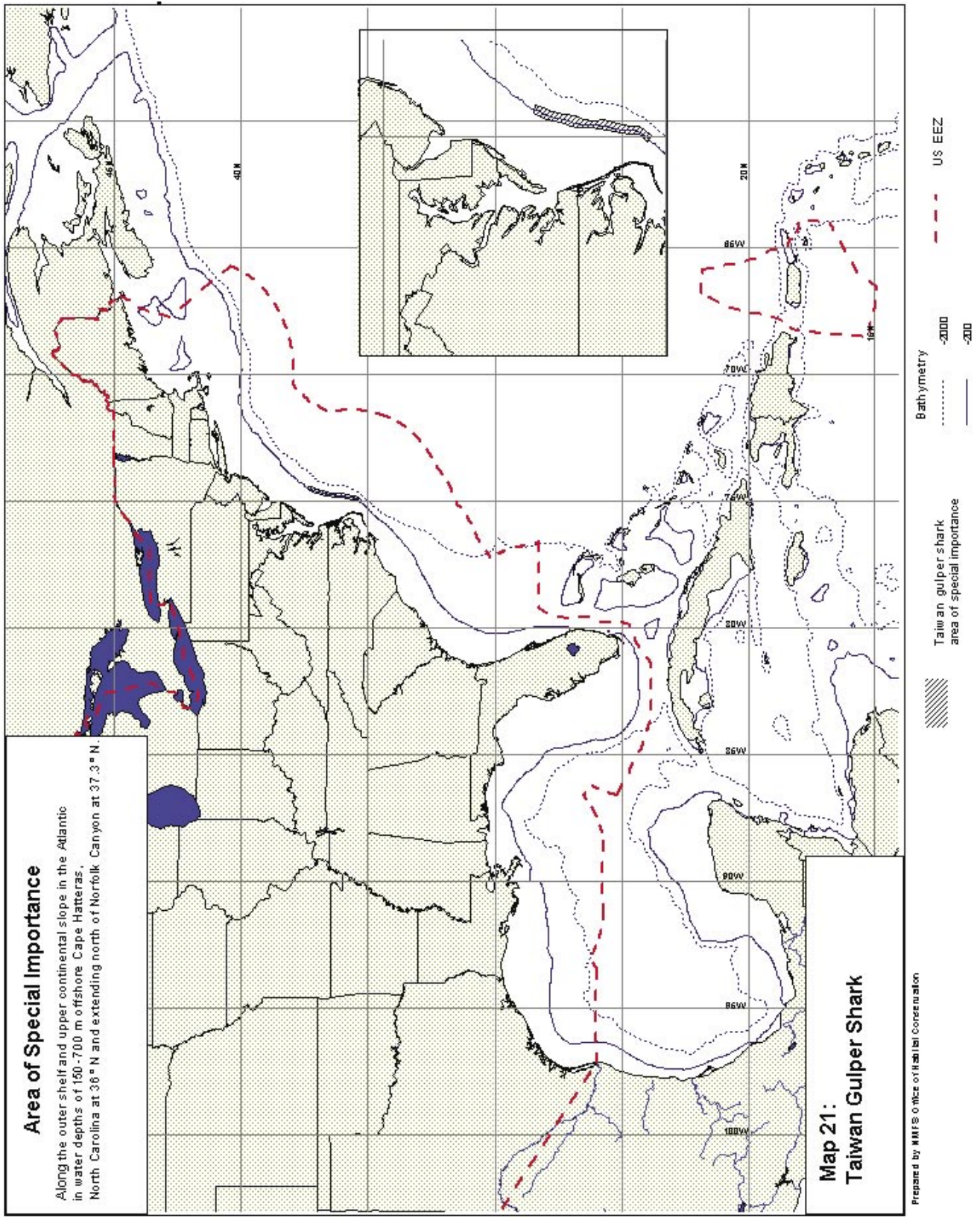










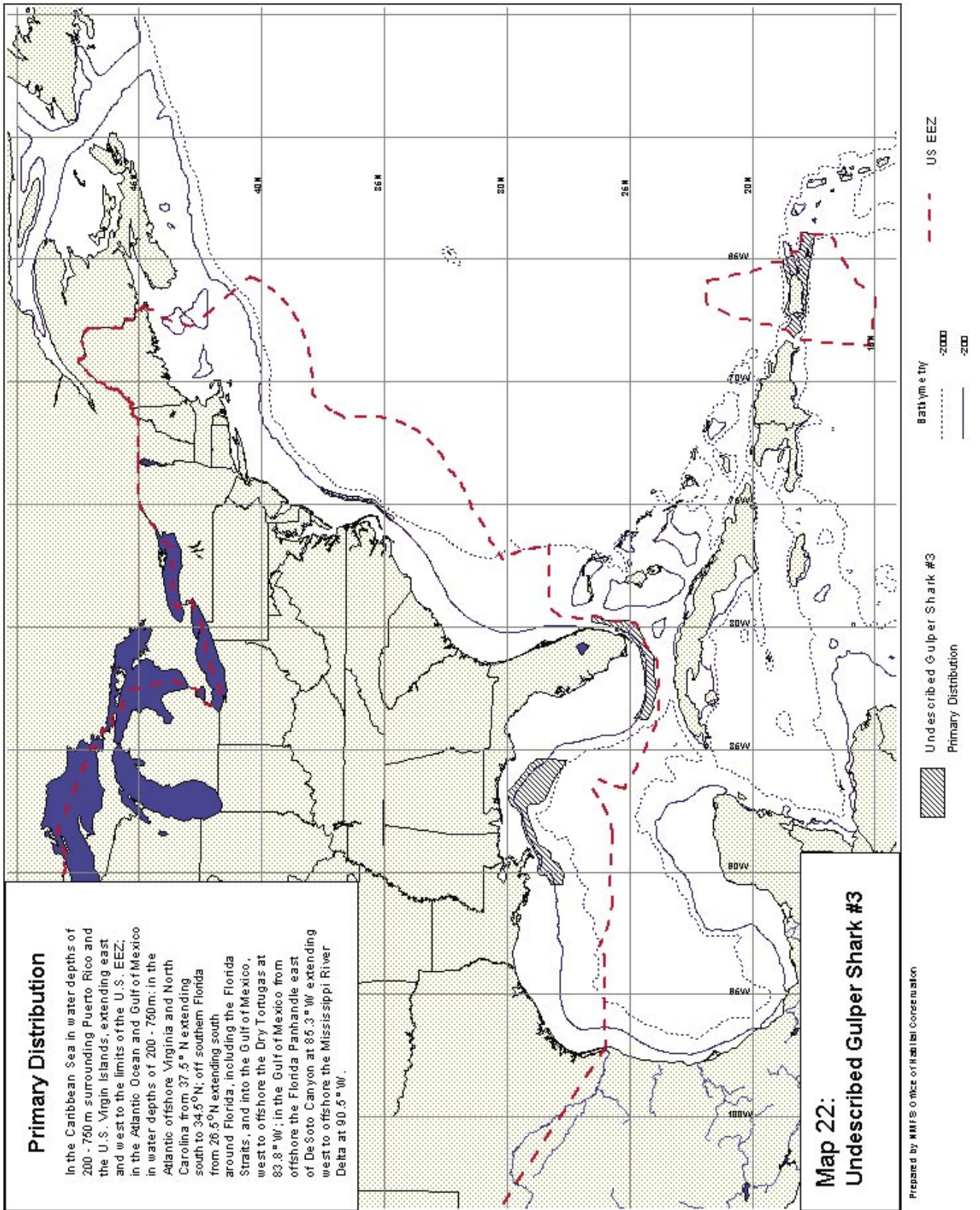


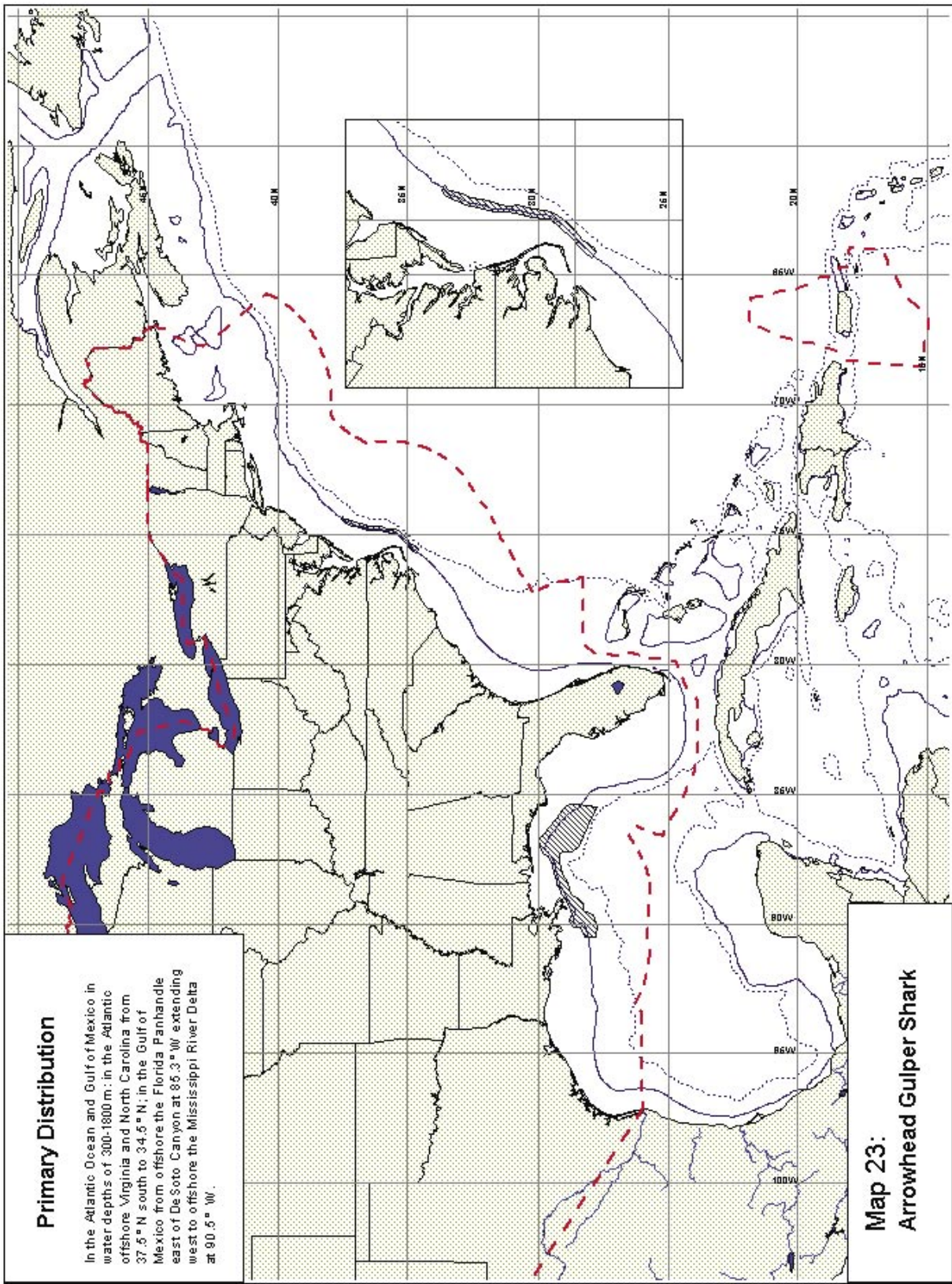
Area of Special Importance

Along the outer shelf and upper continental slope in the Atlantic in water depths of 150-700 