4.0 ESSENTIAL FISH HABITAT FOR MANAGED AND SELECTED SPECIES

The identification and description of EFH is by necessity a work in progress. It is work that began with the compilation of information by Mr. Ivan Mateo, who as an intern with the American Fisheries Society and assigned to the CFMC, diligently gathered the data summarized in the EFH Tables in Volume II. The activities carried out by the Office of Ocean Resources Conservation and Assessment Strategic Environmental Assessment (SEA) Division to define and interpret the coupling of species distribution and their habitat requirements are summarized in the following web site (Caribbean): http://christensenmac.nos.noaa.gov/briefing.html. And included in this document as Appendix I (Volume I). The inventory of available databases for the US Caribbean, such as bathymetry, bottom sediments, benthic community distribution, and others has served to establish the first layers of an analytical tool, namely geographic information systems (GIS), that will be most helpful in specifying EFH. The data and information that are missing has been identified in the inventory included in Appendix I (Volume I). Additionally the direction of future research has been delineated in cooperation with a number of individuals and agencies. Many of the government agencies contacted are also in the process of making inventories of the databases available (for example, the AAA – the Water Works Authority). In the case of the AAA, many of the water treatment plants empty into the marine ecosystem and yet the toxicity tests are done on temperate organisms, not on tropical, resident organisms. The U.S. Geological Survey provided sediment maps which have been scanned and which will be referenced to their original databases in the future. The inventory from the USVI and the GIS database is under development by the Conservation Data Center at the University of the Virgin Islands and The Nature Conservancy.

EFH is identified and described based on areas where various life phases of 17 selected species (six under management) and the coral complex commonly occur. The selected species that are used to aid EFH description are: (1) *Epinephelus fulvus* (coney); (2) *Epinephelus guttatus* (red hind); (3) *Epinephelus striatus* (Nassau grouper); (4) *Lutjanus analis* (mutton snapper); (5) *Lutjanus apodus* (schoolmaster); (6) *Lutjanus griseus* (gray snapper); (7) *Lutjanus vivanus* (silk snapper); (8) *Ocyurus chrysurus* (yellowtail snapper); (9) *Haemulon plumieri* (white grunt); (10) *Chaetodon striatus* (banded butterflyfish); (11) *Balistes vetula* (queen triggerfish) (12) *Holocentrus ascensionis* (squirrelfish); (13) *Malacanthus plumieri*, (sand tile fish); (14) *Sparisoma chrysopterum* (redtail parrotfish),; (15) *Lactophrys quadricornis* (trunkfish); (16) *Panulirus argus* (spiny lobster); and (17) *Strombus gigas* (queen conch).

The selected species represent some of the key species under management by the Council. Collectively, these species commonly occur throughout all the marine and estuarine waters of the U.S. Caribbean. The Council believes that the EFH for these species fairly represent the EFH for the remaining species in the management unit. Therefore, EFH for the remaining managed species will be addressed in future FMP amendments, as appropriate.

EFH is defined as everywhere that the managed and selected species commonly occur (see above). Because these species collectively occur in all habitats of the US Caribbean, the EFH includes all waters and substrates (e.g., mud, sand, shell, rock, and associated biological communities), including coral habitats (coral reefs, coral hardbottoms, and octocoral reefs), sub-tidal vegetation (seagrass and algae) and adjacent intertidal vegetation (wetlands and mangroves). Therefore, EFH includes virtually all marine waters and substrates (mud, shell, rock, coral reefs, and associated biological communities) from the shoreline to the seaward limit of the EEZ.

The following sections (4.1, 4.2, 4.3, 4.4) and Section 2.0 identify the EFH for each species' life stage managed by the CFMC and for a number of additional species in the FMU that are used as indicator species.

A. Habitat areas of particular concern (HAPC)

Habitat areas of particular concern (HAPC) are those which are essential to the life cycle of important species. Since Puerto Rico and the USVI estuaries are important to many fishery species, particularly as nursery grounds, we are generically identifying them as HAPCs. Nearshore reefs and other hard bottom areas also are considered HAPCs because of their fishery value. A great deal of life history work needs to be done in order to adequately identify HAPCs. Section 2.0 includes a description of certain areas within the territorial waters of Puerto Rico and the US Virgin Islands which have already been denominated special areas (e.g., Buck Island). The Council has identified the area southwest of St. Thomas USVI, an area known as the "Hind Bank", as an HAPC. Amendment 1 to the Coral FMP establishes a no-take marine conservation district in this area. The area was already seasonally closed to protect the red hind spawning aggregation. The year-round closure is intended to protect corals and associated flora and fauna.

4.1 AMENDMENT TO THE REEF FISH FMP

The Reef Fish FMP includes a large number of species in the FMU. However, only 10 species have specific management measures in place. These management measures include the total prohibition on the harvest of Nassau grouper and jewfish, as well as on the removal of red hind, butterflyfish, and sea horses for the aquarium trade. A size limit of 12 inches is in place for the yellowtail snapper. There are 5 areas that are seasonally closed to all fishing during three months of the year to protect red hind spawning aggregations in the US Caribbean. There is 1 area seasonally closed to protect the spawning aggregation of the mutton snapper. There are other regulations regarding gear and reef fish species, but none that prohibit the deployment of these gears (nets, traps, etc.) under the Reef Fish FMP.

The information available to the Council is presented in the EFH Tables Attached as Appendix A of Section 4 in Volume II). [These Tables are not identified with numbers but by the common and scientific names of the species.] The information that is summarized in the following paragraphs describes what is identified as EFH.

There are 43 species for which EFH Tables are included in this Draft Amendment. EFH is identified and described based on areas where the various life stages of the 15 selected (5 of which are under management) species commonly occur. The selected species to that describe EFH are: (1) *Epinephelus fulvus* (coney); (2) *Epinephelus guttatus* (red hind); (3) *Epinephelus striatus* (Nassau grouper); (4) *Lutjanus analis* (mutton snapper); (5) *Lutjanus apodus* (schoolmaster); (6) *Lutjanus griseus* (gray snapper); (7) *Lutjanus vivanus* (silk snapper); (8) *Ocyurus chrysurus* (yellowtail snapper); (9) *Haemulon plumieri* (white grunt); (10) *Chaetodon striatus* (banded butterflyfish); (11) *Balistes vetula* (queen triggerfish) (12) *Holocentrus ascensionis* (squirrelfish); (13) *Malacanthus plumieri*, (sand tile fish); (14) *Sparisoma chrysopterum* (redtail parrotfish),; and (15) *Lactophrys quadricornis* (trunkfish). The EFH Tables for these species are in Appendix B of Section 4 in Volume II. The EFH described for these species is believed to be representative of the other species in the FMU where insufficient information is available to describe EFH. Sections 5 and 6 describe research needs to better fulfill the requirements of the ACT.

