

FM Coll
v. 2

Essential Fish Habitat (EFH) Generic Amendment
To The
Fishery Management Plans (FMPs)
Of The
U.S. Caribbean
Including a Draft Environmental Assessment
Volume II
(APPENDICES)

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CARIBBEAN FISHERY MANAGEMENT COUNCIL
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Volume II

Need Titles

Appendices for:

Section 3

Appendix A - FMP Mgt. Unit Species - List

Section 4 EFH for managed species

Appendix A - { Summary tables of fish species
Association + interaction
(with env. and habitat variables

Appendix B - EFH Tables for life stages

Appendix C - { Reef Fish Species - Selected
Habitat + habitat occurrence for ~ (17) selected species

Appendix D - Map

Appendix E - Queen Coral

Appendix F - Coral

Section 5

Appendix A - Non Fish Impacts

Appendix B - Reef Fish And. 3

1. Reef Fish FAMILIES

2. Surge / Surgefish

1. *Thalassoma*, *Thalassoma* spp.
2. *Goniistius*, *Goniistius* spp.
3. *Odontaspis*, *Odontaspis* spp.

3. Surge / Surgefish

4. *Thalassoma*, *Thalassoma* spp.

4. Surge / Surgefish

5. *Thalassoma*, *Thalassoma* spp.

5. Surge / Surgefish

6. *Thalassoma*, *Thalassoma* spp.

6. Surge / Surgefish

7. *Thalassoma*, *Thalassoma* spp.

7. Surge / Surgefish

8. *Thalassoma*, *Thalassoma* spp.
9. *Thalassoma*, *Thalassoma* spp.
10. *Thalassoma*, *Thalassoma* spp.
11. *Thalassoma*, *Thalassoma* spp.

8. Surge / Surgefish

12. *Thalassoma*, *Thalassoma* spp.

9. Surge / Surgefish

13. *Thalassoma*, *Thalassoma* spp.
14. *Thalassoma*, *Thalassoma* spp.

10. Surge / Surgefish

15. *Thalassoma*, *Thalassoma* spp.

11. Surge / Surgefish

12. Surge / Surgefish

16. *Thalassoma*, *Thalassoma* spp.
17. *Thalassoma*, *Thalassoma* spp.
18. *Thalassoma*, *Thalassoma* spp.
19. *Thalassoma*, *Thalassoma* spp.
20. *Thalassoma*, *Thalassoma* spp.
21. *Thalassoma*, *Thalassoma* spp.

Section 3

Appendix A

I. Reef Fish FMU

Morays - Muraenidae

1. Chain moray, *Echidna catenata*
2. Green moray, *Gymnothorax funebris*
3. Goldentail moray, *Gymnothorax miliaris*

Snake eels - Ophichthidae

4. Goldspotted eel, *Myrichthys oculatus*

Lizardfishes - Synodontidae

5. Sand diver, *Synodus intermedius*

Frogfishes - Antennariidae

6. Frogfish, *Antennarius spp.*

Batfishes - Ogcocephalidae spp.

7. Batfish, *Ogcocephalus spp.*

Squirrelfishes - Holocentridae

8. Squirrelfish, *Holocentrus ascensionis*
9. Longspine squirrelfish, *Holocentrus rufus*
10. Blackbar soldierfish, *Myripristis jacobus*
11. Cardinal soldierfish, *Plectropops retrospinis*

Trumpetfishes - Aulostomidae

12. Trumpetfish, *Aulostomus maculatus*

Pipefishes - Syngnathus spp.

13. Seahorses, *Hippocampus spp.*
14. Pipefishes, *Syngnathus spp.*

Flying gurnards - Dactyloptaridae

15. Flying gurnard, *Dactylopterus volitans*

Scorpionfishes - Scorpaenidae

Sea basses - Serranidae

16. Rock hind, *Epinephelus adscensionis*
17. Graysby, *Epinephelus cruentatus*
18. Yellowedge grouper, *Epinephelus flavolimbatus*
19. Coney, *Epinephelus fulvus*
20. Red hind, *Epinephelus guttatus*
21. Jewfish, *Epinephelus itajara*

22. Red grouper, *Epinephelus morio*
23. Misty grouper, *Epinephelus mystacinus*
24. Nassau grouper, *Epinephelus striatus*
25. Butter hamlet, *Hypoplectus unicolor*
26. Swissguard basslet, *Liopropoma rubre*
27. Yellowfin grouper, *Mycteroperca venenosa*
28. Tiger grouper, *Mycteroperca tigris*
29. Creole-fish, *Paranthias furcifer*
30. Greater soapfish, *Rypticus saponaceus*
31. Orangeback bass, *Serranus annularis*
32. Lantern bass, *Serranus baldwini*
33. Tobaccofish, *Serranus tabacarius*
34. Harlequin bass, *Serranus tigrinus*
35. Chalk bass, *Serranus tortugarum*

Basslets - Grammatidae

36. Royal gramma, *Gramma loreto*

Bigeyes - Priacanthidae

37. Bigeye, *Priacanthus arenatus*
38. Glasseye snapper, *Priacanthus cruentatus*

Cardinalfishes - Apogonidae

39. Flamefish, *Apogon maculatus*
40. Conchfish, *Astrapogon stellatus*

Tilefishes - Malacanthidae

41. Blackline tilefish, *Caulolatilus cyanops*
42. Sand tilefish, *Malacanthus plumieri*

Jacks - Carangidae

43. Yellow jack, *Caranx bartholomaei*
44. Blue runner, *Caranx crysos*
45. Horse-eye jack, *Caranx latus*
46. Black jack, *Caranx lugubris*
47. Bar jack, *Caranx ruber*
48. Greater amberjack, *Seriola dumerili*
49. Almaco jack, *Seriola rivoliana*

Snappers - Lutjanidae

50. Black snapper, *Apsilus dentatus*
51. Queen snapper, *Etelis oculatus*

52. Mutton snapper, *Lutjanus analis*
53. Schoolmaster, *Lutjanus apodus*
54. Blackfin snapper, *Lutjanus buccanella*
55. Gray snapper, *Lutjanus griseus*
56. Dog snapper, *Lutjanus jocu*
57. Mahogany snapper, *Lutjanus mahogoni*
58. Lane snapper, *Lutjanus synagris*
59. Silk snapper, *Lutjanus vivanus*
60. Yellowtail snapper, *Ocyurus chrysurus*
61. Wenchman, *Pristipomoides aquilonaris*
62. Vermilion snapper, *Rhomboplites aurorubens*

Grunts - Haemulidae

63. Porkfish, *Anisotremus virginicus*
64. Margate, *Haemulon album*
65. Tomtate, *Haemulon aurolineatum*

Grunts - Haemulidae (cont.)

66. French grunt, *Haemulon flavolineatum*
67. White grunt, *Haemulon plumieri*
68. Bluestriped grunt, *Haemulon sciurus*

Porgies - Sparidae

69. Sea bream, *Archosargus rhomboidalis*
70. Jolthead porgy, *Calamus bajonado*
71. Sheepshead porgy, *Calamus penna*
72. Pluma, *Calamus pennatula*

Drums - Sciaenidae

73. High-hat, *Equetus acuminatus*
74. Jackknife-fish, *Equetus lanceolatus*
75. Spotted drum, *Equetus punctatus*

Goatfishes - Mullidae

76. Yellow goatfish, *Mulloidichthys martinicus*
77. Spotted goatfish, *Pseudupeneus maculatus*

Spedefishes - Ephippidae

78. Atlantic spadefish, *Chaetodipterus faber*

Butterflyfishes - Chaetodontidae

79. Longsnout butterflyfish, *Chaetodon aculeatus*
80. Foureye butterflyfish, *Chaetodon capistratus*

81. Spotfin butterflyfish, *Chaetodon ocellatus*

82. Banded butterflyfish, *Chaetodon striatus*

Angelfishes - Pomacanthidae

83. Cherubfish, *Centropyge argi*

84. Queen angelfish, *Holacanthus ciliaris*

85. Rock beauty, *Holacanthus tricolor*

86. Gray angelfish, *Pomacanthus arcuatus*

87. French angelfish, *Pomacanthus paru*

Damselfishes - Pomacentridae

88. Sergeant major, *Abudefduf saxatilis*

89. Blue chromis, *Chromis cyaneus*

90. Sunshinefish, *Chromos insolatus*

91. Yellowtail damselfish, *Microspathodon chrysurus*

92. Dusky damselfish, *Pomacentrus fuscus*

93. Beaugregory, *Pomacentrus leucostictus*

94. Bicolor damselfish, *Pomacentrus partitus*

95. Threespot damselfish, *Pomacentrus planifrons*

Hawkfishes - Cirrhitidae

96. Redspotted hawkfish, *Amblycirrhitus pinos*

Wrasses - Labridae

97. Spanish hogfish, *Bodianus rufus*

98. Creole wrasse, *Clepticus parrai*

99. Yellowcheek wrasse, *Halichoeres cyanocephalus*

100. Yellowhead wrasse, *Halichoeres garnoti*

101. Clown wrasse, *Halichoeres maculipinna*

102. Puddingwife, *Halichoeres radiatus*

103. Pearly razorfish, *Hemipteronotus novacula*

104. Green razorfish, *Hemipteronotus splendens*

105. Hogfish, *Lachnolaimus maximus*

106. Bluehead wrasse, *Thalassoma bifasciatum*

Parrotfishes - Scaridae

107. Midnight parrotfish, *Scarus coelestinus*

108. Blue parrotfish, *Scarus coeruleus*

109. Striped parrotfish, *Scarus croicensis*

110. Rainbow parrotfish, *Scarus guacamaia*

111. Princess parrotfish, *Scarus taeniopterus*

112. Queen parrotfish, *Scarus vetula*
- Parrotfishes - Scaridae (cont.)
113. Redband parrotfish, *Sparisoma aurofrenatum*
 114. Redtail parrotfish, *Sparisoma chrysopteron*
 115. Redfin parrotfish, *Sparisoma rubripinne*
 116. Stoplight parrotfish, *Sparisoma viride*
- Jawfishes - Opistognathidae
117. Yellowhead jawfish, *Opistognathus aurifrons*
 118. Dusky jawfish, *Opistognathus whitehursti*
- Combtooth blennies - Blenniidae
119. Redlip blenny, *Ophioblennius atlanticus*
- Gobies - Gobiidae
120. Neon goby, *Gobiosoma oceanops*
 121. Rusty goby, *Priolepis hipoliti*
- Surgeonfishes - Acanthuridae
122. Ocean surgeonfish, *Acanthurus bahianus*
 123. Doctorfish, *Acanthurus chirurgus*
 124. Blue tang, *Acanthurus coeruleus*
- Lefteye flounders - Bothidae
125. Peacock flounder, *Bothus lunatus*
- Soles - Soleidae
126. Caribbean tonguefish, *Symphurus arawak*
- Leatherjackets - Balistidae
127. Scrawled filefish, *Aluterus scriptus*
 128. Queen triggerfish, *Balistes vetula*
 129. Whitespotted filefish, *Cantherhines macrocerus*
 130. Ocean triggerfish, *Canthidermis sufflamen*
 131. Black durgon, *Melichthys niger*
 132. Sargassum triggerfish, *Xanthichthys ringens*
- Boxfishes - Ostraciidae
133. Spotted trunkfish, *Lactophrys bicaudalis*
 134. Honeycomb cowfish, *Lactophrys polygonia*
 135. Scrawled cowfish, *Lactophrys quadricornis*
 136. Trunkfish, *Lactophrys trigonus*
 137. Smooth trunkfish, *Lactophrys triqueter*