m offshore Cape Hatteras, North Carolina at 38° N and extending north of Norfolk Canyon at 37.3° N.

**Map 21:
Taiwan Gulper Shark**

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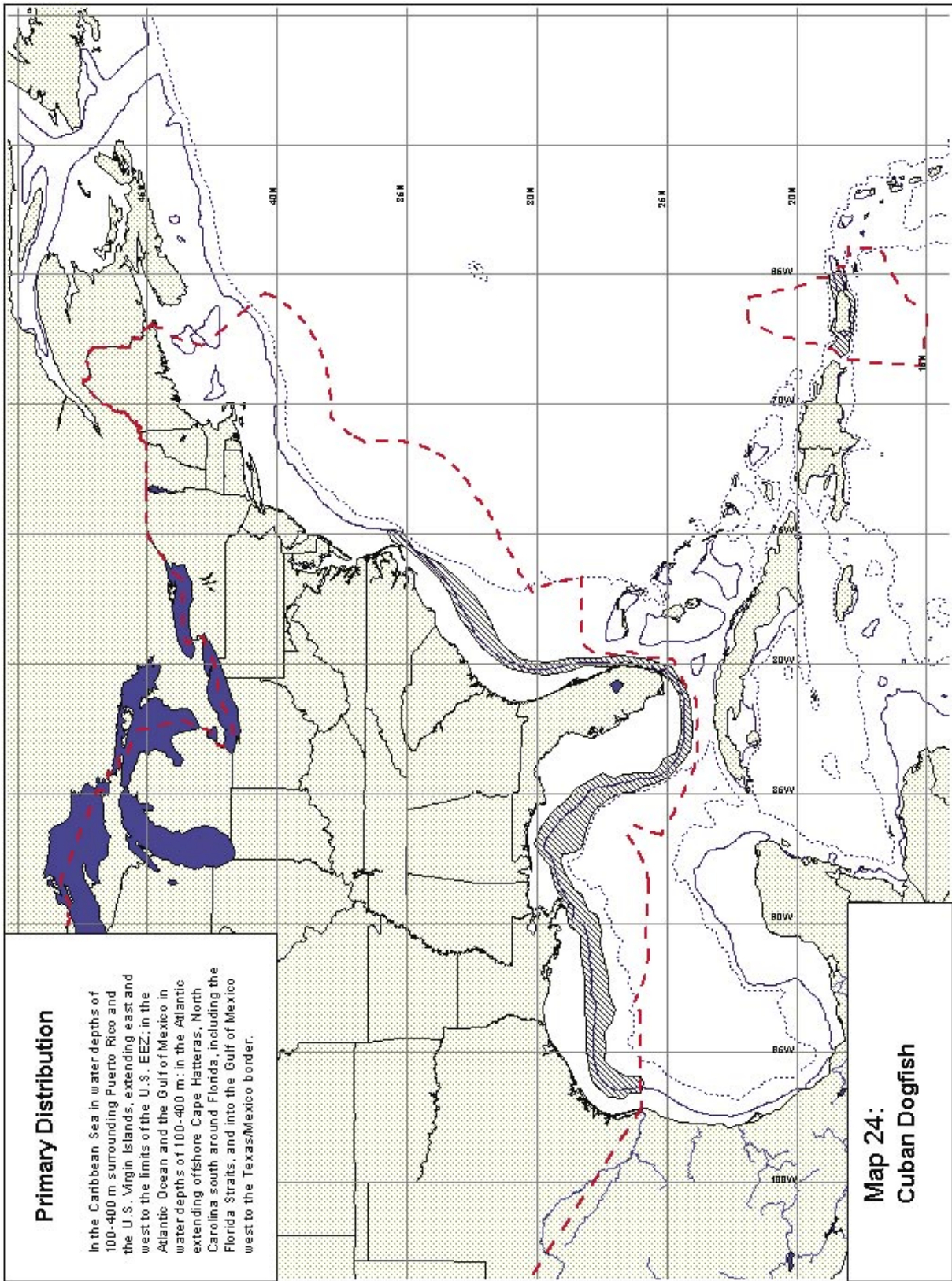
Primary Distribution