Although *Epinephelus itajara* is a species under management, there is no recent information regarding this species and its EFH Table is included in Appendix A of Section 4 in Volume II.

The selected species represent some of the key species under management by the Council and key species in the commercial catch. The criteria for selecting these species included the availability of a database and the information available to the Council regarding the type of habitat they most closely represent. For example, fishery-independent data is available for the trunkfish Lactophrys quadricornis (see below); a species that could be used an indicator species for seagrass habitats.

Collectively, these species commonly occur throughout all the marine and estuarine waters of the U.S. Caribbean. EFH for the remaining managed species will be addressed in future FMP amendments, as appropriate.

Most of the information has been summarized in Section 2 of this document. The information on much of the description of habitat is from the Habitat Section for the Amendment Number 1 to the FMP for Shallow-Water Reeffish Fishery (Amendment Number 1 dated May, 1990). This document adds information regarding EFH for reef fish species and amends the Reef Fish FMP to include the definition and identification of EFH for the species in the FMU.

A. List of actions of Amendment

No Management Measures are proposed at this time.

B. Summary of habitats used by reef fish

The habitats described in Section 2.0 of this document include (1) mangroves; (2) seagrass beds; (3) non-vegetated bottoms such as sand and mud; (4) algal plains; and (5) coral reefs (including solitary corals, patch reefs, emerging reefs, etc.). Other habitat for which there is very little information is hard bottom; amazingly the single most common bottom type in the US Caribbean. There is no overall description of hard bottoms and no map of their distribution. All of the selected species, except for the sand tilefish, have been reported over hard bottom. The water flow, currents, and water movement was also described. Most of the literature reviewed however, did not have information on the life stage of the species reported as present in the specific study sites.

1. Distribution and Habitat Usage by Life Stage

The beginning efforts mapping these distributions of fish species and habitat have resulted in the products available at the following site:

http://christensenmac.nos.noaa.gov/briefing.html

The tables that are presented in the Appendices of these sections were the basis for the map products. The most detailed source of information was the SEAMAP-Caribbean Program. This Program collects fishery-independent data with which it was possible to determine site specificity, although not habitat specificity, for the selected species.

The problem of scale is manifested in the figures where a number of species are shown to overlap. An example is seen in the figure shown at the end of Appendix I (Volume I) (Appendix A) were three species, representing three habitats have been overlaid. The differences in habitat were represented by the sandtile fish (a species which builds burrows in the sand), the red hind (a reef associated species), and the trunkfish (a seagrass associated species). Although there are a few very specific sites for the trunkfish, and the species overlap considerably a pattern begins to emerge. Higher resolution and finer scale analysis could provide a better habitat specific map. The Council as a necessary next step in addressing EFH identifies detailed analysis of the long-term database off the West Coast of Puerto Rico provided by the SEAMAP-Caribbean.

The "best studied" area in the US Caribbean is probably La Parguera. Comprehensive assessments of habitat types and species distributions in this area are underway. New information from this area of relevance to managed species will be incorporated into future Council assessments of EFH.

(a). Eggs

Except for general descriptions there is little information on the distribution of eggs and the development to larvae, let alone information on the settling of fish larvae and subsequent development. All of the 15 selected species have planktonic eggs and larvae, the distribution of which is unknown. Most of the information available for these stages is, except for a few exceptions, only known at the Family level.

The seasonality of the presence or absence of eggs was based primarily on the spawning seasonality of the species. The information on distribution in terms of distance from shore, depth, temperature, and other environmental factors that might affect egg survival is not yet available for the US Caribbean. At present information is being gathered in the area of La Parguera, Puerto Rico regarding fish egg distribution.

(b). Larvae

Presence or absence of larvae has also been determined from the available information on the spawning seasonality of the species. The information on distribution in terms of distance from shore, depth, temperature, and other environmental factors that might affect larval survival is not yet available for the US Caribbean. At present information is being gathered in the area of La Parguera, Puerto Rico regarding larval fish distribution.

(c). Juveniles

Much of the literature that has been reviewed includes listing of species "seen" in the study areas but fail to provide information of the life stage of the individuals seen. Often there are no data on the size of the fish, an important variable in determining whether the fish are juveniles or adults.

Most of the information on feeding is limited, for many species, to stomach contents described for a "range of sizes" of individuals caught over a "range of habitats" (Randall, 1968).

Juvenile grunts are reported to use the spines of urchins (Diadema antillarum) during the early stages, 20-40 mm in length, and an age of 1 to 2 months. These juveniles also use Acropora cervicornis among other branching corals. The use of urchin spines has been explained as offering protection from predation by moray eels, Nassau and other groupers, snappers, and barracuda. Branching corals occur dispersed over sand bottoms, seagrass beds, around reefs (emergent or submerged), etc. and are used by both early and late juveniles.

Nursery grounds for red hind, the most important grouper, at present, in the commercial harvest, for example are still unknown. These have been seen in habitats described as shallow (less than 10 m) sand and coral rubble areas (Sadovy per. obs), including beer cans (per. obs.) and in areas with the same characteristics but at 20-30 m depths (J. Beets).

(d). Adults

Spawning areas for red hind have been identified in Federal and State waters and most are already under management. The Regulatory Amendment to the Reef Fish FMP (dated August 1996) protects two additional sites off the West Coast of Puerto Rico. The proposed Amendment Number 1 to the Coral FMP (dated May 1998) includes as one of the alternatives the establishment of a no-take zone in what is known as the "hind bank" (see Section 4.4). The area is already under a seasonal closure to protect the red hind spawning aggregation; a management measure which has been shown to be successful. Still there is no detailed description of these areas. The best description available to the Council is that of the hind bank on the southwest of St. Thomas (e.g., Beets and Friedlander 1997; Olsen and LaPlace 1978). The red hind aggregations take place in areas of high relief (apparently uncommon in the USVI platform) with large colonies of Montastrea annularis. The data is not available at this time to determine if the same is true for the other already protected aggregations.