Puffers - Tetraodontidae

- 138. Sharpnose puffer, *Canthigaster rostrata*
- 139. Porcupinefish, *Diodon hystrix*

II. Spiny Lobster FMU

Palinuridae

- Caribbean spiny lobster, *Panulirus argus*
- Spotted spiny lobster, *Panulirus guttatus*
- Smoothtail spiny lobster, *Panulirus laevis*

III. Queen Conch FMU

Phylum Mollusca

Class Gastropoda (Snails)

Order Mesogastropoda

Family Strombidae

Strombus gigas

S. costatus

S. pugilis

S. gallus

S. raninus

Family Fasciariidae

Fasciaria tulipa

Family Cymatiidae

Charonia variegata

Family Cassidae

Cassis flammea

C. madagascarensis

C. tuberosa

Family Trochidae

Cittarium pica

Astrea tuber

Family Turbinellidae

Vasum muricatum

IV. Coral FMU

Scientific Name

PHYLUM PORIFERA

Class Demospongiae

Niphates digitalis

N. erecta

Aphimedon compressa

Spinosella polycifera

S. vaginalis

Geodia neptuni

Chondrilla nocola

Cynachirella alloclada

Tethya crypta

Myriastrea sp.

Haliclona

PHYLUM CNIDARIA

Class Hydrozoa

Order Hydroida

Order Milleporina

Millepora spp.

Order Stylasterina

Stylaster roseus

Class Anthozoa

Order Antipatharia

Antipathes spp.

Stichopathes spp.

Subclass Octocorallia

Order Alcyonacea

Family Anthothelidae

Erythropodium caribaeorum

Iciligorgia schrammi

Family Briareidae

Briareum asbestinum

Family Telestacea

Telesto riisei

Order Gorgonacea

Family Gorgoniidae

Gorgonia mariae

G. ventalina

G. flabellum

Pseudopterogorgia acerosa

P. americana

P. bipinnata

P. rigida

P. albatrossae

Pterogorgia anceps

P. citrina

Family Plexauridae

Eunicea mammosa

E. succinea

E. laxispica

E. fusca

E. laciniata

E. touneforti

E. clavigera

E. knighti

E. calyculata

Muricea atlantica

M. muricata

M. pinnata

M. laxa

M. elongata

Muriceopsis sp.

M. sulphurea
M. flavida
Plexaura flexuosa
P. homomalla
Pseudoplexaura porosa
P. flagellosa
P. wagnaari
P. crucis
Plexaurella dichotoma
P. nutans
P. grandiflora
P. grisea
P. fusifera
Family Ellisellidae
Ellisella spp.
Order Scleractinia
Family Astrocoeniidae
Stephanocoenia michelinii
Family Pocilloporidae
Madracis decactis
M. mirabilis
Family Acroporidae
Acropora palmata
A. cervicornis
A. prolifera
Family Agaricidae
Agaricia agaricites
A. fragilis
A. tenuifolia
A. lamarcki
Leptoseris cucullata
Family Siderastreidae
Siderastrea siderea
S. radians
Family Poritidae
Porites astreoides

P. porites
P. branneri
P. divaricata
Family Faviidae
Favia fragum
Diploria clivosa
D. strigosa
D. labyrinthiformis
Manicina areolata
M. mayori
Colpophyllia natans
Cladocora arbuscula
Montastrea annularis
M. cavernosa
Solenastrea bourmoni
Family Rhizangiidae
Phyllangia americana
Astrangia solitaria
Family Meandrinidae
Meandrina meandrites
Dichocoenia stokesi
D. stellaris
Dendrogyra cylindrus
Family Mussidae
Mussa angulosa
Scolymia lacera
S. cubensis
Isophyllia sinuosa
Isophyllastrea rigida
Mycetophyllia lamarckiana
M. aliciae
M. danae
M. ferox
Family Caryophyllidae
Eusmilia fastigiata
Tubastrea aurea

Family Oculinidae

Oculina diffusa

Order Actiniaria

Condylactis gigantea

Bartholomea annulata

Hereractis lucida

Aiptasia tagetes

Lebrunia spp.

Stichodactyla helianthus

Order Zoanthidea

Zoanthus spp.

Order Corallimorpharian

Ricordia florida

Discosoma spp.

(formally Rhodactis)

Phylum Mollusca

Class Gastropoda

Order Mesogastropoda

Family Strombidae

Strombus spp. (except

Queen Conch (S. gigas)

Family Ovulidae

Cyphoma gibbosum

Family Ranellidae

Charonia tritonis

Order Neogastropoda

Family Olividae

Oliva reticularis

Order Sacoglossa

Family Elysiidae

Tridachia crispata

Class Bivalvia

Order Limoida

Family Limidae

Lima spp.

Literature Yellowedge grouper *Epinephelus flavolimbatus*

1. Vivaldi J.L. 1986. Compendio Enciclopédico de Los Recursos naturales 2 Vol.7 Los Peces Marinos de Puerto Rico por D.S. Erdman, J.M. Berrios, I. Corujo y J.G. Gonzalez Source: CMFC
2. Brownell, W.N. and W.E. Rainey. 1971. Research and development of deep water commercial and sport fisheries around the Virgin Islands plateau. Carib. Res. Inst. Ecol. Stat. Contr. 3:1-88 Source CMFC Files
- 3.

Epinephelus flavolimbatus (Yellowedge grouper) - Distribution and Abundance with comments on life history, ecology and management									
Year	Location	Depth (m)	Abundance	Comments	Notes	References	Source	Notes	Notes
1971	St. John	100-200	Common	Yellowedge grouper	1971	St. John	CMFC		
1972	St. John	100-200	Common	Yellowedge grouper	1972	St. John	CMFC		
1973	St. John	100-200	Common	Yellowedge grouper	1973	St. John	CMFC		
1974	St. John	100-200	Common	Yellowedge grouper	1974	St. John	CMFC		
1975	St. John	100-200	Common	Yellowedge grouper	1975	St. John	CMFC		
1976	St. John	100-200	Common	Yellowedge grouper	1976	St. John	CMFC		
1977	St. John	100-200	Common	Yellowedge grouper	1977	St. John	CMFC		
1978	St. John	100-200	Common	Yellowedge grouper	1978	St. John	CMFC		
1979	St. John	100-200	Common	Yellowedge grouper	1979	St. John	CMFC		
1980	St. John	100-200	Common	Yellowedge grouper	1980	St. John	CMFC		
1981	St. John	100-200	Common	Yellowedge grouper	1981	St. John	CMFC		
1982	St. John	100-200	Common	Yellowedge grouper	1982	St. John	CMFC		
1983	St. John	100-200	Common	Yellowedge grouper	1983	St. John	CMFC		
1984	St. John	100-200	Common	Yellowedge grouper	1984	St. John	CMFC		
1985	St. John	100-200	Common	Yellowedge grouper	1985	St. John	CMFC		
1986	St. John	100-200	Common	Yellowedge grouper	1986	St. John	CMFC		
1987	St. John	100-200	Common	Yellowedge grouper	1987	St. John	CMFC		
1988	St. John	100-200	Common	Yellowedge grouper	1988	St. John	CMFC		
1989	St. John	100-200	Common	Yellowedge grouper	1989	St. John	CMFC		
1990	St. John	100-200	Common	Yellowedge grouper	1990	St. John	CMFC		
1991	St. John	100-200	Common	Yellowedge grouper	1991	St. John	CMFC		
1992	St. John	100-200	Common	Yellowedge grouper	1992	St. John	CMFC		
1993	St. John	100-200	Common	Yellowedge grouper	1993	St. John	CMFC		
1994	St. John	100-200	Common	Yellowedge grouper	1994	St. John	CMFC		
1995	St. John	100-200	Common	Yellowedge grouper	1995	St. John	CMFC		
1996	St. John	100-200	Common	Yellowedge grouper	1996	St. John	CMFC		
1997	St. John	100-200	Common	Yellowedge grouper	1997	St. John	CMFC		
1998	St. John	100-200	Common	Yellowedge grouper	1998	St. John	CMFC		
1999	St. John	100-200	Common	Yellowedge grouper	1999	St. John	CMFC		
2000	St. John	100-200	Common	Yellowedge grouper	2000	St. John	CMFC		
2001	St. John	100-200	Common	Yellowedge grouper	2001	St. John	CMFC		
2002	St. John	100-200	Common	Yellowedge grouper	2002	St. John	CMFC		
2003	St. John	100-200	Common	Yellowedge grouper	2003	St. John	CMFC		
2004	St. John	100-200	Common	Yellowedge grouper	2004	St. John	CMFC		
2005	St. John	100-200	Common	Yellowedge grouper	2005	St. John	CMFC		
2006	St. John	100-200	Common	Yellowedge grouper	2006	St. John	CMFC		
2007	St. John	100-200	Common	Yellowedge grouper	2007	St. John	CMFC		
2008	St. John	100-200	Common	Yellowedge grouper	2008	St. John	CMFC		
2009	St. John	100-200	Common	Yellowedge grouper	2009	St. John	CMFC		
2010	St. John	100-200	Common	Yellowedge grouper	2010	St. John	CMFC		
2011	St. John	100-200	Common	Yellowedge grouper	2011	St. John	CMFC		
2012	St. John	100-200	Common	Yellowedge grouper	2012	St. John	CMFC		
2013	St. John	100-200	Common	Yellowedge grouper	2013	St. John	CMFC		
2014	St. John	100-200	Common	Yellowedge grouper	2014	St. John	CMFC		
2015	St. John	100-200	Common	Yellowedge grouper	2015	St. John	CMFC		
2016	St. John	100-200	Common	Yellowedge grouper	2016	St. John	CMFC		
2017	St. John	100-200	Common	Yellowedge grouper	2017	St. John	CMFC		
2018	St. John	100-200	Common	Yellowedge grouper	2018	St. John	CMFC		
2019	St. John	100-200	Common	Yellowedge grouper	2019	St. John	CMFC		
2020	St. John	100-200	Common	Yellowedge grouper	2020	St. John	CMFC		
2021	St. John	100-200	Common	Yellowedge grouper	2021	St. John	CMFC		
2022	St. John	100-200	Common	Yellowedge grouper	2022	St. John	CMFC		
2023	St. John	100-200	Common	Yellowedge grouper	2023	St. John	CMFC		
2024	St. John	100-200	Common	Yellowedge grouper	2024	St. John	CMFC		
2025	St. John	100-200	Common	Yellowedge grouper	2025	St. John	CMFC		