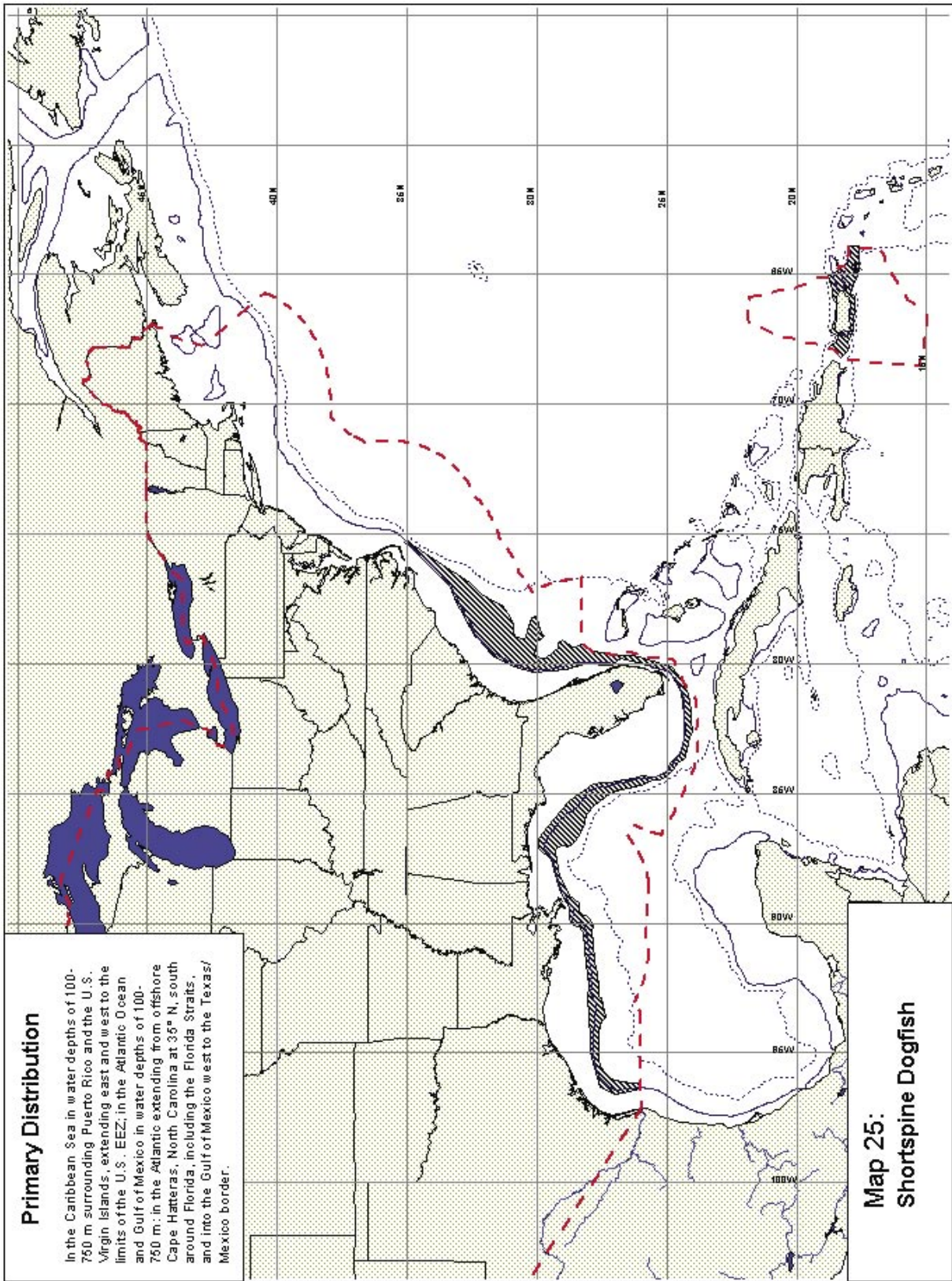
In the Atlantic Ocean and Gulf of Mexico in water depths of 300-1800 m; in the Atlantic offshore Virginia and North Carolina from 37.5° N south to 34.5° N; in the Gulf of Mexico from offshore the Florida Panhandle east of De Soto Canyon at 85.3° W extending west to offshore the Mississippi River Delta at 90.5° W.