The fishery for Nassau grouper and Jewfish are closed. Historical spawning areas and nursery grounds are known but all of these areas continue to be fished for other species which appear to have replaced these larger groupers. Of the other groupers, the red hind, rock hind, and graysby support the grouper fishery in the US Caribbean. Several known spawning areas have been closed during the spawning season but others continue to be fished. As stated in Appendix I (Volume I), new benthic community maps will become available in the near future for the USVI. However, the Council has identified and inventoried a number of olds maps (e.g., 1958-1959; 1971; 1982-1983) which describe the communities at that time and which could be digitized to determine changes in area and perhaps "migration" of some habitat types.

Size at sexual reproduction, which until recently has been largely unknown for reef fish in the US Caribbean (Table below) have served as the basis for the first steps in trying to identify specific juvenile and adult areas.

Information for Puerto Rico

Species (numbers in () are references)	Size at sexual Overall	fishery-independent females	 males	fishery-dependent	
		mm FL	mm FL	mm FL	mm FL
Epinephelus striatus	300 mm TL (1)				
Epinephelus guttatus	215 mm FL (2)	262.6 (3)	304.1 (3)		
Epinephelus fulvus		208.7 (3)	217.5 (3)		
Ocyurus chrysurus	260 mm FL (1)	268.6 (3)	250.2 (3)	248 (4)	224 (4)
Lutjanus analis					
Lutjanus apodus	250 mm FL (1)				
Lutjanus griseus					
Lutjanus vivanus	470 mm FL (5) 400-490 mm SL USVI (8)	500 (5) 274.6 (3)	380 (5) 276.1 (3)	410 (6)	265 (6)
Chaetodon striatus		119.4 (3)	122.2 (3)		
Holocentrus ascensionis	135 mm TL (1)	205.1 (3)	208.7 (3)		
Haemulon plumieri	144 mm TL (1)	233.9 (3) 210 (7)	255.2 (3) 165 (7)		
Balistes vetula		309 (3)	324.2 (3)		
Malacanthus plumieri		309.3 (3)	350.9 (3)		
Sparisoma chrysopterum	235 mm FL (4)	246.7 (3)	258.5 (3)		
Lactophrys quadricornis (this species should be a seagrass indicator)		251.8 (3)	247 (3)		

References:

(1) CFMC. 1985. Reef fish FMP.
(2) Sadovy, Y., A. Rosario, and A. Roman. 1994. Reproduction in an aggregating grouper, the red hind, Epinephelus guttatus. Environ Biol. Of Fishes 41:269-286
(3) Rosario, A. 1997. Size of 50% maturation of marine fishes from Puerto Rico. Proceedings Gulf and Caribbean Fisheries Institute, 50th Meeting, Merida Mexico (in press).
(4) Figuerola, M y W. Torres. 1997. Madurez y estacionalidad reproductiva de cuatro especies de peces de arrecife de importancia comercial en Puerto Rico. Puerto Rico Department of Natural and Environmental Resources. 33p
(5) Boardman, C. and D. Weiler. 1979. Aspects of the life history of three deepwater snappers around Puerto Rico. Proc GCFI 32:158-172.
(6) Figuerola, M. 1991. Aspectos reproductivos del chillo Lutjanus vivanus (Cuvier, 1828) (Pisces: Lutjanidae) en el Oeste de Puerto Rico y sus implicaciones para el manejo pesquero. Memorias del XVII Simposio de los Recursos Naturales. Depto. Rec. Nat. de PR. Noviembre 1991.
(7) Roman, A.M. 1991. Estudio sobre la dinamica reproductiva de la cachicata blanca Haemulon plumieri (Lacepede, 1802) (Pisces: Pomadasyidae). MS Universidad de Puerto Rico-Mayaguez. 120p
(8) Sylvester, J.R. 1974. A preliminary study of the length composition, distribution and relative abundance of three species of deepwater snappers from the Virgin Islands. J.Fish Biol 6:43-49.

2. Habitat Condition

The information on habitat condition, to the extent possible, has been reviewed in Section 2.0 of this document.

EFH is defined as everywhere that the above-managed species commonly occur. Because these species collectively occur in all habitats of the U.S. Caribbean, EFH includes all waters and substrates (e.g., mud, sand, shell, rock, and associated biological communities), including subtidal vegetation (seagrasses and algae) and adjacent intertidal vegetation (wetland and mangroves). Therefore, EFH includes virtually all marine waters and substrates (mud, shell, rock, coral reefs, and associated biological communities) from the shoreline to the seaward limit of the EEZ.

The following tables summarize data on presence or absence of selected species of finfish for each of their life stages. These data are summarized from (a) EFH Tables found in Volume II, and (b) EFH Tables found in Appendix I (Volume I).

Summary information
P= present; A= absent O=no data

Epinephelus fulvus	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	A	A	A
SEAGRASS	A	A	O	A	A
ALGAE	A	A	**P**	O	O
PLAIN	A	A	**P**	**P**	O
REEF	A	A	**P**	**P**	**P**
REEF/SAV INTERFACE	A	A	O	O	O
SAND	A	A	O	O	O
HARD	A	A	**P**	**P**	**P**
MUD	A	A	A	A	A

Epinephelus guttatus	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	A	A	A
SEAGRASS	A	A	O	O	A
ALGAE	A	A	**P**	O	O
PLAIN	A	A	**P**	**P**	O
REEF	A	A	**P**	**P**	**P**
REEF/SAV INTERFACE	A	A	O	O	O
SAND	A	A	O	O	O
HARD	A	A	**P**	**P**	**P**
MUD	A	A	A	A	A

Epinephelus striatus	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	O	O	**P**	A	A
SEAGRASS	O	O	**P**	O	A
ALGAE	O	O	O	O	O
PLAIN	A	A	**P**	**P**	O
REEF	O	O	**P**	**P**	**P**
REEF/SAV INTERFACE	O	O	**P**	O	O
SAND	O	O	**P**	O	O
HARD	O	O	**P**	**P**	**P**
MUD	O	O	A	A	A

Lutjanus analis	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	**P**	**P**	A
SEAGRASS	A	A	**P**	**P**	A
ALGAE	A	A	**P**	**P**	O
PLAIN	A	A	**P**	**P**	**P**
REEF	A	A	**P**	**P**	**P**
REEF/SAV INTERFACE	A	A	**P**	**P**	O
SAND	A	A	**P**	**P**	O
HARD	A	A	**P**	**P**	**P**
MUD	A	A	O	A	O

Lutjanus apodus	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	**P**	**P**	O
SEAGRASS	A	A	**P**	A	O
ALGAE	A	A	**P**	**P**	O
PLAIN	A	A	**P**	O	**P**
REEF	A	A	**P**	**P**	**P**
REEF/SAV INTERFACE	A	A	**P**	**P**	**P**
SAND	A	A	**P**	**P**	O
HARD	A	A	**P**	**P**	**P**
MUD	A	A	O	O	A