Summary table of fish species

Summary table of Tiger grouper (<i>Mycteroperca tigris</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage ^e	Season ^e	Zonation	Specific site	Temp	Salinity(p	Oxygen	Depth(	Trophic relation		Habitat associations and interactions			
								Food	Predat	Selection	Growth	Mortality	Production
Eggs													
Larvae													
Postlarvae													
Early juveniles													
Late juveniles													
		Reefs:6**High reliefshelledge (4) Acropora palmata zone (5**) slope (5**)	PRS:La Parguera (4)PRS:Ponce Cayoe Ratones (5) Cayoe Berberia(5) STJ 6**										
Adults													
	January to April Peaks in February and March two days after full moon and lasts 5 to 6 days (1,2)	Deep reef,level coral bottom close to the edge of the shelf dominated by <i>M. annularis</i> but not in the shelf break with areas of extensive vertical relief as other groupers (1)	V:El Seco (1,2,3) Caletas(2), STH: Sailrock (LA Boya, La Profesora) (2)				36-40m ¹		^e	Shelter in flattened coral colonies ¹			^e
Spawning adults													

Summary table of fish species

Summary table of Tiger grouper (<i>Mycteroperca tigris</i>) (Cont.)													
Source	Specific site	Coordinates latitude	Coordinates longitude	Potential use									
	2 Vieques : Seco	18° 07'27"N,	65° 11' 40" W	Spawning ground									
	3 Vieques : Seco	18° 07'32"N,	65° 11' 43" W	Spawning ground									
	3 Vieques : Seco	18°07'28"N	65°11'30"W	Spawning ground									
	3 Vieques : Seco	18°07'45"N	65°11'13"W	Spawning ground									
	3 Vieques : Seco	18°07'53"N	65°11'27"W	Spawning ground									
	2 Caletas	18°35'00"N	65°20'30"W	Spawning ground									
	2 Unknown	18°04'54"N	65°36'57"W	Spawning ground									
	5 Ponce Cayo Ratones	17°57'15"N	66°40'12"W										
	5 Ponce Cayo Berberia	17°55'50"N	66°27'20"W										

Literature Tiger Grouper *Mycteroperca tigris*

1. Sadovy, Y., P.L. Colin and .L. Domeier. 1994. Aggregation and spawning in the tiger grouper, *Mycteroperca tigris*. *Copeia* 1994(2):511-516
2. Lilyestrom, C. 1994. Monitory report on the reproductive aggregation of the tiger grouper, *Mycteroperca tigris* in Vieques. CMFC Report 8 pp. Source Miguel Figuerola FRL Archives
3. Posada, Juan. 1997. Final report on a tag and release tiger grouper project from a spawning aggregation site at Vieques, Puerto Rico, February- March 1997 CMFC report Source : CMFC files
4. Kimmel J.J. 1985 A characterization of Puerto Rican fish assemblages. PHD. Diss. Univ. Puerto rico, Mayaguez 106 p Source Dr. Appeldoorn Collection
5. Berrios J and J Gonzalez Azar. 1985. Fish populations studies of the seagrass beds and coral reefs of Cayo Berberia and Cayo Ratones , Ponce, P.R. Report to DNR Source CMFC
6. **Garrison G. 1997. ST. John, U.S. Virgin Islands Fish Trap study, 1992-1994 VINP technical report pp. 14 Source DR. Richard Appeldoorn library
- 7.
- 8.

Summary table of fish species

Summary table of Red grouper (<i>Epinephelus morio</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(p	Oxyge	Depth(	Trophic relation		Habitat associations and interactions			
Eggs								Food	Predat	Selecti	Growth	Mortality	Production
Larvae													
Postlarvae													
Early juveniles													
Late juveniles													
Adults													
Spawning adults	Mature females in February and March (1)												

Literature red grouper *Epinephelus morio*

1. Erdman D.S. 1976. Spawning patterns of fishes from the northern-eastern Caribbean. Dept. Agric. Puerto Rico. Agric. Fish. Contr. 8:1-36. [Source CFMC]
2. **Garrison G. 1997. ST. John, U.S. Virgin Islands Fish Trap study. 1992-1994. VINP. Technical report. pp. 14. [Source DR. Richard Appeldoorn library]

Summary table of Tobacco fish <i>Serranus tabacarius</i> associations and interactions with environmental and habitat variables are listed with citations														
Life Stage	Season	Zonation	Specific site	Temp	Salinity	Oxygen	Depth(m)	Trophic relationships		Habitat associations and interactions				
								Food	Predators	Selection	Growth	Mortality		Production
Eggs														
Larvae														
Postlarvae														
		Artificial reefs (cement) (1)	STC: Salt River Canyon (1)				17-20m (1)							
Early juveniles														
Late juveniles														
Adults														
Spawning adults														

Literature review of Tobbaccofish *Serranus tabacarius*

1. Shulman M, J Ogden J.C. Ebersole, J.P. McFarland, W.N., Miller, S.L. Wolf, N.F. (1983)
Priority effects in the recruitment of coral reef fishes Ecology 64:1508-1513 [Source:DMS
Library]

Summary table of fish species

Summary table of Lantern bass (<i>Serranus baldwini</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(p	Oxyge	Depth(	Trophic relation		Habitat associations and interactions			
Eggs								Food	Predat	Selecti	Growth	Mortality	Production
Larvae													
Postlarvae													
Early juveniles		Artificial reefs (cement) (1)	STC: Salt River Canyon (1)				17- 20m (1)						
Late juveniles													
Adults													
Spawning adults													

1. Shulman M, J Ogden J.C. Ebersole, J.P. McFarland, W.N., Miller, S.L. Wolf, N.F. (1983) Priority effects in the recruitment of coral reef fishes Ecology 64:1508-1513 Source:DMS Library

1. Shulman M, J Ogden J.C. Ebersole, J.P. McFarland, W.N., Miller, S.L. Wolf, N.F. (1983) Priority effects in the recruitment of coral reef fishes Ecology 64:1508-1513 Source:DMS Library

[illegible]

Summary table of fish species

Summary table of Creole Bass (<i>Paranthias furcifer</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships		Habitat associations and interactions			
								Food	Predators	Selection	Growth	Mortality	Production
Eggs													
Larvae													
Postlarvae													
Early juveniles													
Late juveniles													
Adults											k= 0.306 , L _∞ =223.2 mm (1)	M=0.708 - 0.854 (1)	
Spawning adults	Spawning peak occurs in November and December around full moons(1)	Shelf edge (1)	PRS Guánica Pta Jorobada (1)	26.5oC- 29.4oC (1)			16-46 m (1)						
References	Specific site	Latitude	Longitude										
1	Guánica Pta Jorobada shelf edge	17°53.86	66°57.35										

Literature review Creole Bass

Posada J. 1996 Life-history, reproductive biology and sexual pattern of the Creole fish, *Paranthias furcifer* PhD. Dissertation Department of marine sciences. University of Puerto Rico at Mayaguez. Pp.210 [source: Dr. Appeldoorn]

Summary table of fish species

Summary table of Graysby (<i>Epinephelus cruentatus</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity	Oxygen	Depth(m)	Trophic relation		Habitat associations and interactions			
								Food	Predator	Selection	Growth	Mortality	Production
Eggs													
Larvae													
Postlarvae													
Early juveniles													
Late juveniles		Patch reefs (4), mangrove, (7); seagrass, (7)	STH.Perseverance Bay(4), PRS Ponce Cayo Berberia (7)Cayo Ratones (7)				Up to 12m (17)						
Adults		Reefs crevices(1, 5**11) (forereef)(5**6) (A palmata zone)(7**)(HR shoreward, LR apron LR slope (7**) HR shelf edge, HR, LR offshore)(6); rubble/sandy areas (6)	PRS La Parguera (6) Turrumote (5), Media Luna (5) San Cristobal (5); PRS PonceCayo Berberia (7) Cayo Ratones (7) STC.Salt River Canyon (11)				Commonly in depths below 25m but can be found up to 70m (1)	Fishes and crustaceans (3)		Abundance decrease with high sedimentation rates (7**)			

Summary table of fish species

Summary table of Graysby (<i>Epinephelus cruentatus</i>) associations and interactions with environmental and habitat variables are listed with citations (Cont)														
Life Stage	Season	Zonation	Specific site	Temp	Salinity	Oxygen	Depth(m)	Trophic relation		Habitat associations and interactions				
								Food ^a	Predato	Selection	Growth	Mortality	Production	
Spawning adults	Males and femalesa with sexually mature organs in March, June and July (2), May, August, and September (14,15)		PRW (14,15)											
Source	Specific site	Coordinates latitude	Coordinates longitude	Potential use										
	La Parguera San Cristobal	17°56.4'N	67°4 5'W											
5	La Parguera Mediaa	17°56.4'N	67°2.8'W											
5	Luna	17°56.4'N	67°2.8'W											
5	La Parguera Turrumote	17°56.2'N	67°1.2'W											
7	Ponce Cayo Ratones	17°57'15"N	66°40'12"W	Nursery ground										
7	Ponce Cayo Berberia	17°55'50"N	66°27'20"W	Nursery ground										

Literature Graysby *Epinephelus cruentatus*

1. Vivaldi J.L. 1986. Compendio Enciclopedico de Los Recursos naturales 2 Vol.7 Los Peces Marinos de Puerto Rico por D.S. Erdman, J.M. Berrios. I. Corujo y J G. Gonzalez Source: CMFC
2. Erdman D.S. 1976. Spawning patterns of fishes from the northern-eastern Caribbean. Dept. Agric. Puerto Rico, Agric. Fish. Contr. 8:1-36. Source CFMC
3. Randall, J. E. 1967. Food habits of the reef fishes of the west indies. Univ. Miami Studies in Trop. Oceanog. 5: 665-847 Source Miguel Figuerola archives Fish lab DNR
4. Beets J and M.Hixon. 1994. Distribution, persistence and growth of groupers on artificial and natural patch reefs in the Virgin Islands .Bull. Mar. Sci: 55(2-3):470-483
5. **Garcia Saiz Jorge 1994 La Parguera Marine reserve a feasibility study CFMC Annual Report pp 111 Source: Sea Grant Mayaguez
6. Kimmel J.J. 1985 A characterization of Puerto Rican fish assemblages. PHD. Diss. Univ. Puerto rico, Mayaguez 106 p Source Dr. Appeldoorn Collection
7. **Berrios J and J Gonzalez Azar. 1985. Fish populations studies of the seagrass beds and coral reefs of Cayo Berberia and Cayo Ratones , Ponce, P.R. Report to DNR Source CMFC
8. **Turnigan , R.G. and A.B. Acosta . 1994 An analysis of the fish assemblages on a Coral Patch Reef in Puerto Rico pp. 242-263 In: Proceedings of the 43rd Annual Gulf and Caribbean Fisheries Institute. 1990, Miami USA (Ed. By M.H. Charleston, South Carolina Source Dr. Rich Appeldoorn
9. ** Beets J. 1997 Effects of a predatory fish on the recruitment and abundance of Caribbean coral reef fishes Mar. Ecol. Prog. Ser. In Review Source: Dr. Appeldoorn library
10. **Hixon M, and J Beets. 1993. Predation, prey refuges, and the structure of coral reef fishes assemblages Ecological Monographs 63(1) pp. 77-101 source Dr. Appeldoorn library
11. Kaufman L. and J Ebersole 1984 Microtopography and the organization of two assemblages of coral reef fishes in the west indies J. Exp. Mar. Biol. Ecol., vol. 78. Pp.253-268 Source: Dept. of Marine Sciences Library
12. **Garrison G. 1997. ST John, U.S. Virgin Islands Fish Trap study, 1992-1994 VINP technical report pp. 14. Source DR. Richard Appeldoorn library
13. **Wolff N.H. 1996 The fish assemblages within four habitats found in the nearshore waters of ST. John, United States Virgin Islands: with some insights into the nature of trap fishing MS Thesis University, Rhode Island pp. 205pp Source: DR. Richard Appeldoorn library
14. Rosario A. 1994. Shallow Reef Fish Monitoring Caribbean/ NMFS Cooperative SEAMAP Program . Report submitted to DNR. 142pp [source: CFMC]
15. Rosario A. 1996. Shallow Reef Fish Monitoring Caribbean/ NMFS Cooperative SEAMAP Program . Report submitted to DNR. 133pp [source: CFMC]
- 16.