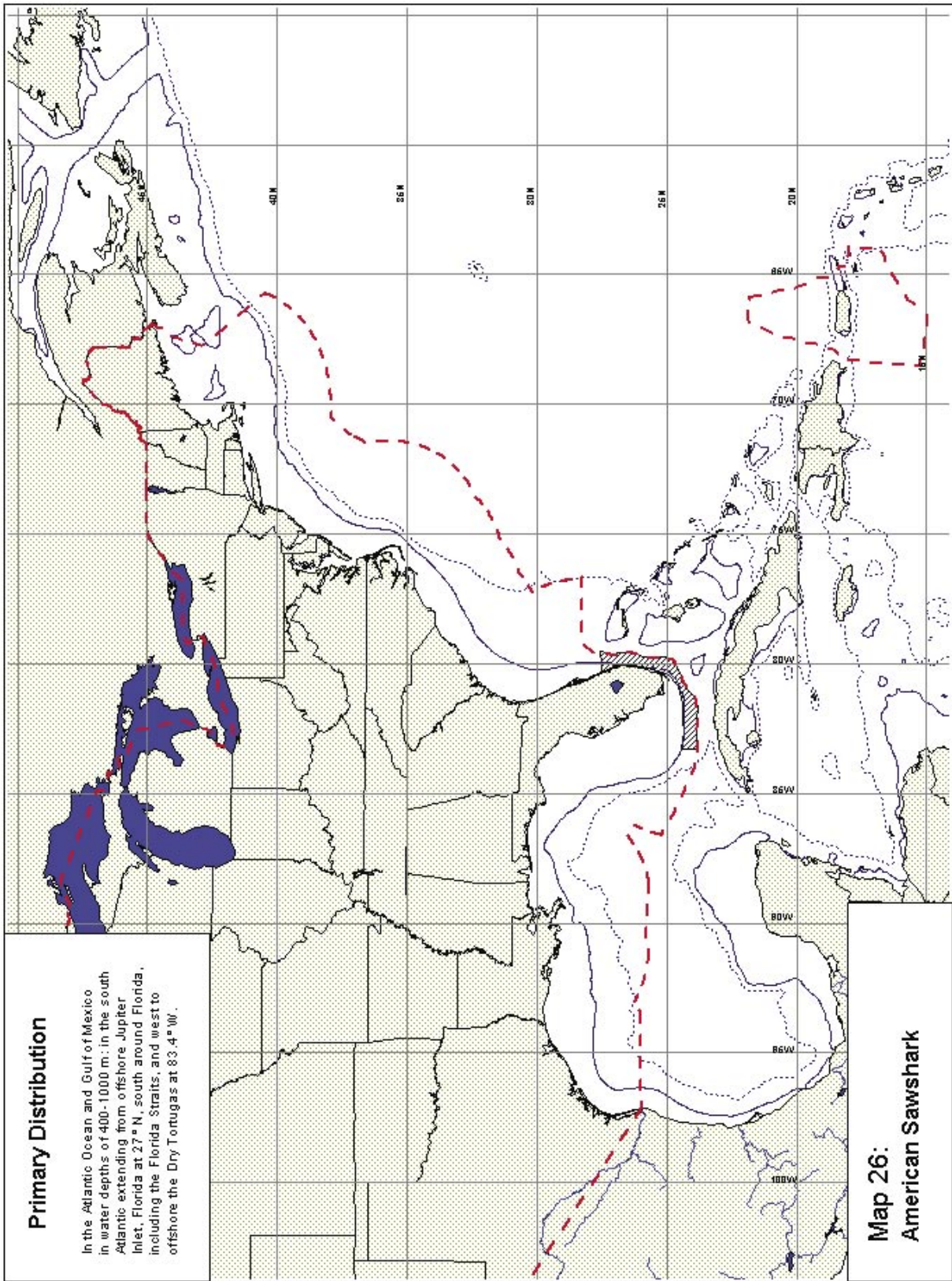
**Map 23:
Arrowhead Gulper Shark**

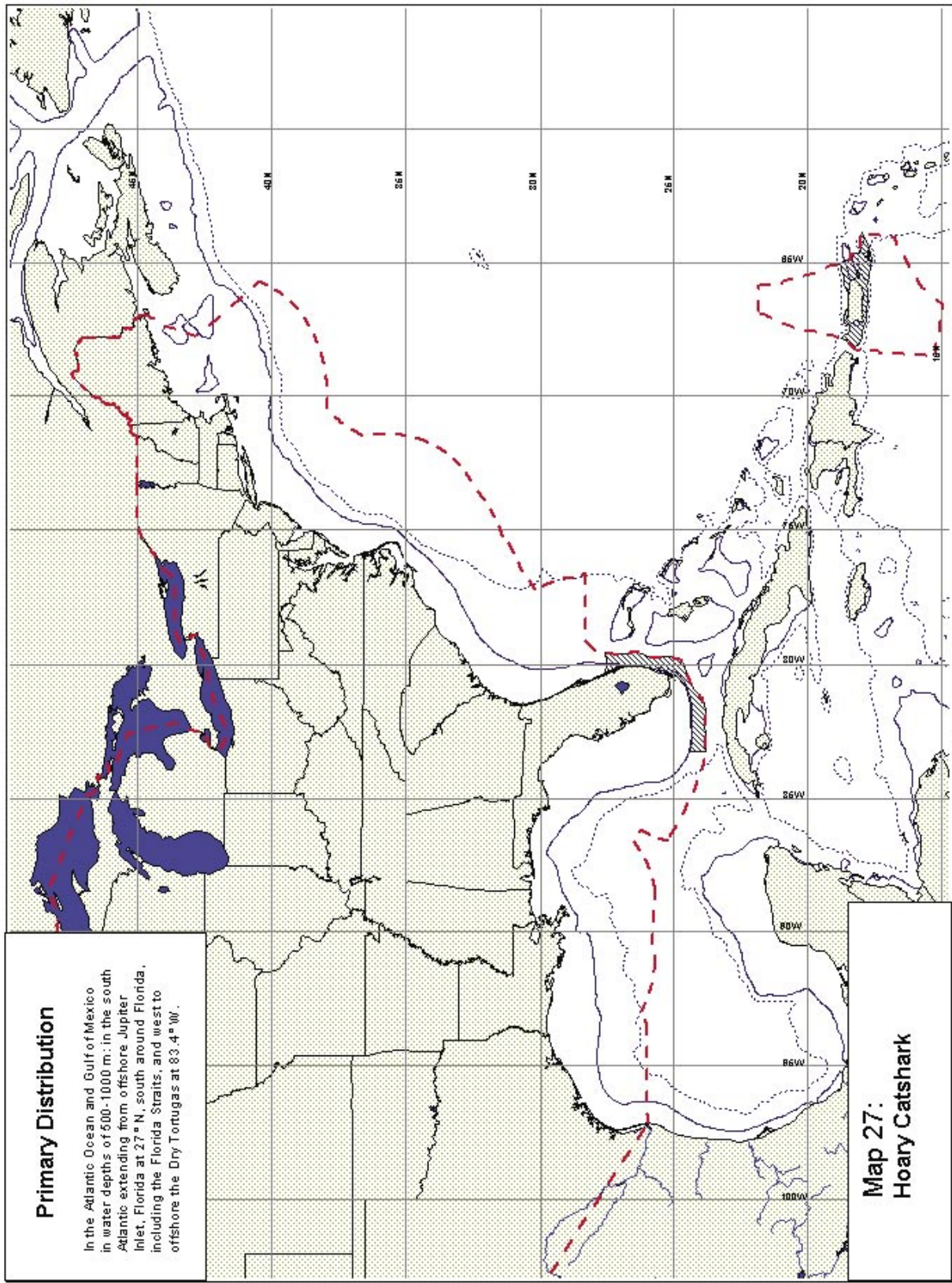
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 Arrowhead Gulper Shark
 Primary Distribution
 Bathymetry
 US EEZ