Lutjanus griseus	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	**P**	**P**	A
SEAGRASS	A	A	**P**	**P**	A
ALGAE	A	A	**P**	**P**	O
PLAIN	A	A	**P**	**P**	**P**
REEF	A	A	**P**	**P**	**P**
REEF/SAV INTERFACE	A	A	**P**	**P**	O
SAND	A	A	**P**	**P**	O
HARD	A	A	**P**	**P**	**P**
MUD	A	A	O	O	O

Lutjanus vivanus	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	A	A	A
SEAGRASS	A	A	A	A	A
ALGAE	A	A	O	A	O
PLAIN	A	A	O	A	A
REEF	A	A	**P**	A	O
REEF/SAV INTERFACE	A	A	O	O	O
SAND	A	A	**P**	**P**	O
HARD	A	A	**P**	**P**	O
MUD	A	A	O	**P**	O

Ocyurus chrysurus	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	**P**	O	A
SEAGRASS	A	A	**P**	**P**	A
ALGAE	A	A	**P**	O	O
PLAIN	A	A	**P**	**P**	O
REEF	A	A	**P**	**P**	**P**
REEF/SAV INTERFACE	A	A	**P**	**P**	O
SAND	A	A	**P**	O	O
HARD	A	A	**P**	**P**	**P**
MUD	A	A	O	O	A

Haemulon plumieri	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	**P**	O	A
SEAGRASS	A	A	**P**	**P**	A
ALGAE	A	A	**P**	**P**	O
PLAIN	A	A	**P**	**P**	**P**
REEF	A	A	**P**	**P**	**P**
REEF/SAV INTERFACE	A	A	**P**	**P**	O
SAND	A	A	**P**	**P**	O
HARD	A	A	**P**	**P**	**P**
MUD	A	A	O	**P**	O

Chaetodon striatus	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	O	**P**	A
SEAGRASS	A	A	O	**P**	A
ALGAE	A	A	O	O	A
PLAIN	A	A	**P**	**P**	A
REEF	A	A	**P**	**P**	**P**
REEF/SAV INTERFACE	A	A	O	O	O
SAND	A	A	O	**P**	A
HARD	A	A	**P**	**P**	**P**
MUD	A	A	O	O	A

Balistes vetula	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	A	A	A
SEAGRASS	A	A	A	A	A
ALGAE	A	A	**P**	A	A
PLAIN	A	A	O	**P**	**P**
REEF	A	A	O	**P**	**P**
REEF/SAV INTERFACE	A	A	O	O	O
SAND	A	A	O	O	O
HARD	A	A	O	**P**	**P**
MUD	A	A	A	A	A

Holocentrus ascensionis	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	A	A	A
SEAGRASS	A	A	A	A	A
ALGAE	A	A	O	O	O
PLAIN	A	A	**P**	**P**	O
REEF	A	A	O	P	**P**
REEF/SAV INTERFACE	A	A	O	O	O
SAND	A	A	O	O	O
HARD	A	A	O	**P**	**P**
MUD	A	A	A	A	A

Malacanthus plumieri	**EGGS**	**LARVAE**	**JUVENILE**	**ADULT**	**SPAWNERS**
PLANKTONIC	**P**	**P**	A	A	A
MANGROVES	A	A	A	A	A
SEAGRASS	A	A	A	A	A
ALGAE	A	A	O	O	O
PLAIN	A	A	**P**	**P**	**P**
REEF	A	A	O	O	O
REEF/SAV INTERFACE	A	A	A	A	A
SAND	A	A	**P**	**P**	**P**
HARD	A	A	O	O	O
MUD	A	A	A	A	A

Collectively, the information can be summarized as follows: (a) There is not one habitat that is not utilized by the selected species at some stage of their life history; (b) only 2 species appear to have only one specific habitat during their juvenile phase (queen triggerfish and the squirrelfish); (c) all 15 species have planktonic eggs. There are a number of unknowns: (1) how abundant are these species (or any of the species in the FMU) in any one of these habitats? (2) where are these habitats located in the US Caribbean? (3) how extensive are these habitats and in what condition are they?

Number of species present per habitat based on 13 of the selected species

	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS	
PLANKTONIC	13	13	0	0	0	
MANGROVES	N/A	N/A	6	4	N/A	
SEAGRASS	0	0	6	5	N/A	
ALGAE	0	0	8	5	N/A	
PLAIN	0	0	11	8	6	
REEF	0	0	10	10	11	Most studied habitat
REEF/SAV INTERFACE	0	0	6	5	1	
SAND	0	0	8	7	1	
HARD	0	0	10	12	11	Most common habitat
MUD	0	0	N/A	2	N/A	

These data are considered to be representative of the species and are useful in providing an idea of which species are found per habitat. However, further habitat evaluations are needed to complete the information gaps for a more thorough picture. These evaluations include mapping of habitats and density estimates of fish populations.

C. Prey Dependence

Among the selected species there are both prey and predators. For example, the Nassau grouper feeds on small grunts as juveniles and on spiny lobster as adults (among other prey items), the red hind feeds on squirrelfish, the mutton snappers also feed on spiny lobsters as adults, the yellowtail snapper feeds on planktonic organisms as juveniles and prey on fish eggs and larvae as adults. Most finfish have a varied diet of fish, shrimp, copepods, amphipods, cephalopods, stomatopods and crabs among many other organisms.

Several reef fish species feed on sponges, and Zoanthus (a colonial anemone) is a food source of major importance for at least 16 species of fishes in 7 families (Randall, 1967). In this study, polychaetes were among the most important food items of 62 West Indian reef-fish species in 24 families and were surpassed as preferred foods only by crustaceans (copepods, barnacles, amphipods, stomatopods, shrimps, crabs and lobsters). Ophiuroids (brittlestars) were food for 33 fish species and 16 species fed on benthic tunicates. Larger predators such as groupers and snappers feed on fish (e.g., Cubera snapper feeds on red hinds).

The trunkfish feed primarily on sponges and tunicates; queen triggerfish mostly feeds on echinoids (primarily Diadema antillarum) and the redtail parrotfish mostly feed on algae and seagrass (Randall 1967).

D. Review and Update of Amendment

The Habitat Suitability Models (Appendix I (Volume I), Appendix C) shows the combined potential habitat for the selected species. The benthic habitat data for St. John were combined with the information summarized in this section. These data were converted to presence or absence of the selected reef fish species for the various zones, structures and depths at which these occur as taken from the literature (and presented in Volume II Appendix B of Section 4) and knowledgeable people.