Summary table of Harlequin bass (*Serranus tigrinus*) associations and interactions with environmental and habitat variables are listed with citations

[illegible]

1. Shulman M, J Ogden J.C. Ebersole, J.P. McFarland, W.N., Miller, S.L. Wolf, N.F. (1983) Priority effects in the recruitment of coral reef fishes Ecology 64:1508-1513 Source:DMS Library

1. Shulman M, J Ogden J.C. Ebersole, J.P. McFarland, W.N., Miller, S.L. Wolf, N.F. (1983) Priority effects in the recruitment of coral reef fishes Ecology 64:1508-1513 Source:DMS Library

Summary table of fish species

Summary table of Yellowfin grouper (<i>Mycteroperca venenosa</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(p	Oxyge	Depth(	Trophic relations		Habitat associations and interactions			
Eggs								Food	Predat	Selecti	Growth	Mortality	Production
Larvae													
Postlarvae													
Early juveniles													
Late juveniles		Seagrass(1) and reef (1)											
Adults		Reefs (1,2,4**,5**); and rocky substrates (1)	PRS: Laurel, STJ (5**)					Fishes (3)					
Spawning adults	Spawning season from February to May (3)												

Literature Yellowfin grouper *Mycteroperca Venenosa*

1. Vivaldi J.L. 1986. Compendio Enciclopedico de Los Recursos naturales 2 Vol.7 Los Peces Marinos de Puerto Rico por D.S. Erdman, J.M. Berrios. I. Corujo y J G. Gonzalez Source: CMFC
2. Caribbean Fishery Management Council. 1979 Fishery management plan fro reef fishes resources.Natl. Mar. Fish Ser, Source:CMFC
3. Randall, J. E. 1967. Food habits of the reef fishes of the west indies. Univ. Miami Studdies in Trop. Oceanog. 5: 665-847Source Miguel Figuerola archives Fish lab DNR
4. **Tumigan , R.G. and A.B. Acosta . 1994 An analysis of the fish assemblages on a Coral Patch Reef in Puerto Rico pp. 242-263 In: Proceedings of the 43rd Annual Gulf and Caribbean Fisheries Institute. 1990, Miami USA(Ed. By M.H. Charleston, South Carolina Source Dr. Rich Appeldoorn
5. **Wolff N.H. 1996 The fish assemblages within four habitats found in the nearshore waters of ST. John, United States Virgin Islands: with some insights into the nature of trap fishing MS Thesis University. Rhode Island pp. 205pp Source:DR. Richard Appeldoorn library

Summary table of fish species

Summary table of Porkfish (<i>Anisostremus virginicus</i>) associations and interactions with environmental and habitat variables are listed with citations ^a													
Life Stage	Season	Zonation	Specific site	Temp	Salinity	Oxygen	Depth	Trophic relation	Habitat associations and interactions	Food	Predat	Selecti	Growth
Eggs													
Larvae													
Postlarvae													
Early juveniles													
Late juveniles		Reefs (9), mangrove (9,11) seagrass(9) coastal lagoon (11)	PRS:Peñuelas, Encarnación (9) PRE: Ceiba lagoon (11)		Salinity range from 30o/oo to 38.4 o/oo (11)	Oxygen concentration range from 1.4 mg/l to 6.2 mg/l (11)							
Adults		Reefs(1,2,3**,12**,13**) (A.Palmata zone)(3**) (HRShoreward,LRApron, LRSlope (3**)HR shelf edge,HR,LR offshore)(2) Rubble sandy (2,13**) areas mangrove (2)	PRS:La Parguera (2) PRS:Ponce Cayo Ratones (3)Cayoa Berberia (3)a PRS: Jobos Baya (12**,13**)a										
Spawning adults	Found enlarged gonads in December (10)		PRS: Jobos Bay (10)										

Summary table of fish species

Summary table of Porkfish (<i>Anisostremus virginicus</i>) (Cont.)									
Source	Specific site	Coordinates latitude	Coordinates longitude	Potential use					
3	Ponce Cayo Ratones	17o57'15"N	66o40'12"W	Nursery ground					
	Ponce Cayo Berberia	17o55'50"N	66o27'20"W						
	Peñuelas, Barrio Encarnación	17o59'00"N	66o42'20"W						
9									

Literature Porkfish *Anisostremus virginicus*

1. Vivaldi J.L. 1986. Compendio Enciclopedico de Los Recursos naturales 2 Vol.7 Los Peces Marinos de Puerto Rico por D.S. Erdman, J.M. Berrios. I. Corujo y J G. Gonzalez Source: CMFC
2. Kimmel J.J. 1985 A characterization of Puerto Rican fish assemblages. PHD. Diss. Univ. Puerto rico, Mayaguez 106 p Source Dr. Appeldoorn Collection
3. ** Berrios J and J Gonzalez Azar. 1985. Fish populations studies of the seagrass beds and coral reefs of Cayo Berberia and Cayo Ratones , Ponce, P.R. Report to DNR Source CMFC
4. **Boulon R.H. 1992 Use of Mangrove Prop Root habitats by Fish in the Northern U.S. Virgin Islands 41Proc.Gulf Carib. Fish. Inst St. ThomasPp.189-205 Source: Dr. Appeldoorn Library
5. **Tumigan , R.G. and A.B. Acosta . 1994 An analysis of the fish assemblages on a Coral Patch Reef in Puerto Rico pp. 242-263 In: Proceedings of the 43rd Annual Gulf and Caribbean Fisheries Institute. 1990, Miami USA(Ed. By M.H. Charleston, South Carolina Source Dr. Rich Appeldoorn
6. Hixon M, and J Beets. 1993. Predation, prey refuges, and the structure of coral reef fishes assemblages Ecological Monographs 63(1) pp. 77-101 Dr. Appeldoorn Library
7. ** Martin F.D. and J Patus 1973. A comparison of fish faunas in a highly stressed and a less stressed Tropical Bay -Guayanilla and Jobos Bay, Puerto Rico Proc. 27th Annual Conference of the Southeastern Association of Game and Fish Commissioners Source.: Department of marine Sciences Library
8. **Wolff N.H. 1996 The fish assemblages within four habitats found in the nearshore waters of ST. John, United States Virgin Islands: with some insights into the nature of trap fishing MS Thesis University. Rhode Island pp. 205pp Source:DR. Richard Appeldoorn library
9. Hernandez .E 1997. Evaluacion biologica de las comunidades marinas del Barrio Encarnacion, Peneuelas, para el Proyecto El cano Resort. Technical Report Servicios Cientificos y Tecnicos pp. 85 Source: Edwin Hernandez
10. Martin F.D. 1971. Report on the Fishes and fisheries of Jobos Bay. Puerto Rico Nuclear center. Aguirre Power Project Environmental studies annual report pp.78-93. [Source:CEER]
11. Gonzalez azar J. and Vilella M. 1975. Biologia de Las Lagunas Costeras . 2do Simposio de Recursos Naturales pp. 4-40. Source: [Dr. Manuel Velez library]
12. **Martin F.D. 1971. Report on the fish and fisheries of Jobos Bay. Puerto Rico Nuclear center. Aguirre Power Project Environmental studies annual report pp.78-90. [Source:CEER]
13. **Martin F.D. 1972. The Distribution, and feeding ecology of the fishes of Jobos Bay. 1972. PRNC-162 Aguirre Power Project 1:225-253[Source:CEER]
- 14.
- 15.

Summary table of fish species

Summary table of Tomate (<i>Haemulon aurolineatum</i>) associations and interactions with environmental and habitat variables are listed with citations														
Life Stage	Season	Zonation	Specific site	Temp	Salinity(p	Oxygen	Depth(m)	Trophicrelationships Food	Predators	Habitat associations and interactions				Production
Eggs										Selection	Growth	Mortality		
Larvae														
Postlarvae		Cement Model Reefs (10)	STH Great St.James (10)				4.5m to8m 10		Holocentrus adscencionis (10)			Reefs with high densities of predators can deppresse Postlarval recruitment10		
Early juveniles		Cement Model Reefs (10,11,17)	STH Great St.James (10) STH:Perseverance Bay (11) STC:Salt River Canyon (17)				4.5mto20m (10,17)		Holocentrus adscencionis (10)			Mortality greatly influenced by predation in newly settled individuals in reefs with high number of predators (11)		
Late juveniles		Reefs (18);, thalassia beds(19); sand flats (1); mangrove (19,22)	PRS: Jobos Bay (18,19) STJ Hurricane Hole (22)					Gammarids, Cumacean, Natantia shrimp, copepods, isopods (19)		Form large aggregations under the large spines of <i>Diadema antillarum</i> for protection(18) Nursery grounds: seagrass-mangrove communities (19)				
Adults		Reefs(4**7**14,20**21**) (forereef slope)(4**6**8**9) (Acropora palmata zone) (6**)(HRshoreward,LR apron LR slope HRshelf edge, HR,LR offshore),(5) rubble/ sandyareas (5,7**8**21**); seagrass(1,5);tide channel (21**) bay and shore are (21**)Mangrove (22)	PRS:La Parguera (5);Turumote(4,9). Media Luna(4) Enrique(9); Collado(9)San Cristóbal (4); PRS:Ponce Cayo Berberia (6);Cayo Ratones(6); FRW: Mayagüez:Punta Ostiones (7**8**); STC:Salt River Canyon (14); PRS: Jobos Bay (20**,21**); STJ: Hurricane Hole (22)				To 25m (1,9)	Shrimps (8**), poliquets, crustaceans hermit crabs,larvae, gastropods, and pelecipods (3), crabs (8**) brachyurans (8**)		Mostly rest in reefs and feeds at night in seagrass (1)		Mortality greatly influenced by predation in juveniles in reefs with high number of predators (10)		