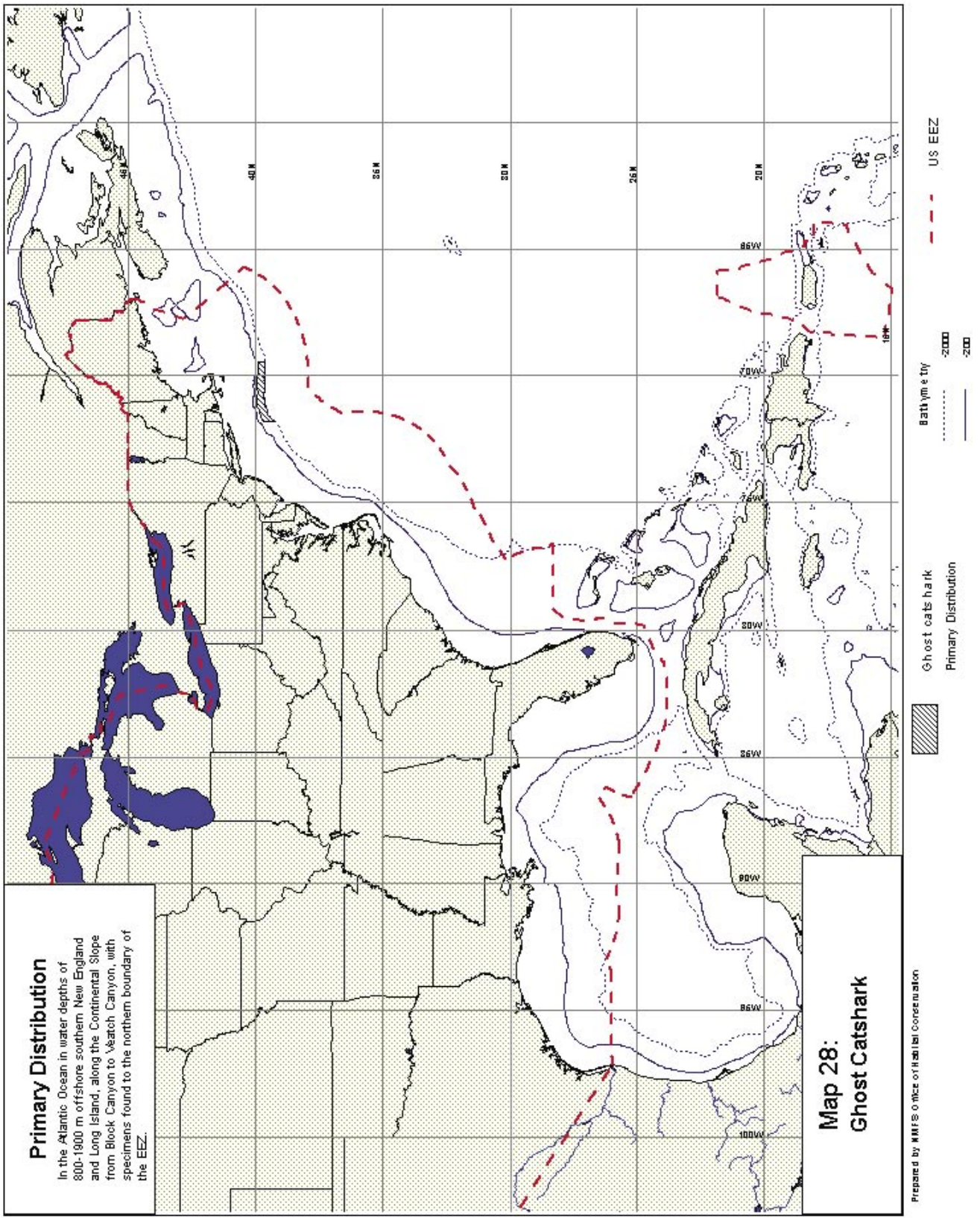


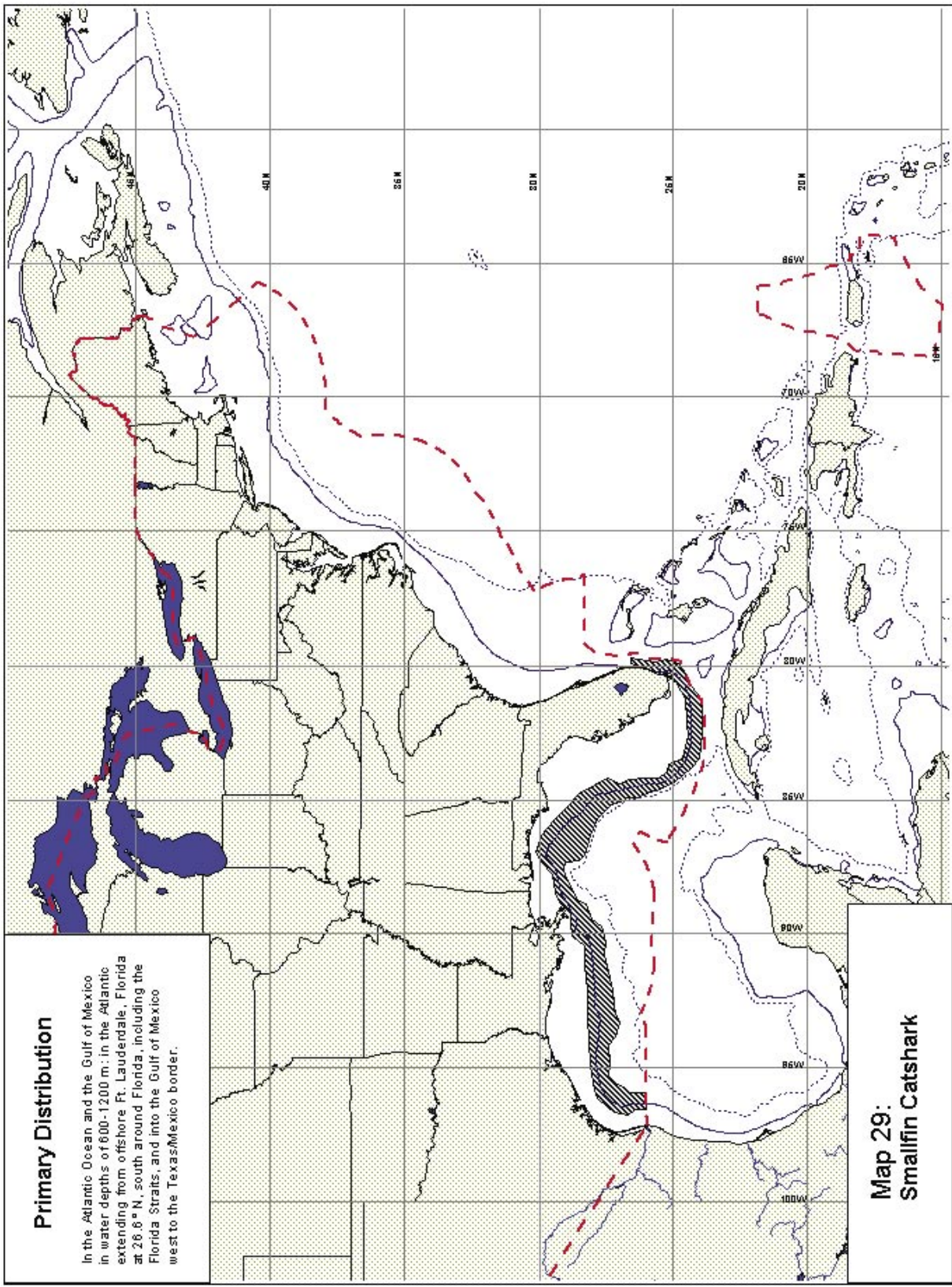
Primary Distribution

In the Atlantic Ocean and Gulf of Mexico in water depths of 500-1000 m; in the south Atlantic extending from offshore Jupiter Inlet, Florida at 27° N, south around Florida, including the Florida Straits, and west to offshore the Dry Tortugas at 83.4° W.

**Map 27:
Hoary Catshark**

Prepared by NMFS Office of Habitat Conservation





Primary Distribution

In the Atlantic Ocean and the Gulf of Mexico in water depths of 600-1200 m; in the Atlantic extending from offshore Ft. Lauderdale, Florida at 26.8° N, south around Florida, including the Florida Straits, and into the Gulf of Mexico west to the Texas/Mexico border.