The habitat information available from St. John and used in the Habitat Suitability Models is for very shallow, near shore marine areas. The variable of depth in the model then restricts the presence of Lutjanus vivanus, a species that only occurs at depth greater than 20 meters.

Temporal scales have not been incorporated into the models. For example, the spawning season dictates the presence of adults in certain areas (as for the red hind and mutton snapper). Eggs are planktonic and hatch in about 30 hrs (laboratory experiments). Larvae spend hours, days or months in the plankton (at varying depths); juveniles spend 2-3 years in the nursery grounds but some species have diurnal migrations; and adults it seems do not have specific habitat preferences except for Lutjanus vivanus (a species then that is representative of deep water environments). The integration of all this information defines EFH. That is: EFH is defined as everywhere the managed and selected species commonly occur. Because these species collectively occur in all habitats of the US Caribbean, the EFH includes all waters and substrates (mud, sand, shell, rock, and associated biological communities), including coral habitats (coral reefs, coral hardbottoms and octocoral reefs), sub-tidal vegetation (seagrasses and algae) and adjacent intertidal vegetation (wetland and mangroves).

4.2 AMENDMENT TO THE SPINY LOBSTER FMP

The EFH Table for Panulirus argus can be found in Volume II under Section 4 Appendix D. Also, Table 15 in Appendix B of Appendix I (Volume I) shows the summary information for EFH by life stage that was used in the modeling of potential EFH of the spiny lobster depicted in Appendix C (Habitat Suitability Models) of Appendix I (Volume I).

This document broadens the habitat section of Amendment #1 (1990), regarding EFH for spiny lobster, and amends the Spiny Lobster FMP to include the definition and identification of EFH for the species in the FMU.

A. List of actions of Amendment

No Management Measures are proposed at this time.

B. Summary of habitats used by spiny lobster

Work in progress at the Department of Marine Sciences, University of Puerto Rico, Mayaguez Campus (Dr. Jorge Garcia Sais and his group) will be of great importance in the determination of EFH for the early life history stages of the spiny lobster, Panulirus argus, as well as for many other species. Meanwhile, the following table summarizes the presence (P) or absence (A) of Panulirus argus from the various habitats described in Section 2 of this document and the information presented in the Lobster FMP, Amendment and below. These habitats are areas where they are commonly found. This simple table establishes also the missing information regarding this species (O), habitats from which the spiny lobster has not been reported in the US Caribbean.

Spiny Lobster Panulirus argus

	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	P	P	A	A	A
MANGROVES	A	A	P	O	O
SEAGRASS	A	A	P	P	O
ALGAE	A	A	P	O	O
PLAIN	A	A	P	O	O
REEF	A	A	P	P	P
REEF/SAV INTERFACE	A	A	P	P	O
SAND	A	A	O	O	O
HARD	A	A	P	P	O
MUD	A	A	O	A	A

1. Distribution and Habitat Usage by Life Stage

Most of the information has been summarized in Section 2 of this document. The information on much of the description of habitat is from the Habitat Section for the Lobster FMP (Amendment Number 1 dated November, 1990).

(a). Eggs

Male spiny lobsters deposit sperm packets on the underside of the female. The fertilized eggs stick to the swimmerets beneath her tail and hatch in about four weeks. Mating takes place at the shelf edge.

(b). Larvae

The larval stage of spiny lobster is long (0-6 months) and there are numerous planktonic larval stages (phyllosoma). The distribution of lobster phyllosoma larvae (Panulirus) in the water column (depth), its temporal and ontogenetic patterns across an inshore-offshore gradient is currently being undertaken (Sabater and Garcia, 1997: GCFI 50th Meeting). Seasonal variation in depth (e.g. absent from the surface (0-20 m) in May and most abundant at the surface in August) and horizontal distribution (maximum abundance at the innermost stations) are currently being assessed for the area of La Parguera, Puerto Rico.

Phyllosoma larvae have been reported from beyond their normal tropical range. Temperature tolerance for post-larvae is high ranging from 10 to 35 degrees C.

Post-larval recruitment has been scantly assessed in the US Caribbean (i.e., Monterrosa, 1986; Maidment, 1997 (USVI SEAMAP-Caribbean Program)). The Puerto Rico SEAMAP-Caribbean Program is currently assessing post-larval recruitment on the West Coast of Puerto Rico. Pueruli have been collected in Acanthopora clumps and Thalassia beds but were never found in coral rubble (Monterrosa, 1986). Additional juvenile habitat includes sea urchins, algal mats (plains), and rock crevices. All these habitats reported from very shallow areas.

(c). Juveniles

The most important habitats for juvenile lobster appear to be Thalassia beds and mangroves. At an age of about 2 years emigration to reef areas begins.

(d). Adults

Adult populations of Panulirus argus are associated with reefs and hard bottoms, mostly with coral outcrops, crevices, caves, and ledges. The association of adult Panulirus argus to seagrass beds and algal plains relates to their nocturnal feeding activities.

2. Habitat Condition

There is no quantitative information available to the Council to determine the condition of habitats used by spiny lobster.

Among the information needs to assess the condition of habitats utilized by the various life stages of the spiny lobster: The identification and mapping of shelf and slope habitats and the areal extent and distribution of juvenile habitats. Of outmost importance is the mapping of seagrass beds that are described as EFH for spiny lobster juveniles.

C. Prey Dependence

Panulirus argus depends on the healthy condition of seagrass beds were most of the adult feeding activities take place. Among the prey items identified for spiny lobster are mollusks, crustaceans, echinoderms, annelids, and sponges.

D. Review and Update of Amendment

The Habitat Suitability Models (Appendix I (Volume I), Appendix C) shows the combined potential habitat for Panulirus argus. The benthic habitat data for St. John were combined with the information summarized in this section. These data were converted to presence or absence of spiny lobster for the various zones, structures and depths at which lobsters occur as taken from the literature (and presented in Volume II Appendix D of Section 4) and knowledgeable people.

4.3 AMENDMENT TO THE QUEEN CONCH FMP

The Queen Conch FMP dates to 1996. The document describes EFH for eggs (which are demersal), larvae (that are pelagic), juveniles (which bury in sand/seagrass-beds, as best is known), and adults (which are found in a number of habitats such as reef, sand, seagrass, etc.). The areas from which these descriptions are obtained are limited in number (e.g., La Parguera area in Puerto Rico or transect data from around the USVI) but are thought to be representative of the habitat preference during the various life stages of the queen conch Strombus gigas.