Summary table of fish species

Summary table of Tomlate (<i>Haemulon aurolineatum</i>) (Cont.)													
Life Stage a	Season	Zonation	Specific site	Temp	Salinity(p	Oxygen	Depth(m)	Trophic relationships		Habitat associations and interactions			
								Food	Predators	Selection	Growth	Mortality	Production
Spawning adults	Males and females with ripe gonads from January to August (2)	PR (2)											
Source	Specific site	Coordinates latitude	Coordinates longitude	Potential use									
4	La Parguera San Cristóbal	17°56.4'N	67°4.5'W										
4	La Parguera Media Luna	17°56.4'N	67°2.8'W										
4	La Parguera Turrumole	17°56.2'N	67°1.2'W										
6	Ponce Cayo Ralones	17°57.15'N	66°40.12'W										
6	Ponce Cayo Berberia	17°55.50'N	66°27.20'W										
7.8	PRW: Mayagüez Punta Ostiones	18°5.50'N	67°17.20'W										

Literature Review Tomtate Haemulon aeorlineatum

1. Vivaldi J.L. 1986. Compendio Enciclopedico de Los Recursos naturales 2 Vol.7 Los Peces Marinos de Puerto Rico por D.S. Erdman, J.M. Berrios. I. Corujo y J.G. Gonzalez Source: CMFC
2. Erdman D.S. 1976. Spawning patterns of fishes from the northern-eastern Caribbean. Dept. Agric. Puerto Rico, Agric. Fish. Contr. 8:1-36. Source CFMC
3. Randall, J. E. 1967. Food habits of the reef fishes of the West Indies. Univ. Miami Studies in Trop. Oceanog. 5: 665-847 Source Miguel Figuerola archives Fish lab DNR
4. Garcia Saiz Jorge 1994 La Parguera Marine reserve a feasibility study CFMC Annual Report pp 111 Source: Sea Grant Mayaguez
5. Kimmel J.J. 1985 A characterization of Puerto Rican fish assemblages. PHD. Diss. Univ. Puerto Rico, Mayaguez 106 p Source Dr. Appeldoorn Collection
6. Berrios J and J Gonzalez Azar. 1985. Fish populations studies of the seagrass beds and coral reefs of Cayo Berberia and Cayo Ratones, Ponce, P.R. Report to DNR Source CMFC
7. **Parrish, J.D. 1982. Fishes at Puerto Rican Coral reef: distribution, Behavior and Response to passive fishing Caribb. J. Sci Vol. 18. No. 1-4 pp.9-21 Source: Dr. Richard Appeldoorn collection
8. **Parrish J.D. and R.J. Zimmerman 1977 Utilization by fishes of space and food resources on an offshore Puerto Rican coral reef and its surroundings. Proc., Third Intern. Coral Reef Symp. 297-303 Source: Dr. Richard Appeldoorn collection
9. Dennis G.D. 1992. Resource utilization by members of a guild of benthic feeding coral reef fish PhD dissertation 224pp UPR Mayaguez Department of marine sciences Source: Dr. Appeldoorn Library
10. **Beets J. 1997 Effects of a predatory fish on the recruitment and abundance of Caribbean coral reef fishes Mar. Ecol. Prog. Ser. In Review Source: Dr. Appeldoorn library
11. Hixon M. and J Beets. 1993. Predation, prey refuges, and the structure of coral reef fishes assemblages Ecological Monographs 63(1) pp. 77-101 source Dr. Appeldoorn library
12. **Martin F.D. and J Patus 1973. A comparison of fish faunas in a highly stressed and a less stressed Tropical Bay -Guayanilla and Jobos Bay, Puerto Rico Proc. 27th Annual Conference of the Southeastern Association of Game and Fish Commissioners Source.: Department of marine Sciences Library
13. **Ogden J.C. and J. P. Ebersole. 1981 Scale and community structure of Coral Reef Fishes: A long Term Study of a Large Artificial Reef Mar. Ecol. Prog. Ser. Vol 4:97-103 Source: Dept. of Marine Sciences Library
14. Kaufman L. and J Ebersole 1984 Microtopography and the organization of two assemblages of coral reef fishes in the west indies J. Exp. Mar. Biol. Ecol., vol. 78. Pp.253-268 Source: Dept. of Marine Sciences Library
15. **Garrison G. 1997. ST. John, U.S. Virgin Islands Fish Trap study, 1992-1994 VINP technical report pp. 14. Source DR. Richard Appeldoorn library
16. **Wolff N.H. 1996 The fish assemblages within four habitats found in the nearshore waters of ST. John, United States Virgin Islands: with some insights into the nature of trap fishing MS Thesis University. Rhode Island pp. 205pp Source: DR. Richard Appeldoorn library
17. Shulman M, J Ogden J.C. Ebersole, J.P. McFarland, W.N., Miller, S.L. Wolf, N.F. (1983) Priority effects in the recruitment of coral reef fishes Ecology 64:1508-1513 Source: DMS Library
18. Martin F.D. 1974. Distribution, seasonality and feeding ecology of the fishes of Jobos Bay. Puerto Rico Nuclear Center Jobos Bay Annual Environmental Report 1:90-190. [Source: CEER]
19. Piastro L. 1974. Juvenile Fish of Jobos Bay Puerto Rico Nuclear Center Jobos Bay Annual Environmental Report 1:196-213. [Source: CEER]
20. **Martin F.D. 1971. Report on the fish and fisheries of Jobos Bay. Puerto Rico Nuclear center. Aguirre Power Project Environmental studies annual report pp.78-90. [Source: CEER]
21. **Martin F.D. 1972. The Distribution, and feeding ecology of the fishes of Jobos Bay. 1972. PRNC-162 Aguirre Power Project 1:225-253 [Source: CEER]
22. Boulon, R.H., Jr. 1985a. Distribution and species composition of fisheries habitats within the Virgin Islands Biosphere Reserve Unpl. Report

Summary table of fish species

Summary table of Margate(<i>Haemulon album</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(p	Oxygen	Depth(m)	Trophic relations		Habitat associations and interactionsa			
Eggs								Food	Predat	Selection	Growt	Mortality	Production
Larvae													
Postlarvae													
Early juveniles													
Late juveniles		Mangrove (4)	PRS:La Parguera (4)				4feet (4)			Mangrove: nursery ground (4)			
Adults		Reef (1**,2,6) Forereefs(1**6) HR shoreward (2), slope(3**) and flats (5**)	PRS: La Parguera (2); San Cristóbal (1)Turrumote (6) PRW:a Mayagüez, Punta Ostiones (3**5**)				To 60 feeta (1,6)		Barra-cuda (6)				
Spawning adults													
References	Specific site	Coordinates latitude	Coordinates longitude										
1	La Parguera San Cristóbal	17°56.4'N	67°4.5'W										
3,5	PRW: Mayagüez Punta Ostiones	18°5'50"N	67°17'20"W										

Literature review Margate Haemulon album

1. Garcia Saiz Jorge 1994La Parguera Marine reserve a feasibility study CFMC Annual Report pp 111 Source: Sea Grant Mayaguez
2. Kimmel J.J. 1985 A characterization of Puerto Rican fish assemblages. PHD. Diss. Univ. Puerto rico, Mayaguez 106 p Source Dr. Appeldoorn Collection
3. Parrish, J.D. 1982. Fishes at Puerto Rican Coral reef: distribution, Behavior and Response to passive fishing Caribb. J. Sci Vol. 18. No. 1-4 pp.9-21 Source: Dr. Richard Appeldoorn collection
4. Austin, H.A. 1971. A survey of the ichthyofauna of the mangroves of western Puerto Rico during December, 1967- August, 1968. Carib J.Sci., 11(1-2):27-39. Source Dr. appeldoorn collection
5. Parrish J.D. and R.J. Zimmerman 1977 Utilization by fishes of space and food resources on an offshore puerto Rican coral reef and its surroundings. Proc., Third Intern. Coral Reef Symp.:297-303 Source: Dr. Richard Appeldoorn collection
6. Dennis G.D. 1992. Resource utilization by members of a guild of benthic feeding coral reef fish PhD dissertation 224pp UPR Mayaguez Department of marine sciences Source:Dr. Appeldorm Library

Summary table of fish species

Summary table of Bluestriped grunt (<i>Haemulon sciurus</i>) associations and interactions with environmental and habitat variables are listed with citations								a	
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships	
Eggs									
Larvae									
Early juveniles									
Late juveniles	More abundant on dry season April/May (9)	Mangroves(7,22,23) patch reefs behind lagoon (11,17) seagrass (22) Coastal Lagoon (23)	PRS:La Parguera(7), STC Tague Bay(11)STJ Greater Lameshur Bay(17) PRS: Jobos Bay (21,22) PRE Ceiba lagoon (23)		Salinity range from 30o/oo to 38.4 o/oo (23)	Oxygen concentration range from 1.4 mg/l to 6.2 mg/l (23)	1-4m (7,17)	Gammarids ostracods, polychaete setae, fish scales, Natantia shrimps, Cumacean shrimps (22)	
Adults		Reefs(1,4,18,24**)(forereef) (10),(A Palmata zone)(6**), (HR shoreward, LR apron LR slope(4**,6**) HR shelf edge(10), HR, LR offshore)(5), rubble/sandy areas(5) reef lagoon areas(5) mangrove(5,6,9,10,24**) seagrass(1,5,6) tide channel bay & shore areas (24**),	PRS:La Parguera (5), Turumote (10) Collado (9,10) Enrique(10), San Cristobal(4), PRS Ponce Cayo Berberia(6), PRS.STC.Salt River Canyon(18) PRS: Jobos Bay (24**) PRS Guayanilla bay (25**)	Can tolerate temperature ranges from 25 to 40°C (25**)			To ≥20m (4**10)	Crabs(3,10) and pelecipods(3) amphipods(10), crustaceans(10), holothurian(10), ophiuroids(10) hermit crabs(10) limpets(10)	Potential threats: Barracuda (9) subadults migrate from proprot protection before peak predation time begins; however, they stay in mangrove habitat for protection(9),
		Tide channel(24**) bay and shore areas (24**)							

Summary table of fish species

Summary table of Bluestriped grunt (<i>Haemulon sciurus</i>) associations and interactions with environmental and habitat variables are listed with citations (Cont)									
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships	
								Food	Predators
Spawning adults	Individuals with mature gonads in February (2)								
Source		Coordinates Latitude	Coordinates longitude						
	Specific site								
	4 La Parguera								
	San Cristobal	17°56'4"N	67°4'5"W						
	6 Ponce Cayo	17°55'50"N	66°27'20"W						
	Berberia								
	6 Ponce Cayo	17°57'15"N	66°40'12"W						
	Ratones								

Habitat associations and interactions			
Selection	Growth	Mortality	Production
Mangrove nursery area (7) Form large aggregation beneath <i>Diadema antillarum</i> spines for protection (21) Nursery ground Seagraas-mangrove communities (22) specially on shallow protected seagraas beds in inner and outer mangroves(22)			
Reef areas -to rest or diurnal shelter grassbeds- Nocturnal feeding areas(1,10) mangroves and backreef areas-settlement (10) little direct competition for space among species (10)		Have a high risk of predation due to its propensity to seek shelter and not to avoid predators (10). has a small foraging distance (10)	

Literature review Blue striped grunt *Haemulon sciurus*

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Summary table of fish species