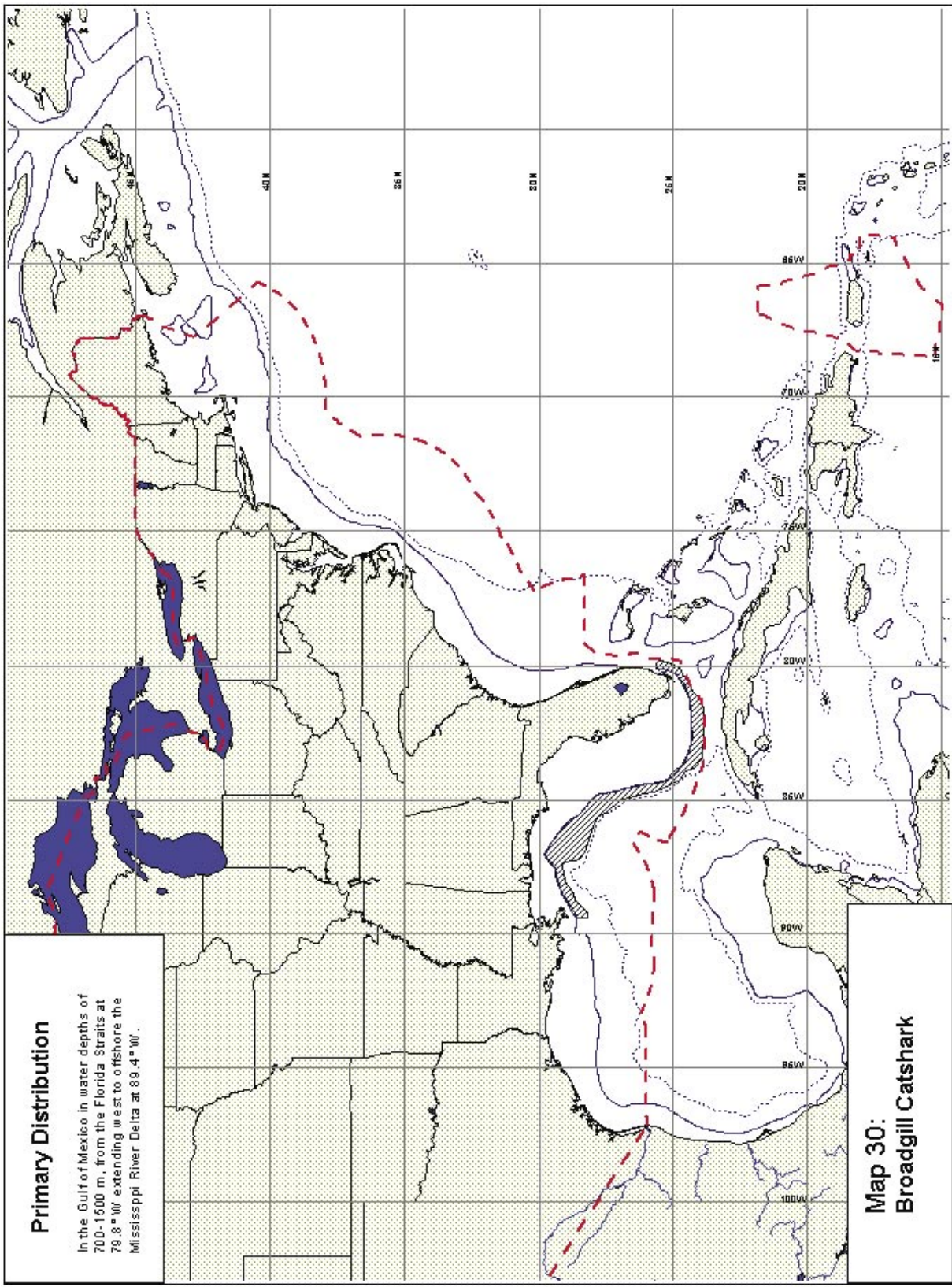
**Map 29:
Smallfin Catshark**

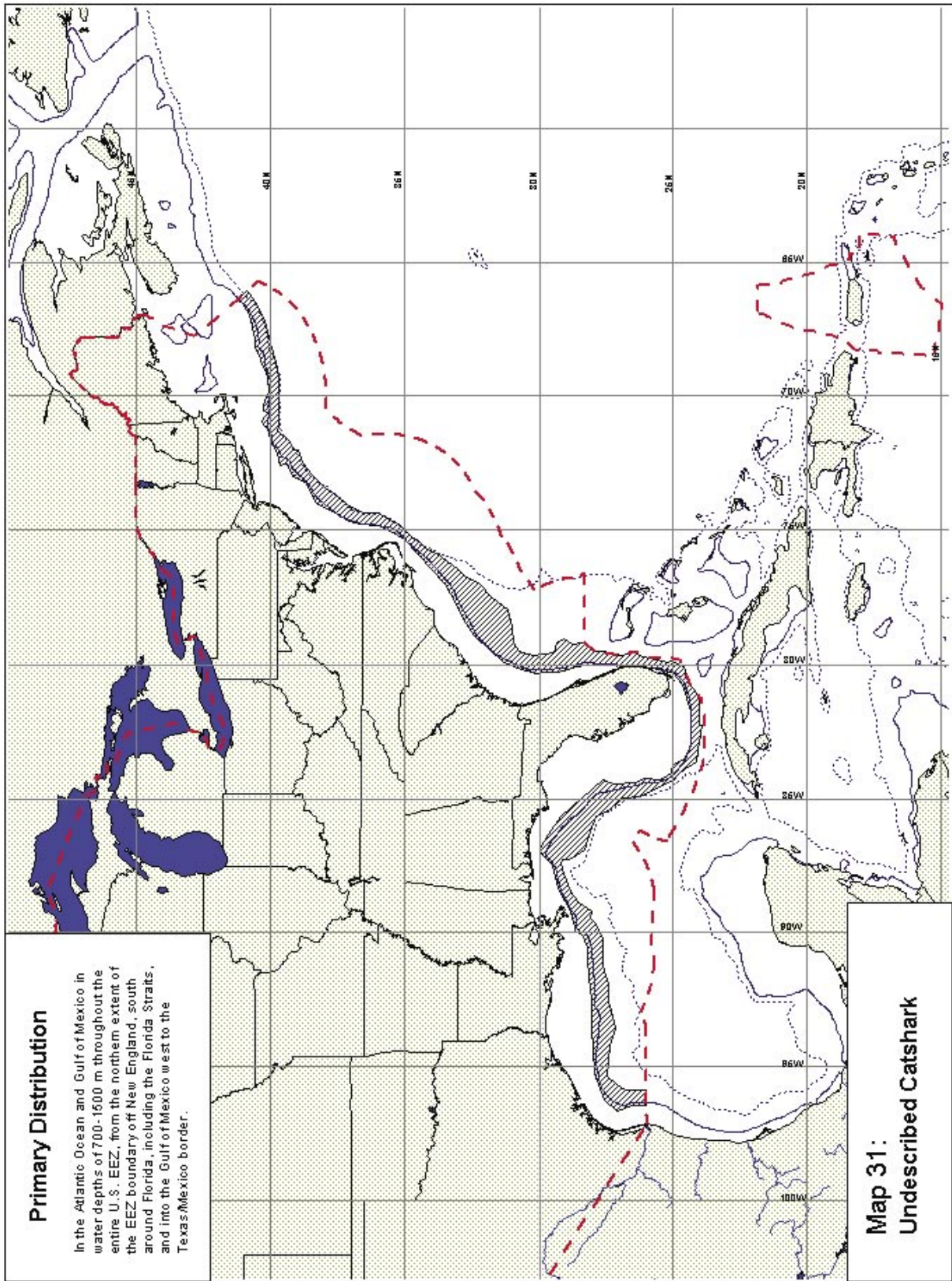
Smallfin catshark
Primary Distribution

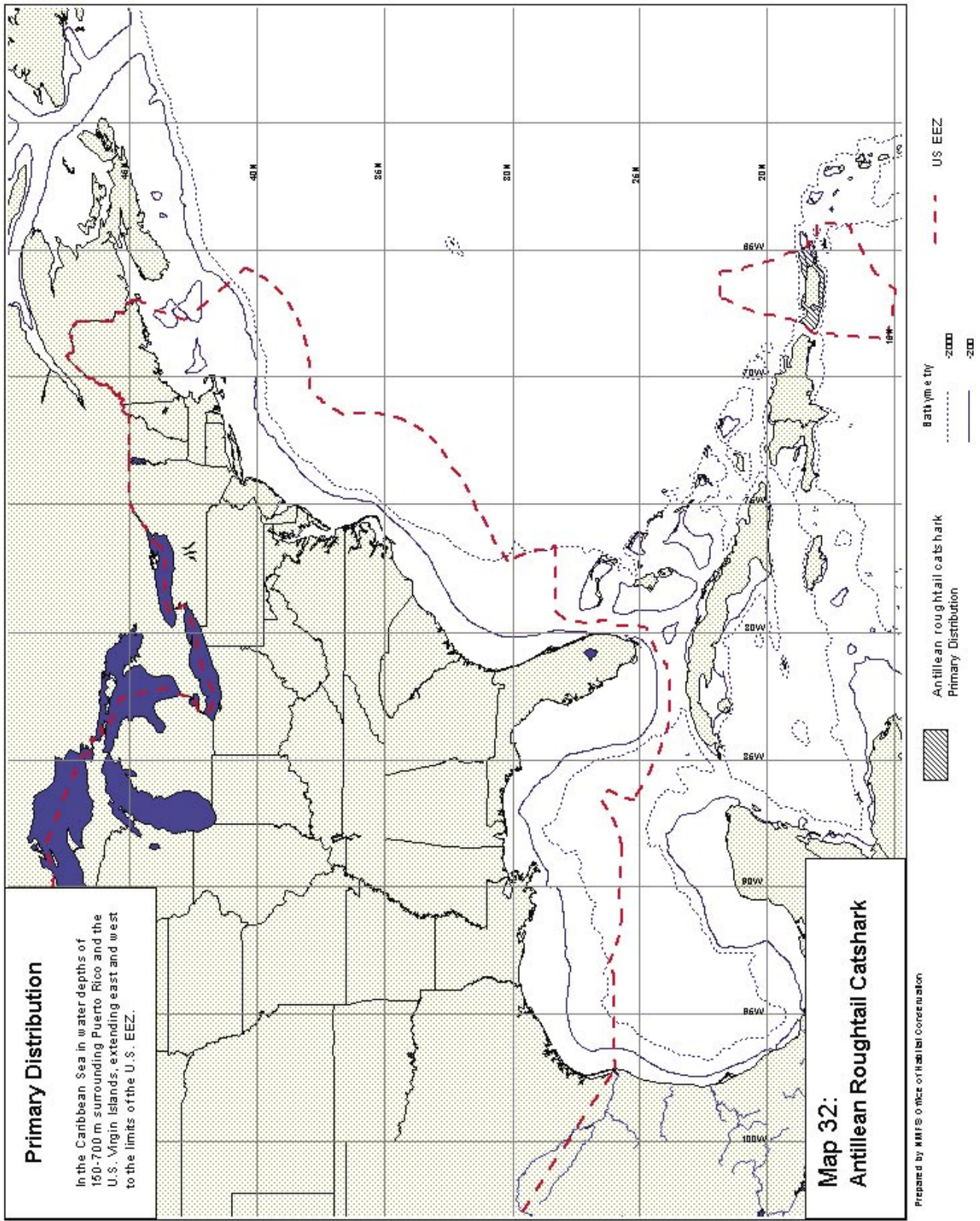
Bathymetry
-2000
-3000

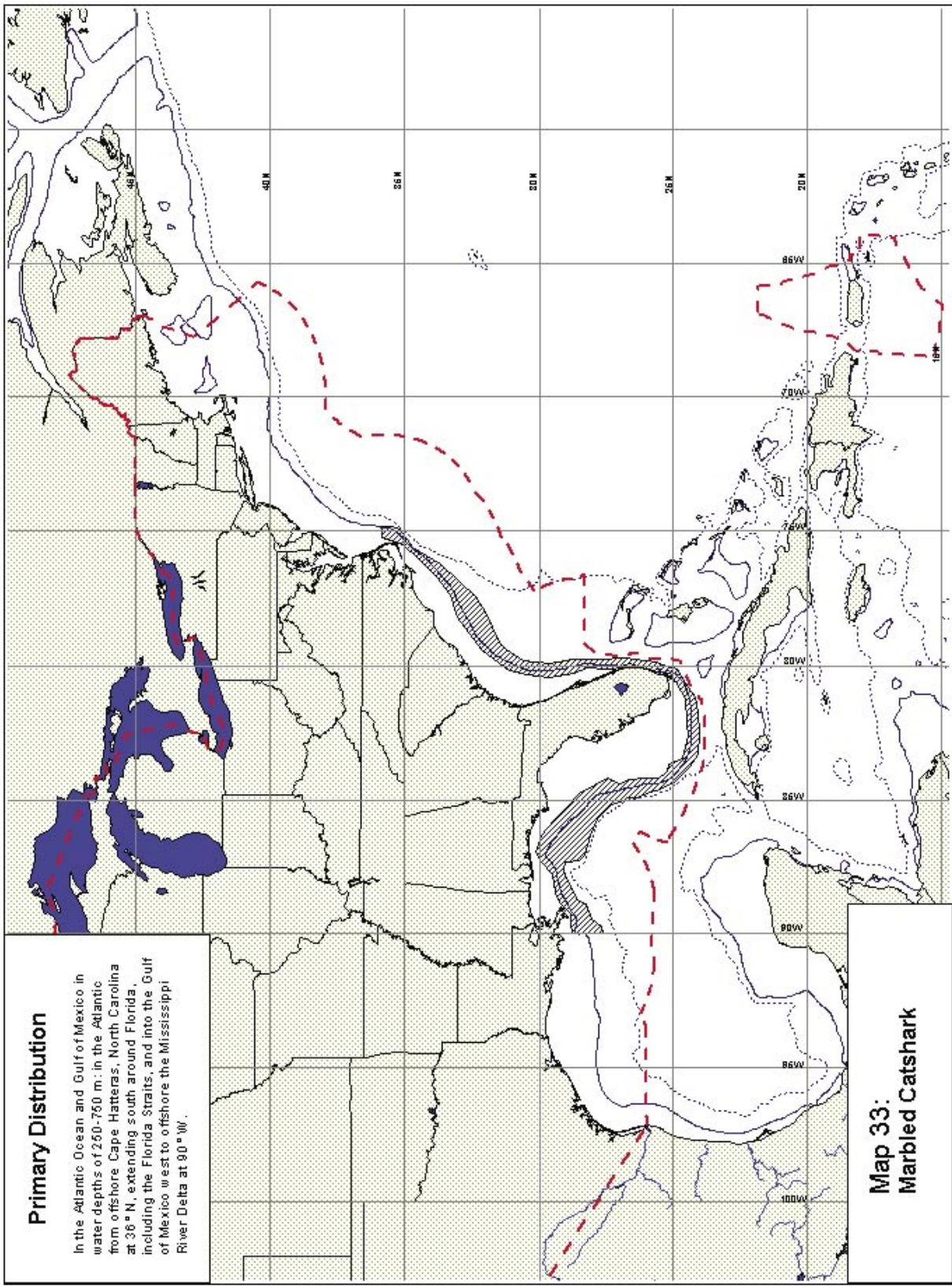
US EEZ

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Primary Distribution