The EFH Table for Strombus gigas can be found in Volume II under Section 4 Appendix E. Also, Table 16 in Appendix B of Appendix I (Volume I) shows the summary information for EFH by life stage that was used in the modeling of potential EFH depicted in Appendix C (Habitat Suitability Models) of Appendix I (Volume I).

This document amends the Queen Conch FMP to include a description of EFH for Strombus gigas.

A. List of actions of Amendment

No Management Measures are proposed at this time.

B. Summary of habitats used by queen conch

The following table summarizes the presence (P) or absence (A) of Strombus gigas from the various habitats described in Section 2 of this document; the information from the FMP and that presented below. These habitats are areas where they are commonly found. This simple table establishes also the missing information regarding this species (O), habitats from which queen conch has not been reported in the US Caribbean.

Queen Conch Strombus gigas

	EGGS	LARVAE	JUVENILE	ADULT	SPAWNERS
PLANKTONIC	A	**P**	A	A	A
MANGROVES	A	A	O	A	A
SEAGRASS	**P**	A	**P**	**P**	**P**
ALGAE	A	A	A	A	A
PLAIN	**P**	A	**P**	**P**	**P**
REEF	A	A	**P**	P	A
REEF/SAV INTERFACE	O	A	**P**	O	O
SAND	**P**	A	**P**	P	P
HARD	A	A	A	P	A
MUD	A	A	A	A	A

1. Distribution and Habitat Usage by Life Stage

(a). Eggs:

As stated in the Queen Conch FMP (1996) eggs masses are spawned in clean coral sand with low organic content but have also been reported from seagrass beds (historical information). Females cover the egg mass with sand grains. The production of egg masses has been correlated to temperature and weather conditions (highest temperatures and longer photoperiods increase number of egg masses while stormy weather conditions decrease the number of egg masses laid. Incubation period is about 5 days.

(b). Larvae:

The larvae (known as veligers) of the queen conch are pelagic. Substrate conditions to metamorphose and settle to the bottom seem critical but unfortunately at present the requirements are largely unknown (Queen Conch FMP, 1996). No additional information is available to the Council at this time. The laboratory data could be applied to environmental gradients in the field once these have been identified.

Larvae have been found offshore and can be transported up to 26 miles per day (i.e., 540 miles during the 3- week larval period). Posada and Appeldoorn (1994) however conclude that even when larvae are found offshore most larvae are retained within the area where they spawned.

(c). Juveniles:

The information available to the Council that identifies EFH for juveniles is presented in the Queen Conch FMP (1996). Very little information has become available to the Council since the Queen Conch FMP was prepared and approved. The most important task in relation to EFH for each of the life stages is to identify the location and distribution as well as to assess the condition of these habitats.

Little is known about juveniles in the wild. Juveniles are found buried in the sediment, the burial depth changing with size. For example, conch 35-54 mm are found buried 3-4 cm in the sand. Predation is very high at this early stage (e.g., 50% survival reported by Sandt and Stoner, 1993; see Section 2.8). Information is available from laboratory and hatchery reared juvenile that includes a complete description of development, growth, and stocking densities. Field releases of juvenile conch reared in the laboratory have not been as successful as expected.

In the Bahamas, Stoner et al. (1994) found that areas of strong tidal circulation contain a higher number of juveniles. "The occurrence of sandbars, where larval settlement may occur, adjacent to seagrass meadows as nursery areas is potentially significant" at least in Lee Stocking Island (Stoner et al., 1994). Stoner and Waite (1990) suggested that seagrass biomass, as well as seagrass shoot density were critical features in these nursery habitats. However, areas with optimal sea grass biomass did not contain the populations of conch expected. A possible explanation is the lack of adequate numbers of larvae available for recruitment to prime settlement grounds. It also may be speculated that other more important aspects of the habitat needed for settlement were absent. Among these, are the overall condition of the habitat (e.g., increased sedimentation, sediment size and type, water quality, etc.), the availability of a required food, and the number of juveniles already present in the area. Davis and Stoner (1994) showed that for laboratory cultured conch, larvae metamorphose in response to algae, epiphytes, and sediments found in natural nursery grounds. However, they reported that no conch metamorphosed when exposed to conspecifics.

Required habitat for juvenile conch includes among other things a delicate balance between seagrass beds and the surrounding sandy areas. Juveniles require red algae for feeding. The degradation of these habitats worsens the problem of overfishing since for juvenile settlement the presence of other juveniles seems to be required (Stoner and Ray, 1993).

(d). Adults:

Queen conchs are found on sandy bottoms that support the growth of seagrasses and epiphytic algae upon which they feed. They also occur on gravel, coral rubble, smooth-hard coral, or beach rock bottoms.

Queen conch commonly occur on sandy bottoms that support the growth of seagrasses, primarily turtle grass (Thalassia testudinum), manatee grass (Syringodium filiforme), shoal grass (Halodule wrightii), and epiphytic algae upon which they feed (Randall, 1964). They also occur on gravel, coral rubble, smooth hard coral or beach rock bottoms and sandy algal beds. They are generally restricted to waters where light can penetrate to a depth sufficient for plant growth. Queen conch are reported from depths greater than 200 feet. Queen conch are often found in sandy spurs that cut into offshore reefs. Since conch share habitat with the reef fish and coral reef resources that are already under management, the reader is referred to those FMPs for a more complete description of habitat and to Sections 2 and 4.1 of this EFH document.

2. Habitat Condition

There is no quantitative information available to the Council to determine the condition of habitats used by the queen conch.

Among the information needs to assess the condition of habitats utilized by the various life stages of queen conch: The identification and mapping of shelf and slope habitats and the identification of juvenile habitats.

C. Prey Dependence

The queen conch is one of the largest of the herbivorous gastropods, and uses its highly extendable proboscis to graze algae and seagrasses (Yonge, 1932). In general, Randall (1964) found that the dominant plants within the community where conchs occur tend to be the principal foods. Although seagrasses, such as Thalassia and Halophila, are consumed to a certain extent, various species of algae appear to be the main components of the diet of S. gigas. Robertson (1961) observed conchs grazing on epiphytic algae on Thalassia, but did not find leaves of Thalassia in stomach samples. He noted that algae of the genera Cladophora, Hypnea, and Polysiphonia, in particular, were ingested. Conch accidentally may ingest considerable quantities of sand and small benthic animals while feeding on filamentous and unicellular algae. Randall (1964) reported queen conch feeding during the night. Immature conch, in particular, tend to feed most actively at night, often spending most or all of the day buried in the sand. Queen conch larvae (veligers) feed on small plankton.