Summary table of French Grunt (<i>Haemulon flavolineatum</i>) associations and interactions with environmental and habitat variables are listed with citations								
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships Food
Eggs			PRS La Parguera (33)	Optimal temperature for laboratory reared larvae is 25-28°C (33)				
Larvae Postlarvae		Patch reef (12) Diadema antillarum spines (33)	STC Tague Bay (12) Buck Island (12) PRS La Parguera(33)					
Early juveniles	Settlement high from May to November (27)	Patch reef (12) Rubble sandy habitat (19) experimental reef(queen conch) (19) sea grass/algal areas in back reef lagoon (27,28) Diadema Antillarum Spines (33)	STC Tague Bay (12,19,27,28) Buck Island (12) PRS Parguera(33)				(5-8m) (19,26)	
Late juveniles	More abundant in rainy season Oct/Nov(9)	Reefs(25,29,30) associated with extensive A palmata cover (1,4,12) and porites porites beds (12,20) mangrove (5,6,9,13,25,30,31,32)	PRS Parg Collado (9) Media Luna (4) PRS Ponce cayo ratones(6), cayo Bermeria (6) STC Tague Bay (11,12,19,20) STH Benner Bay (13), Vessup Bay (13) STJ Coral Bay (13) PRS. Peñuelas, Encarnación (25) STC Tague Bay (28) PRS Jobos Bay (29,30)		Salinity range from 30o/oo to 38.4 o/oo (31)	Oxygen concentration range from 1.4 mg/l to 6.2 mg/l (31)	(3 to 25m)(1,12,19,27)	Copepods(3) Polyplacophore, Brachyuran crab, ostracod, Natantia shrimps, Cumacean shrimps, gammarids, (30)
Late Juveniles (Cont.)			PRE Ceiba lagoon (31) STJ Hurricane Hole (32)					

Summary table of French Grunt (<i>Haemulon flavolineatum</i>) (Cont.)				
Predators	Habitat associations and interactions	Growth	Mortality	Production
	Selection			
	Highly variable recruitment due to aggregative settlement(19) they settle in seagrass areas to hide from predators (27)		Mortality rates of juveniles reduced when resting in reef areas (19) mortality in settlement by predation reduced as they settle 20m away from edge (27)	
Juveniles avoid predation pressure by restricting their migrational time shedule they migrate out of the mangrove after peak predation time decreases(9) Form large aggregations under the large spines of <i>Diadema antillarum</i> for protection (29)	Reefdiurnal shelter (12) Grassbeds- Nocturnal feeding areas(12) Nursery grounds: Mangrove-seagrassbeds communities (30)	$k=0.24, L=35$ cm for PR (10)	Mortality rates of juveniles reduced when resting in reef areas (19)	

Literature review French grunt *Haemulon flavolineatum*

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Summary table of Ocean triggerfish (<i>Canthidermis sufflamen</i>) associations and interactions with environmental and habitat variables are listed with citations															
Life Stage	Season	Zonation	Specific site	Temp	Salinity(	Oxyge	Depth(	Trophic relatio	Habitat associations and interactions	Food	Predat	Selecti	Growth	Mortality	Production
Eggs															
Larvae															
Postlarvae															
Early juveniles															
Late juveniles															
Adults															
Spawning adults	Spawning seen on September (1) ripe individuals in March and April (2)	Interface coral covered rocky area and smooth sand bottom (1)	STC:West coast (1) PRW (2)												

Literature review Ocean Triggerfish *Canthidermis sufflamen*

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Summary table of fish species

Summary table of Sea bream (<i>Archosargus rhomboidalis</i>)									
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships	
Eggs								Food	Predators
Larvae									
Postlarvae									
Early juveniles									
Late juveniles		Mangrove (3,5,6) seagrass (3) coastal lagoon (5)	PRS:Jobos Bay (3) PRE: Ceiba lagoon (5) PRS: La Parguera (6) PRN Caño Tiburones (6) PRS: Guayanilla (6)	27-32oC (6)	Salinity range from 30o/oo to38.4 o/oo (5) from 4 to 46 ppt (6)	Oxygen concentration range from1.4 mg/l to 6.2 mg/l (5)			
Adults		Semi enclosed shallow water embayment areas (1,8**) and reef (2,7**,8**) mangrove (8**) and seagrass sandy(8**) and muddy bottoms (8**)	PRS: Jobos Bay (2,7**,8**)						
Spawning adults	May spawn throughout the year. Ripe gonads observed in June, August, and December (1), February (4)	Semi enclosed shallow water embayment (1)	PRS:Guayanilla Bay (1) PRS: Jobos Bay (4)	Can resist temperatures close to 40oC (1)				Green Algae, Plant detritus, Halophila red algae, and egg masses (1)	

Summary table of Sea bream (<i>Archosargus rhomboidalis</i>) (Cont.)				
Habitat associations and interactions				
Selection	Growth	Mortality	Production	
Nursery grounds; Mangroves and seagrass (3)				

Literature review Sea Bream *Archosargus rhomboidalis*.

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Summary table of fish species

Summary table of Queen snapper (<i>Etelis oculatus</i>) associations and interactions with environmental and habitat variables are listed with citations												
Life Stage	Season	Zonation	Specific site	Temp	Salinity	Oxyge	Depth(m)	Trophic relationships		Habitat associations and interactions		
Eggs								Food	Predat	Selecti	Growth	Mortality
Larvae												
Postlarvae												
Early juveniles												
Late juveniles		Coral rubble and rocky areas ¹										
Adults		Rocky areas (1) Barren sand and occasional slab and boulder (2**)					Fishes, squids, and crustaceans shrimps, and crabs (1)	Seen at 1200 feet (2)				
Spawning adults	Spawning season unknown, females with ripe organs on July (1)											

Literature Queen snapper

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[illegible][illegible]

Literature black snapper *Apsilus dentatus*

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Summary table of fish species

Summary table of Wenchman (<i>Pristipomoides macrophthalmus</i>) associations and interactions with environmental and habitat variables are listed with citations												a	
Life Stage	Season	Zonation	Specific site	Temp	Salinity(p	Oxyge	Depth(m)	Trophic relationships		Habitat associations and interactions			
Eggs								Food	Predat	Selecti	Growth	Mortality	Productiona
Larvae													
Postlarvae													
Early juveniles													
Late juveniles	More abundant from October to December (3)												
Adults	More abundant from april to June (3)	Rocky and coral rubble areas (1,3,5) Continental slope: Barren sand with occasional slab or boulder (5**)	STH: 100fathom curveN, Tobago cayS, Frenchcap Cay (,3,4) W, STJ:S, STC (3,4): PRN: offshore (1) PR and USVla Continental shelf (5**)				Between 600 to 1200 feet (1,4,5**)	Deepwater shrimps and Crabs (1)	Misty grouper (1)				
Spawning adults	Females with ripe gonads on July (1) and December (2)		PRN: Offshore (1), PRW: Mayagüez(?)										

enchman *Pristipomoides macrophthalmus*
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Summary table of fish species

Summary table of Vermilion snapper (<i>Rhomboplites aurubens</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(p	Oxygen	Depth(m)	Trophic relationships Food a	Predato	Habitat associations and interactions			
Eggs										Selecti	Growth	Mortality	Production
Larvae													
Postlarvae													
Early juveniles													
Late juveniles													
Adults		In rocky bottoms and shelf edge habitats (1)	PRS 100 fathom curve Ponce, Salinas, Guayama, Caja Muertos La Parguera, Margarita Cabo Rojo PRW, Tourmarine, Abir La Sierra, Mona PRN, Isabela, Arecibo, San Juan, Vieques east and west (3)				Common in deeper waters but also found in shallow waters (1), from 41 to 60 fathoms (3)	Planktonic organisms and crustaceans (1)					
Spawning adults	Males and female organs ready to spawn on March, April and May (2,4). Other author say spawning period is year around (3)		PRW (4)										

Literature Vermillion Snapper *Rhomboplites aurorubens*

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- 5.

Summary table of Lane snapper (<i>Lutjanus synagris</i>) associations and interactions with environmental and habitat variables are listed with citations								
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships
Eggs								Food Predators
Larvae								
Postlarvae								
Late juveniles		From coral reefs to murky brackish water, and over mud bottoms close to the shore (1,3). Mangroves (16,17,18) and seagrass (16) coastal lagoon (17)	PRS:Ponce, Cayo Ratones6 PRS: Jobos Bay(16) PRE: Ceiba Lagoon (17) PRS: La Parguera (18) PRN: Arecibo:Caño Tiburones (18) PRS: Guayanilla (18)	From 27°C to 32°C (18)	Salinity range from 30o/oo to38.4 o/oo (17) from 4 to 46 ppt (18)	Oxygen concentration range from1.4 mg/l to 6.2 mg/l (17)a		Gammarids, Natantia shrimps,Brachyuran crabs (16)
Adults		From coral reefs(5,6,7,19**) (lagoon,high relief shoreward and low relief apron) 7(A.Palmata zone)(6**) to murky brackish water, seagrass (7) and mangroves (7)and over mud bottoms a (3,19*) bay and shore areas (19**)a	PRS La Parguera (7) Turrumote (5), Media Luna (5), San Cristóbal (5), PRS: Ponce Cayo Ratones (6) PRS: Guayanilla Bay (10**) PRS: Jobos Bay (19**)a				From shallow waters to depths of 400m (1,5)	Crabs and stomatopods (3)

Summary table of Lane snapper (<i>Lutjanus synagris</i>) (Cont.)			
Habitat associations and interactions			
Selection	Growth	Mortality	Production
Nursery grounds (mangrove and seagrass) (16)			
Prefer sites where soft unconsolidated sediment predominate (7)	k=.23 L 450mm (4) for PR usin length frequency analysis	Mercury levels are below critical limit 1.0g/gb (10**)	Area under influence of disposal of refinery petrochemical waters. Mercury levels are below critical limit 1.0g/gb; not letal.10**

Summary table of Lane snapper (<i>Lutjanus synagris</i>) (Cont.)								
Spawning adults	^a Spawning maxima on May (2.4) although females have ripe organs from March to September (2). Reproductive season extends from March to September with a Peak from April to July around full moon (20)		PR (4,20)					
References	Specific site ^a	Coordinates latitude	Coordinates longitude					
	La Parguera San Cristóbal	17°36.4'N	67°21.5'W					
	La Parguera Media Luna	17°36.4'N	67°21.8'W					
	La Parguera Turrumotea	17°36.2'N	67°21.2'W					
	Ponce Cayo Ratones	17°37'15"N	66°30'12"W					
	Ponce Cayo Berberia	17°35'50"N	66°27'20"W					

Summary table of fish species

Literature Lane snapper *Lutjanus Synagris*
1.