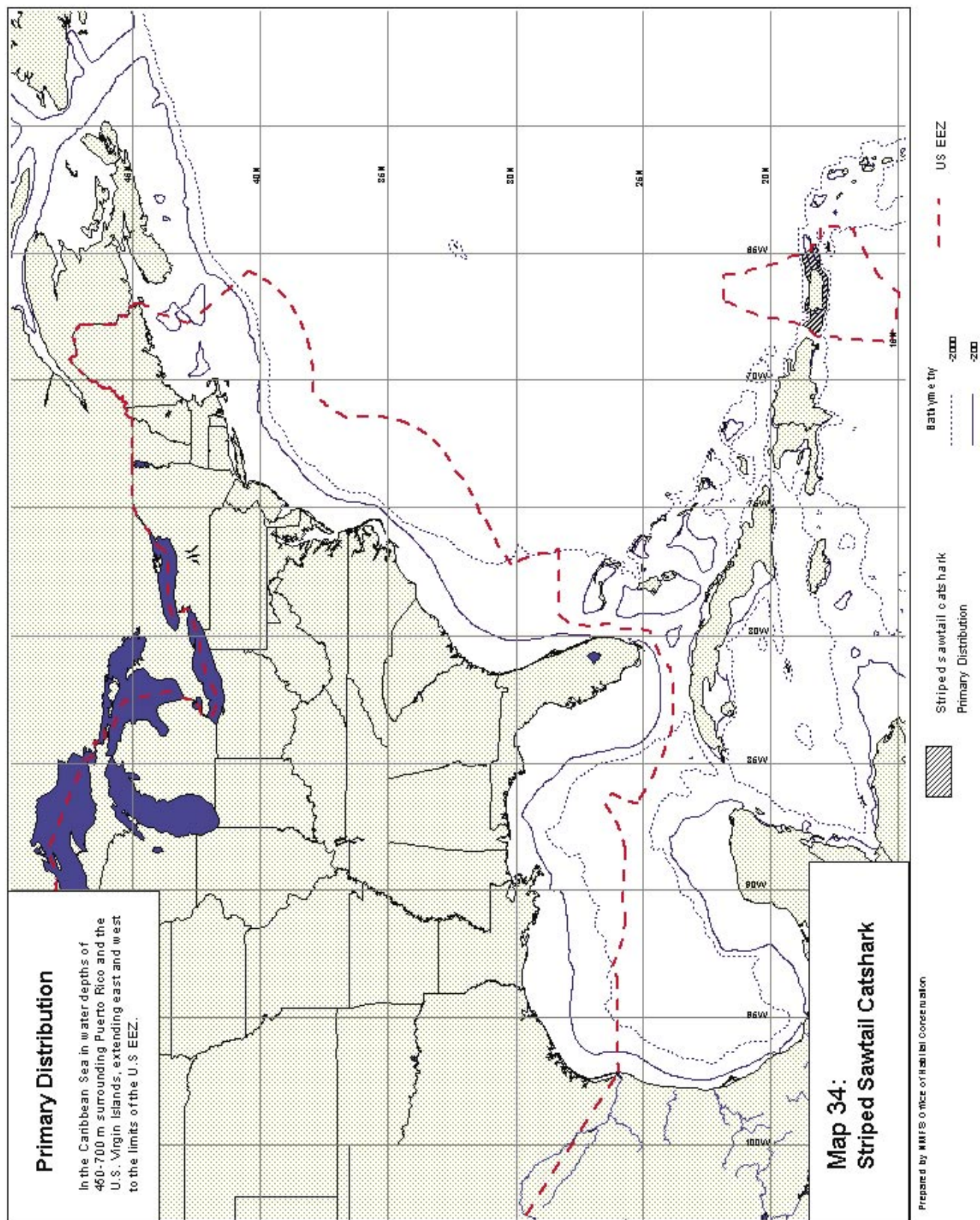
In the Atlantic Ocean and Gulf of Mexico in water depths of 250-750 m; in the Atlantic from offshore Cape Hatteras, North Carolina at 36° N, extending south around Florida, including the Florida Straits, and into the Gulf of Mexico west to offshore the Mississippi River Delta at 90° W.