D. Review and Update of Amendment

The most recent information on Strombus gigas has been included in the Queen Conch FMP and reviewed in this document. The Council established, through the Queen Conch FMP, a seasonal closure for Strombus gigas to protect the organism during its peak reproductive period. However, there is little information on the distribution of the specific habitats required by conch during its reproductive season. The location, distribution, and area extent of the clean coral sand with low organic content and seagrass beds (historical information) needed for the deposition of eggs. Additionally, the location, distribution, and area extent of the other habitats described herewith for juveniles and adults needs to be assessed.

The Habitat Suitability Models (Appendix I (Volume I), Appendix C) shows the combined potential habitat for Strombus gigas. The benthic habitat data for St. John were combined with the information summarized in this section. These data were converted to presence or absence of the queen conch .for the various zones, structures and depth at which queen conch occur as taken from the literature (and presented in Volume II Appendix E of Section 4) and knowledgeable people.

4.4 AMENDMENT TO THE CORAL FMP

The existing Coral FMP establishes regulations to restrict the taking of coral reef resources in or from the exclusive economic zone (EEZ) around Puerto Rico and the U.S. Virgin Islands. It prohibits the harvest or possession of stony corals, sea fans, gorgonians and any species in the fishery management unit if attached to, or existing upon live-rock; it prohibits the sale or possession of any prohibited species unless imported and fully documented as to a point of origin outside the EEZ; it prohibits the use of chemicals, plants or plant derived toxins, and explosives for harvest (consistent with the Caribbean Council's Reef Fish FMP); and it restricts harvest of other invertebrates to dip nets, slurp guns, by hand and other non-habitat destructive gear

The Council has taken final action on the Amendment Number 1 to the Coral FMP and will be submitting the document to the Secretary of Commerce in October 1998. This amendment establishes a “no-take” Marine Conservation District in the area identified in Section IV of the Amendment, the red hind bank southwest of St. Thomas. The Council will also prohibit anchoring of fishing vessels in the designated MCD.

The Fishery Management Plan (FMP) for corals and reef-associated plants and invertebrates includes over 100 species of coral (including stony corals, sea fans and gorgonians) and over 60 species of plants (including seagrasses) and invertebrates. The EFH Tables for corals can be found in Volume II under Section 4 Appendix F. Also, Appendix I (Volume I) shows the summary information for EFH for the selected species which represents where corals, seagrasses, and other organisms listed in the FMU are present and utilized as habitat that was used in the modeling of potential EFH depicted in Appendix C (Habitat Suitability Models). One of the least complex examples being the potential habitat map for sand tilefish and one of the most complex being the spiny lobster (seagrass and coral reefs).

There is an urgent need to conduct comprehensive quantitative surveys of seagrass and reef habitats throughout the insular platform area of Puerto Rico and the U. S. Virgin Islands. Without such information, it is not possible to adequately document the extent of these habitats, to identify those that may be particularly critical to various life phases of significant commercial and recreational species, or to best locate marine reserves. The collection of this information, which should clearly document and distinguish between living coral (and characterize the sites to species level) and rock substrates, should be considered a key research priority for the management of marine resources in the US Caribbean. Given the likelihood that reef habitats are generally quite limited in distribution they should be considered as 'significant habitats of limited distribution' and managed accordingly

This document amends the Coral FMP to includethe description of EFH for corals andassociated flora and fauna.

A. List of actions of Amendment

No Management Measures are proposed at this time.

B. Summary of habitats used by corals

"Reef corals represent a peculiar situation since, in most cases, they are the main constructors of their own habitat, the coral reef. Therefore, their condition reflects the condition of their habitat. If corals are dead or dying, the coral reef is likely to degenerate. Many other organisms, however, do depend to different extents on the condition of the coral reef. These include commercially important species that utilize corals, directly or indirectly, for shelter, food and as spawning sites (Goenaga and Boulon, 1992)".

1. Distribution and Habitat Usage by Life Stage

(a) Eggs and (b) Larvae

Corals reproduce both sexually and asexually. Sexual reproduction results in the formation of minute larvae (planulae) that spend a variable amount of time in the water column as plankton (from days to weeks), eventually settling on an appropriate substrate. If reproduction is asexual, larvae are brooded in the gastric pouch of the parent and released when ready to settle. Most corals have well defined seasonal patterns of sexual reproduction (Szmant, 1986), and many have quite specific requirements for appropriate settlement substrate.

Larval capacity for substrate selection is unknown for most species but is likely to vary among them. After settling, larvae develop a skeleton and, if colonial, start budding additional polyps that will eventually form an adult colony. Natural selection probably acts more intensely during initial larval recruitment (Crisp, 1977) and is probably the reason for production of vast numbers of gametes. Individuals of some species delay sexual reproduction and use the their available energy for asexual growth until a colony size safe from predation has been attained (Szmant, 1985).

Rock and dead coral surfaces are also vital substrates for the settlement of larval phases of benthic organisms that cannot settle onto living coral. Suitability of substrate is one of the major factors controlling the distribution of many species. For example, natural, rough, substrate covered with other living organisms, presence of other larvae, and absence of certain organisms are all-necessary for octocoral settlement. Many other coral species also have specific substrate requirements for larval settlement. Kinzie (1971) found that natural substrate cleared of other organisms had no appreciable octocoral colonization even after six months (Wheaton, 1989). Other factors that influence the settlement of sessile organisms include total surface area available for settlement, conditioning period of substrate, surface relief including crevices and ridges, substrate orientation, and substrate composition (Wheaton, 1989). Thus, both physical and biological complexity are essential for the development of the reef ecosystem. Coral reefs and live-rock habitats form the backbone of this complex.

(c). Juveniles

Even though Montastrea annularis is one of the most abundant corals off La Parguera and in many reefs off Mayaguez, juvenile colonies of this species have not been commonly reported. The same can be said for other sites in the Caribbean (e.g., Bak and Engel, 1979; Hughes, 1985). Very small colonies of this species can be frequently observed in La Parguera. However, Goenaga and Boulon (1992) report that upon close inspection, it can be seen that these are remnants of larger colonies that have undergone partial mortality and the rest of their skeleton have been covered by other organisms such as filamentous algae. While this is generally true for the USVI as well, very small, apparently juvenile colonies have been observed in certain localities (e.g. Salt River submarine canyon (Boulon, 1979; Beets, pers. comm.)).