Summary table of fish species

Summary table of Blackfin snapper (<i>Lutjanus bucanella</i>) associations and interactions with environmental and habitat variables are listed with citations									
Life Stage	Season	Zonation	Specific site	Temp	Salinity (ppt)	Oxygen	Depth (m)	Trophic relationships	Predators
Eggs									
Larvae									
Postlarvae									
Early juveniles		Experimental reefs (concrete) (8)	STC Salt River Canyon (8)				17-20m (8)	Grunts (8)	
Late juveniles							30-50m (3)		
Adults	More abundant on April-June (4)	Sandy, coral rubble and rocky bottoms (1,4,5) Reef Lagoon (5) and shelf edge reefline(5)	STH: 100 fathom curve N, Tobago Cays. Frenchcap Cay (3,4). , STJ: S, STC (4); PRS: 100 fathom curve: Ponce, Salinas, Guayama Caja Muertos La Parguera (5); Margarita Cabo Rojo PRW: Tourmarine, Abrir La Sierra, Mona PRN Isabela Arecibo, San Juan, East and West (1)	Optimal temperature. 27°C to 29°C (3)			75-150m (1)	Fishes, tunicates, squid (4)	

Summary table of Blackfin snapper (*Lutjanus bucanella*) associations and interactions with environmental and habitat variables are listed with citations (Cont)

[illegible]

Summary table of fish species

Summary table of Blackfin snapper (*Lutjanus bucanella*) associations and interactions with environmental and habitat variables are listed with citations (Cont)

[illegible]

Summary table of fish species

Summary table of Blackfin snapper (*Lutjanus bucanella*) associations and interactions with environmental and habitat variables are listed with citations (Cont.)

[illegible]

Literature blackfin snapper *Lutjanus bucanella*

1. Boardman, C.W. and D. Weiler. 1979. Aspects of the life history of two deepwater snappers around Puerto Rico. Proc. Gulf and Carib. Fish. Inst. 32th Annual section:158-172. [Source: Dr. Appeldoorn collection]
2. Erdman D.S. 1976. Spawning patterns of fishes from the northern-eastern Caribbean. Dept. Agric. Puerto Rico, Agric. Fish. Contr. 8:1-36. [Source CFMC]
3. Sylvester, J.R., D. Drew, and A. E. Damman 1980. Selective history of silk and black fin snapper from the Virgin Islands. Carib. J. Sci.15(3-4) Pp.41-48.[Source : Miguel Figuerola collection]
4. Sylvester J.R. 1974. A preliminary study of the length composition, distribution and relative abundance of three species of deep water snappers from the Virgin Islands. J.Fish. Biol.6:43-49 [Source:CMFC]
5. Kimmel J.J. 1985 A characterization of Puerto Rican fish assemblages. PHD. Diss. Univ. Puerto rico, Mayaguez 106 p [Source Dr. Appeldoorn Collection]
6. **Boulon R.H. 1992. Use of Mangrove Prop Root habitats by Fish in the Northern U.S. Virgin Islands 41th Proc. Gulf Carib. Fish. Inst. St. Thomas. Pp.189-205 [Source: Dr. Appeldoorn Library]
7. Hixon M, and J Beets. 1993. Predation, prey refuges, and the structure of coral reef fishes Ecological Monographs 63(1) pp. 77-101 [Source: Dr. Appeldoorn library]
8. Shulman M, J Ogden, J.C. Ebersole, J.P. McFarland, W.N., Miller, S.L. Wolf, N.F. 1983. Priority effects in the recruitment of coral reef fishes. Ecology 64:1508-1513 [Source:DMS Library]
9. Rosario A. 1994. Shallow Reef Fish Monitoring Caribbean/ NMFS Cooperative SEAMAP Program . Report submitted to DNR. 142pp [source: CFMC]
- 10.

Summary table of Dog snapper (<i>Lutjanus jocu</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth	Trophic relationship Food	Pred	Habitat associations and interactions			
Eggs													
Larvae													
Postlarvae Early juveniles		Mangroves 4											
Late juveniles		Coastal waters in shallow rocky areas and reefs 1 ^a 5, 6, mangroves 4, 6, 16, 20 also on estuarine systems and rivers ¹ seagrass ¹⁶ coastal lagoon (17)	PRS Guayanilla Bay ⁴ , La Parguera ⁴ , PRW: Guanajibo ⁴ , PRN Caño Tiburones Arecibo ⁴ PRS: Ponce Cayo Berberia ⁶ PRS: Jobos Bay (16) PRE: Ceiba lagoon (17) STJ Hurricane Hole (20)	Optimal range 27-32°C (4)a	Salinity range from 30‰ to 38.4 ‰ (17) from 4 to 46 ppt (4)	Oxygen concentration range from 1.4 mg/l to 6.2 mg/l (17)		Crustaceans 4		Nursery ground: Mangrove-seagrass communities (16)			
Adults		Coral reefs ^{1,5,6,7,15} (high relief shoreward low relief slope and high relief shelf edge) ⁷ (slope and A Palmata zone) ⁶ , mangroves ^{6,7,20} and seagrass ⁶ Embayment areas (15) coastal lagoon (18**)	PRS: La Parguera ⁷ Ponce Cayo Berberia ⁶ PRW: Mayagüez Punta Ostiones ⁵ Guayanilla Bay 9** PRS: Jobos Bay (15) PRS: Joyuda lagoon (18**) Hurricane Hole (20)	Can tolerate temperature ranges from 25 to 40°C (15)			More than 30 feet ¹ to 60 feet ⁷	Fishes, crabs, lobsters, gastropods squids fishes eggs, lobsters eggs and crustaceans ^{3,4}					

Summary table of fish species

Summary table of Dog snapper (<i>Lutjanus jocu</i>) associations and interactions with environmental and habitat variables are listed with citations (Cont.)													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(	Trophic relationship		Habitat associations and interactions			
								Food	Pred	Selection	Growth	Mortality	Production
Spawning adults	Females with ripe organs from February to May?												
Source	Specific site	Coordinates latitude	Coordinates longitude										
	6 Mayagüez Punta Ostiones6	18°5'50"N	67°17'20"W										

Literature Dog snapper *Lutjanus Jocu*

1. Vivaldi J.L. 1986. Compendio Enciclopédico de Los Recursos naturales 2 Vol.7 Los Peces Marinos de Puerto Rico por D.S. Erdman, J.M. Berrios. I. Corujo y J.G. Gonzalez pp.485 [Source: CMFC]
2. Erdman D.S. 1976. Spawning patterns of fishes from the northern-eastern Caribbean. Dept. Agric. Puerto Rico, Agric. Fish. Contr. 8:1-36.[Source CFMC]
3. Randall, J. E. 1967. Food habits of the reef fishes of the west indies. Univ. Miami Studies in Trop. Oceanog. 5: 665-847[Source Miguel Figuerola archives]
4. Austin, H and S. Austin. 1971. The feeding habits of some juvenile marine fishes from the mangroves in Western Puerto Rico. Carib. J. Sci. 2:3-4 pp. 171-179. [Source: Dr. Manuel Velez library]
5. Parrish, J.D. and R.J. Zimmerman. 1977 Utilization by fishes of space and food resources on an offshore Puerto Rican coral reef and its surroundings. Proc., Third Intern. Coral Reef Symp.:297-303 [source: DMS]
6. **Berrios J and J Gonzalez Azar. 1985. Fish populations studies of the seagrass beds and coral reefs of Cayo Berberia and Cayo Ratones, Ponce, P.R. Report to DNR Source CMFC
7. Kimmel J.J. 1985 A characterization of Puerto Rican fish assemblages. PHD. Diss. Univ. Puerto Rico, Mayaguez 106 p Source Dr. Appeldoorn Collection
8. **Boulon R.H. 1992 Use of Mangrove Prop Root habitats by Fish in the Northern U.S. Virgin Islands 41 Proc. Gulf Carib. Fish. Inst St. Thomas Pp.189-205 Source: Dr. Appeldoorn Library
9. ** Ramirez Barbot J and J.M. Lopez 1979 Biological availability of mercury to the fisheries of Guayanilla Bay IN Proceedings of Symposium on Energy Industry and the Marine Environment in Guayanilla Bay CEER, July 12, 1979, Mayaguez, P.R. Source Department of Marine Sciences Library
10. ** Martin F.D. and J Patus 1973. A comparison of fish faunas in a highly stressed and a less stressed Tropical Bay -Guayanilla and Jobos Bay, Puerto Rico Proc. 27th Annual Conference of the Southeastern Association of Game and Fish Commissioners Source.: [Department of Marine Sciences Library]
11. **Kimmel, J. 1979. Thermal effects on fishes of Guayanilla Bay. IN: Proc. Ener. Mar. Env. Guayanilla bay. Center for Energy and Environmental Research:36-46.
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13. **Garrison G. 1997. ST. John, U.S. Virgin Islands Fish Trap study, 1992-1994 VINP technical report pp. 14. [Source DR. Richard Appeldoorn library]
14. **Wolff N.H. 1996. The fish assemblages within four habitats found in the nearshore waters of ST. John, United States Virgin Islands. with some insights into the nature of trap fishing MS Thesis University. Rhode Island pp. 205pp [Source:DR. Richard Appeldoorn library]
15. Martin F.D. 1974. Distribution, seasonality and feeding ecology of the fishes of Jobos Bay. 1974. Puerto Rico Nuclear Center Jobos Bay Annual Environmental Report 1:90-190. [Source:CEER]
16. Piastro L. 1974. Juvenile Fish of Jobos Bay Puerto Rico Nuclear Center Jobos Bay Annual Environmental Report 1:196-213. [Source:CEER]
17. Gonzalez azar J. and Vilella M. 1975. Biología de Las Lagunas Costeras. 2do Simposio de Recursos Naturales pp. 4-40. Source: [Dr. Manuel Velez library]
18. **Perez, M. M. Llano and C. Liboy 1979. Suplemento técnico para la reserva natural de Laguna Joyuda y Terrenos Asociados Report submitted to DNR. Pp.185 [source: CEER]
19. **Kimmel J. 1979. Thermal effects on fish of Guayanilla Bay. Proceedings of the Symposium on Energy Industry and the Marine Environment in Guayanilla Bay. CEER. Pp.32-45. [Source: CEER]
20. Boulon, R.H., Jr. 1985a. Distribution and species composition of fisheries habitats within the Virgin Islands Biosphere Reserve. Unpl. Report
- 21.