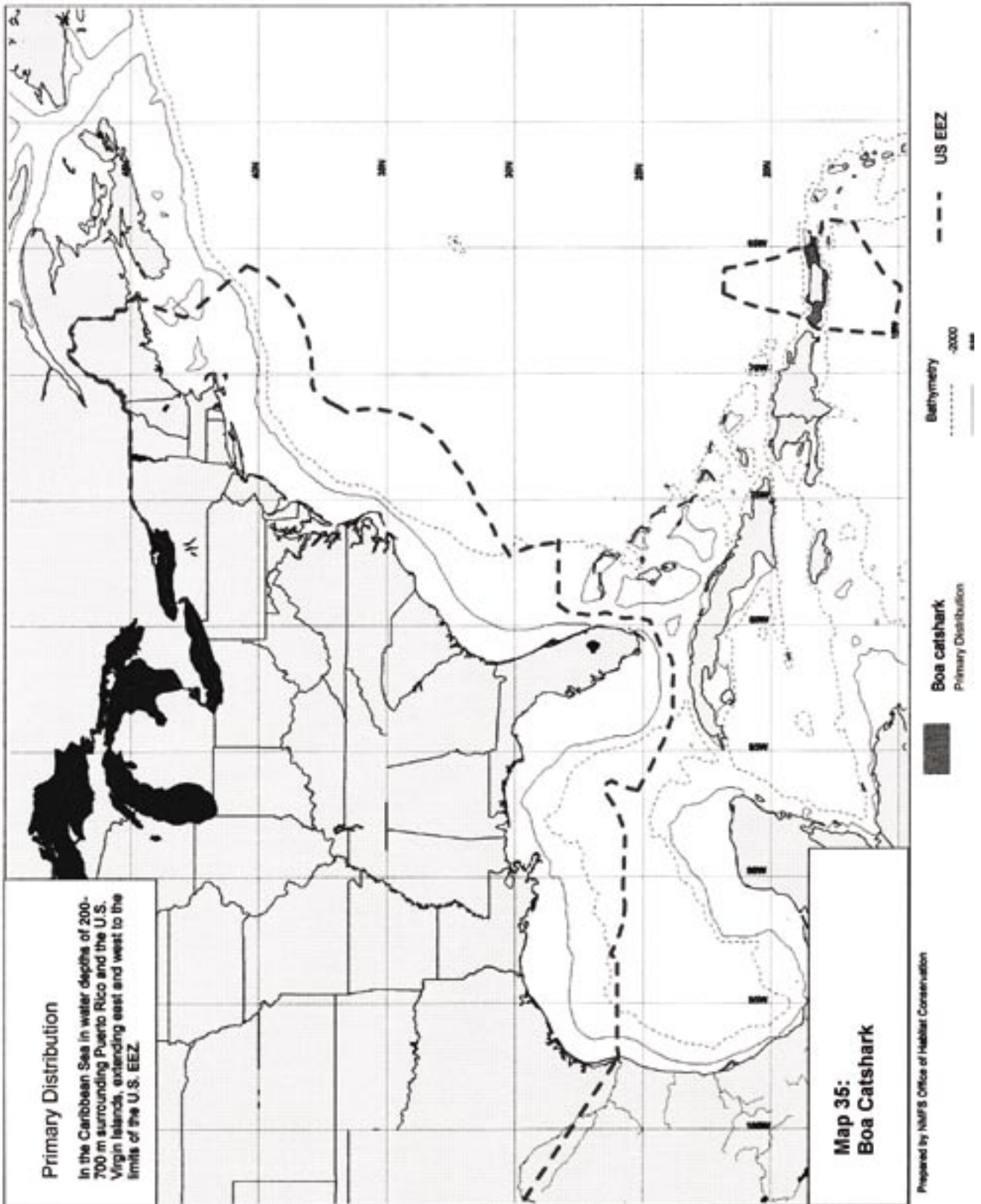
**Map 33:
Marbled Catshark**

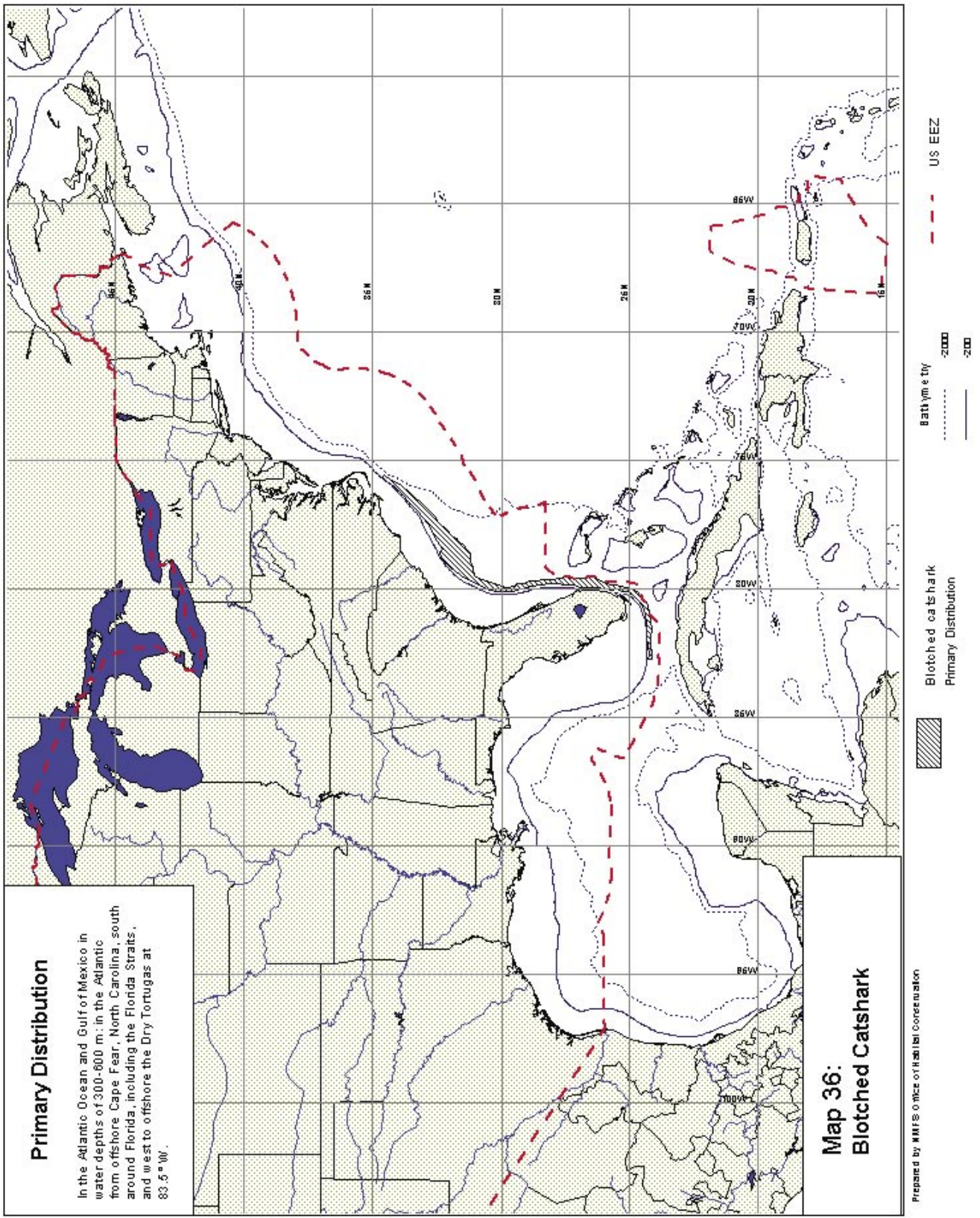
Marbled catshark
Primary Distribution

US EEZ

Prepared by NMFS Office of Habitat Conservation





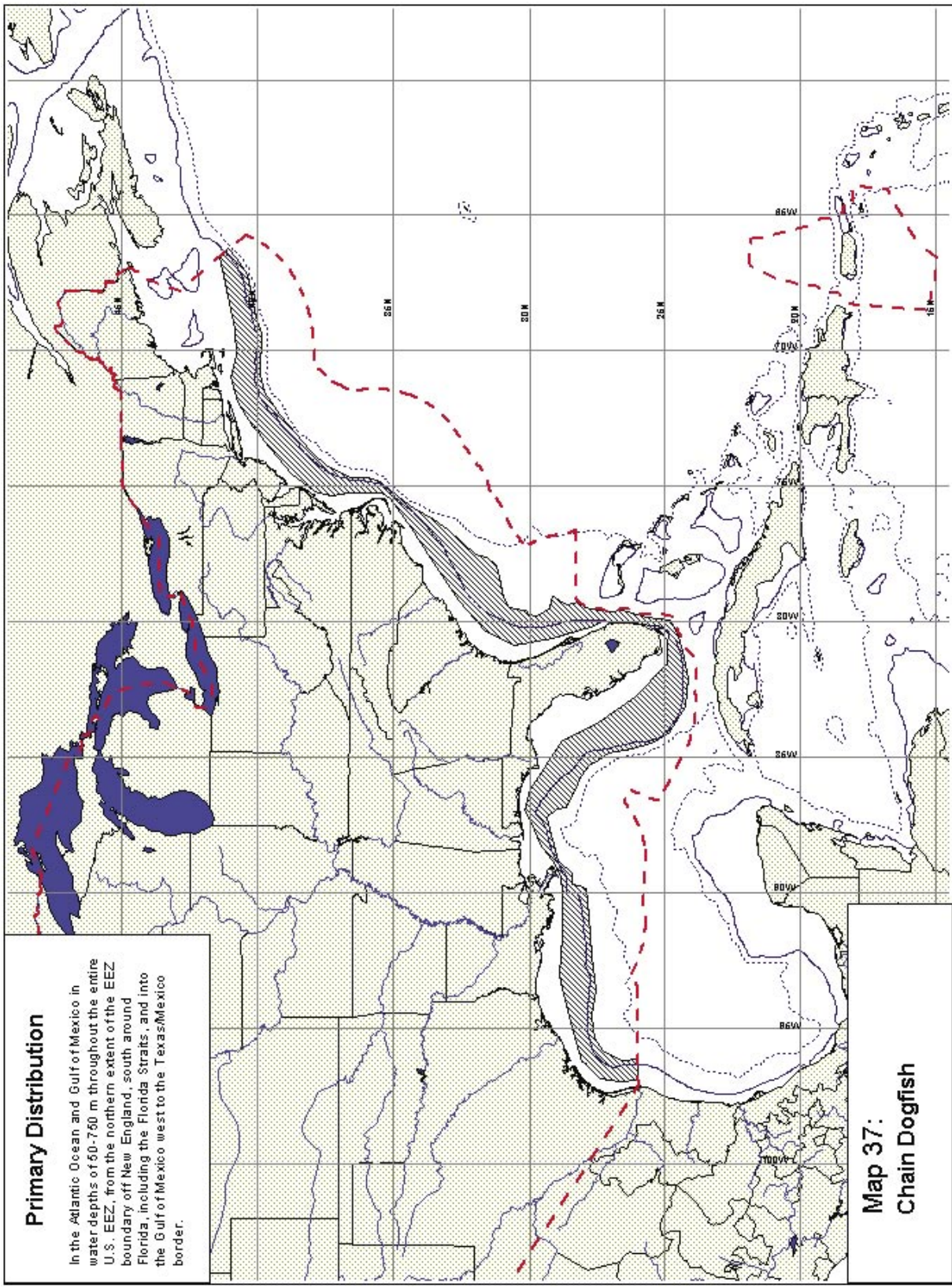


Primary Distribution

In the Atlantic Ocean and Gulf of Mexico in water depths of 300-600 m; in the Atlantic from offshore Cape Fear, North Carolina, south around Florida, including the Florida Straits, and west to offshore the Dry Tortugas at 82.5°W.

**Map 36:
Blotched Catshark**

Prepared by NMFS Office of Habitat Conservation



**Map 37:
Chain Dogfish**

Prepared by NMFS Office of Habitat Conservation

Primary Distribution

In the Atlantic Ocean and Gulf of Mexico in water depths of 60-750 m throughout the entire U.S. EEZ, from the northern extent of the EEZ boundary off New England, south around Florida, including the Florida Straits, and into the Gulf of Mexico west to the Texas/Mexico border.