(d). Adults

The EFH for corals which are sessile organisms is being defined on the basis of the bottom types were they are found since this is where they feed grow to maturity, breed and spawn. The ability to disperse is achieved through sexual reproduction, known for a number of these species, where eggs and sperm are shed, in most cases once a year, into the water column, mixed and are then at the mercy of the currents and tides. Forms with branching morphology and high growth rates (e.g., Acropora palmata and A. cervicornis) can disperse through breakage during storms (e.g., Highsmith, 1982). Resulting fragments can, although not always do, recruit onto the substrate, and form a new colony.

It is not the intention of the Council to reproduce in this document the contents of the FMP's it has in place but to identify what is missing from these documents and set forth the direction of research. The Coral FMP (1995) (a fishery management plan for invertebrates, plants and reef associated species) indicates that fisheries are dependent on these organisms as habitat (also food, shelter, to form spawning aggregations, etc.). Most importantly, that management of reef-building corals needs to focus on habitat rather than on individual organisms (Goenaga and Boulon, 1992). Therefore, the lack of available information on their requirements for suitable substrate, temperature, light and water conditions prevents any other action from the Council than to prohibit harvest of all corals (stony, sea fans and gorgonians, any species in the FMU) as determined in the Coral FMP. The reasons for this are the following:

Most information available is for organisms found in emergent coral reefs (those that break the surface).

There are no maps of the submerged coral reefs, algal plains or seagrass beds and thus their location, area, condition, and their requirements are for the most part unknown.

2. Habitat Condition

Most of the information available to the Council indicates that the temperature, salinity, turbidity, water quality in general, tolerance ranges are derived from adult corals. In general, corals can withstand salinity of 27 to 40 ppt; upper temperature tolerance of 39 degrees C depending on the species, variations in PAR and UV tolerance, etc. These ranges in tolerance are broad and most possibly it is a combination of various environmental changes which cause such events as bleaching. The health status of the colonies are not well documented, except for very specific areas, and its age or condition might also be a factor to consider when trying to determine EFH for corals.

Coral communities exist under a variety of water depths, bottom type, water quality, wave energy, and currents. Well-developed active coral reefs usually occur in tropical and subtropical waters of low turbidity, low terrestrial runoff, and low levels of suspended sediment. Corals may occur scattered in patches attached to hard substrates. Coral reefs in the US Caribbean are formed by the major reef-building coral genera, Acropora, Montastrea, Porites, Diploria, Siderastrea and Agaricia (Tetra Tech, 1992).

The associations, multiple, complex and not well known, of corals and other reef plants and invertebrates, are altered by other organisms (e.g., finfish, urchins, etc.). The specific incidences of changes associated to mass mortality of urchins and other events are summarized in the Coral FMP.

Among other changes that might take place on coral reefs as habitat for other species are those induced by feeding from, for example turtles. Stomach contents of Hawksbill turtles (Vicente, V.P. 1993. Spongivory in Caribbean Hawksbill turtles, Eretmochelys imbricata: data from stranded specimens. Thirteenth Annual Symposium on marine turtle biology and Conservation) show that both juveniles and adults depend on the following species: Chondrila nucula (chicken liver sponge); Chondrosia collectrix and Geodia sp., among a few others. Van Dam and Diez [van Dam, R.P. and C.E. Diez. 1996. Predation by hawksbill turtles on sponges at Mona Island, Puerto Rico. In: Proceedings of the Eighth International Coral Reef Symposium, June 24-29, 1996, Panama] reported that the highest ranking food items found in the hawksbill diet (both juveniles and adults) were sponges (Desmospongiae): Geodia neptuni; Polymastia tenax, Stelletinopis dominicana and Coelosphaera raphidifera and algae.

Possibly the most important threat to corals in Puerto Rico and the USVI is inland deforestation, particularly (although not necessarily restricted to) that adjacent to fringing and platform coral reefs. Sediments derived from inland deforestation are detrimental to reef corals and, therefore to coral reefs, in ways mentioned above (see section on Anthropogenic stressors). Additionally, our coral reefs are stressed, although to generally unknown extents, by chemical pollutants, indiscriminate and careless commercial and scientific collection of living corals, collection of "live rock" (coral reef portions frequently containing endolithic biota as well as living postlarval, juvenile and/or adult corals), and commercial collection of both juvenile and adult reef fish. The latter is largely responsible for unbalances in our reef systems resulting in low or no recruitment and a gradual degradation of these once productive systems. (Goenaga and Boulon 1992)

The corals most likely to be affected are those inhabiting fringing reefs (i.e., those closest to shore) which are generally under the direct influence of human activities (Goenaga, 1986). Those that presumably are least affected by anthropogenic effects are those farthest from land (e.g., shelf edge reefs). Shelf-edge reefs and bank barrier reefs (those in mid portions of insular platforms) are also subject to siltation by dredging and by fishing activities as well as by ocean outfalls.

C. Prey Dependence:

The following text is from Goenaga and Boulon (1992) from a report submitted to the Council.

Cnidarian, skeleton forming animals are well equipped to capture and eat living animal prey. They possess tentacles loaded with batteries of nematocysts. These are stinging cells that serve to paralyze and kill zooplankton. Hermatypic corals (scleractinians and, possibly, hydrocorals and gorgonians), however, are considered polytrophic organisms (Muscatine and Porter, 1977). This means that they can feed at multiple levels in the food web. These modes of feeding include (a) dissolved and suspended organic matter (auxotrophic), (b) photosynthesis from zooxanthellae (primary consumers), and, (c) zooplankton (secondary consumers). In addition, their capacity to photosynthesize, as a symbiotic unit with zooxanthellae, makes them a very special case of primary producer, in which production exceeds consumption in many cases. Hermatypic gorgonians have abundant zooxanthellae in their tissues. The extent to which different species depend on their zooxanthellae for nutrition is, to a large extent, unknown (Muzik, 1982).

Black corals do not contain zooxanthellae. Their tentacular muscles are not well developed and tentacular contraction and retraction are slow. Even so, when presented in the laboratory with living zooplankton they exhibit an efficient preying response. Living food is rapidly engulfed with the aid of ciliary currents inflowing through the pharynx into the gastrovascular cavity.

D. Review and Update of Amendment

The fact that hermatypic corals are capable of forming reefs sets them apart from the other types of corals. Reef-forming corals are habitat-generating organisms and this aspect poses important management considerations. Management of the reef-building corals will need to focus on the habitat rather than on individual organisms (Goenaga and Boulon, 1992). Coral reefs are highly complex and diverse communities of biota the distribution and condition of which are regulated by their requirements for suitable substrate, temperature, light, and water conditions.