Summary table of Mahogany snapper (<i>Lutjanus mahogany</i>) associations and interactions with environmental and habitat variables are listed with citations					
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)
Eggs					
Larvae					
Postlarvae					
Early juveniles		Artificial reef (cement)(14), sea grass/algal areas in back reef lagoon (15)	STC Salt River Canyon (14) STC Tague Bay (15)		
Late juveniles	More abundance in Mangrove habitats in wet season(Oct/Nov) (4)	Mangrove (4, 13, 16), serves as intermediate life stage seagrass (13), reef (13)	PRS La Parguera, El Collado (4), PRS Peñuelas, Encarnación (13) STJ. Hurricane Hole(16)		
Adults		Reefs (1,5,6**, 7, 11, 15) (High relieve shoreward, offshore shelfedge, low relieve slope, apron offshore) (7) coral rubble (7) and rocky areas (1) in clear shallow waters and high salinity sometimes in sandy areas and seagrasses (1). (Cont.)	PRS Ponce Cayo Berberia (6**), and Ratones (6**) La Parguera (7) Turrumote (5), San Cristóbal (5) Media Luna (5) STC Salt River Canyon (11)a PRS Jobos Bay (15) STJ. Hurricane Hole (16)a		
Spawning adults	Females with ripe gonads on August (2)				

Summary table of fish species

Summary table of Mahogany snapper (<i>Lutjanus mahogany</i>) (Cont)							
Oxygen	Depth(m)	Food	Trophic relationships Predators	Habitat associations and Selection	interactions Growth	Mortality	Production
		4 5m to8m 15,17-20m14	Grunts14			They settle in seagrass areas to hide from predators15;	
	0-20m (5,11)	Night feeding fishes,shrimps,crabs (3)		Abundance negatively correlated in places with high sedimentation rates (6**)			

Summary table of fish species

Summary table of Mahogany snapper (<i>Lutjanus mahogany</i>) (Cont.)				
Source	Specific site	Coordinates latitude	Coordinates longitude	Potential use
5	La Parguera San Cristobal	17°56.4'N	67°4.5'W	
5	La Parguera Media Luna	17°56.4'N	67°2.8'W	
5	La Parguera Turrumote	17°56.2'N	67°1.2'W	
6	Ponce Cayo Ratones	17°57'15"N	66°40'12"W	
6	Ponce Cayo Berberia	17°55'50"N	66°27'20"W	
13	Peñuelas, Barrio Encarnación	17°59'00"N	66°42'20"W	Nursery ground

Literature Mahogany snapper , Lutjanus Mahogany

1. Vivaldi J.L. 1986. Compendio Enciclopedico de Los Recursos naturales 2 Vol.7 Los Peces Marinos de Puerto Rico por D.S. Erdman, J.M. Berrios. I. Corujo y J.G. Gonzalez Source: CMFC
2. Erdman D.S. 1976. Spawning patterns of fishes from the northern-eastern Caribbean. Dept. Agric. Puerto Rico, Agric. Fish. Contr. 8:1-36. Source CMFC
3. Randall, J. E. 1967. Food habits of the reef fishes of the west indies. Univ. Miami Studdies in Trop. Oceanog. 5: 665-847 Source Miguel Figuerola archives Fish lab DNR
4. Rooker J.J, and G. Dennis 1991 Diel Lunar and seasonal changes in a Mangrove fish Assemblage off south western Puerto Rico Bull. Mar. Scien. 49(3) :684-698 Source: Dr. Richard Appeldoorn collection
5. Garcia Saiz Jorge 1994 La Parguera Marine reserve a feasibility study CFMC Annual Report pp 111 Source: Sea Grant Mayaguez
6. **Berrios J and J Gonzalez Azar. 1985. Fish populations studies of the seagrass beds and coral reefs of Cayo Berberia and Cayo Ratones , Ponce, P.R. Report to DNR Source CMFC
7. Kimmel J.J. 1985 A characterization of Puerto Rican fish assemblages. PHD. Diss. Univ. Puerto Rico, Mayaguez 106 p Source Dr. Appeldoorn Collection
8. **Boulon R.H. 1992 Use of Mangrove Prop Root habitats by Fish in the Northern U.S. Virgin Islands 41 Proc. Gulf Carib. Fish. Inst. St. Thomas Pp. 189-205 Source: Dr. Appeldoorn Library
9. ** Martin F.D. and J Patus 1973. A comparison of fish faunas in a highly stressed and a less stressed Tropical Bay -Guayanilla and Jobos Bay, Puerto Rico Proc. 27th Annual Conference of the Southeastern Association of Game and Fish Commissioners Source.: Department of marine Sciences Library
10. ** Stoner. A. 1986 Community Structure of the Demersal Fish Species of Laguna Joyuda, Puerto Rico Estuaries Vol 9 No.2, p.142-152 Source Department of marine Sciences Library
11. Kaufman L. and J Ebersole 1984 Microtopography and the organization of two assemblages of coral reef fishes in the west indies J. Exp. Mar. Biol. Ecol., vol. 78. Pp.253-268 Source: Dept. of Marine Sciences Library
12. **Wolff N.H. 1996 The fish assemblages within four habitats found in the nearshore waters of ST. John, United States Virgin Islands: with some insights into the nature of trap fishing MS Thesis University, Rhode Island pp. 205pp Source: DR. Richard Appeldoorn library
13. Hernandez .E 1997. Evaluacion biologica de las comunidades marinas del Barrio Encarnacion, Peneuelas, para el Proyecto El cano Resort. Technical Report Servicios Cientificos y Tecnicos pp. 85 Source : Edwin Hernandez
14. Shulman M, J Ogden J.C. Ebersole, J.P. McFarland, W.N., Miller, S.L. Wolf, N.F. (1983) Priority effects in the recruitment of coral reef fishes Ecology 64:1508-1513 Source:DMS
15. Shulman M 1985 Recruitment of coral reef fishes: Effects of Distribution of predators and shelter Ecology, vol.66.No.3 1056-1066 source Source:DMS Library

Summary table of fish species

Summary table of Greater soapfish (<i>Rypticus saponaceus</i>)													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(p	Oxygen	Depth(m)	Trophic relationship		Habitat associations and interactions			
								Food	Predators	Selection	Growth	Mortality	Production
Eggs													
Larvae													
Postlarvae													
Early juveniles													
Late juveniles		Mangrove(1),a seagrass(1)	PRS: Jobos Bay (1)							Nursery grounds: Mangrove and seagrass communities (1)			
Adults													
Spawning adults													

Literature review of soap fish *Rypticus saponaceus*

1. Piastro L. 1974. Juvenile Fish of Jobos Bay. Puerto Rico Nuclear Center Jobos Bay Annual Environmental Report 1:196-213. [Source:CEER]

Summary table of fish species

Summary table of Hog fish (<i>Lachnolaimus maximus</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(p	Oxygen	Depth	Trophic relation		Habitat associations and interactions			
Eggs		Shelf edge; ridge paralleling shelf break with rocky substrate and abundant coral (1)	PRS: La Parguera Shelf edge(1)	Eggs hatch at 25°C laboratory reared (1)					Yellow tail snapper (1)				
Larvae													
Postlarvae													
Early juveniles													
Late juveniles													
Spawning adults	Spawning observed from December to April (1)	Shelf edge; ridge paralleling shelf break with rocky substrate and abundant coral (1)	PRS: Laa Parguera Shelf edge(1)	Optimal temperature during spawning from 24°C to 26°C (1)			16m (1)						
Source	Specific site	Coordinates latitude	Coordinates longitude	Potential use									
	PRS: La Parguera shelf edge	17°54'N	66°57'W	Spawning ground									

Literature Review Hogfish *Lachnolaimus maximus*

1. Colin P. Spawning and larval development of the Hogfish, *Lachnolaimus maximus* Fish. Bull. 80:4.pp.853-862 [Source: CFMC]

Summary table of Blue head wrasse (<i>Thalassoma bifasciatum</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(pp	Oxygen	Depth(m)	Trophic relationships		Habitat associations and interactions			
								Food	Predators	Selection	Growth	Mortality	Production
Eggs													
Larvae													
Postlarvae													
Early juveniles													
Late juveniles		Inshore reefs (1)	PRW: Aguedilla Crashboat (1)				15 feet (1)			Prefer to swim around sea anemone <i>Condylactis gigantea</i> (1) Probably utilizes the anemone for temporary protection from predators in places where there is lack of proper shelters (1)			
Adults													
Spawning adults													

Literature review of Bluehead wrasse *Thalassoma bifasciatum*

1. Notes on the association of *Thalassoma bifasciatum* with *Condylactis gigantea* in Puerto Rico, Carib J. Sci. 21:3-4 pp. 155- [Source: Dr. Manuel Velez library]

Summary table of fish species

Summary table of Longsnout butterflyfish (<i>Chaetodon aculeatus</i>) associations and interactions with environmental and habitat variables are listed with citations									
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships	
Eggs		Shelf edge (4)	PRS:Guánica Punta Jorobado (4) STC(4)					Food	Predators
Larvae									
Postlarvae									
Early juveniles									
Late juveniles									
Adults		Reef(1,3) (HRShoreward,HR shelf edge,HR,LR offshore) (1)common in rubble arease	PRS:La Parguera (1); STC:Salt River Canyon (3) PR and USVI shelf edge 100 fathom line (5**)e				Between 20 to 300 feet (1,5**)		
Spawning adults	Spawning activity seen in April (4) and September (4)	Shelf edge (4)e	PRS:Guánica Punta Jorobado(4) STC(4)						
References	Specific site	Coordinates latitude	Coordinates longitude	Potential use					
	4 PRS:Guánica Punta Jorobada shelf edge	17°53.86'N	66°57.35'W	Spawning ground					

Summary table of fish species

[illegible]

Literature longsnout butterflyfish chaetodon aculeatus

1. Kimmel J.J. 1985 A characterization of Puerto Rican fish assemblages. PHD. Diss. Univ. Puerto rico, Mayaguez 106 p Source Dr. Appeldoorn Collection
2. Hixon M, and J Beets. 1993. Predation, prey refuges, and the structure of coral reef fishes assemblages Ecological Monographs 63(1) pp. 77-101 Source: Dr. Appeldoorn library
3. Kaufman L. and J Ebersole 1984 Microtopography and the organization of two assemblages of coral reef fishes in the west indies J. Exp. Mar. Biol. Ecol., vol. 78. Pp.253-268 Source: Dept. of Marine Sciences Library

Summary table of fish species

Summary table of Four-eye butterflyfish (<i>Chaetodon Capistratus</i>) associations and interactions with environmental and habitat variables are listed with citations									
Life Stage	Season ^e	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen ^e	Depth(m)	Trophic relationships	
Eggs								Food	Predators
Larvae									
Postlarvae									
Early juveniles		(Experimental reef: concrete)(15); sea grass/algal areas in back reef lagoon (16)	STC: Salt River Canyon (15); STC: Tague Bay(16)				5-20m (15,16)		
Late juveniles	More abundant in rainy season Oct/Nov (3)	Leeward side backreef mangrove stand (3) backreef slope R/S areas(8) (experimental reef: queen conch)(8) reef (14) mangrove (19,20) seagrass(19) coastal lagoon (20)	PRS: La Parguera El Collado (3) STC: Tague Bay (8) PRS: Penueles Encarnacion (14) PRS: Jobos Bay (19) PRE: Ceiba lagoon (20)		Salinity range from 30 o/oo to 38.4 o/oo (20)	Oxygen concentration range from 1.4 mg/l to 6.2 mg/l (20)	5m (8)		
Adults		Deep fore reef (1**), e (HR Shoreward, LR Apron, LR Slope, HR shelf edge, HR, LR offshore) (2); Rubble sandy areas mangrove (2,20); seagrass(2) reef and embayment areas (18)	PRS: La Parguera (2); Turrumote(1**) Colombia: Santa Marta (17) PRS: Jobos Bay (18) PRE: Ceiba lagoon (20)				1-10m (16)e		

Summary table of Four-eye butterflyfish (<i>Chaetodon Capistratus</i>) (Cont.)			
Habitat associations and interactions			
Selection	Growth	Mortality	Production
		They settle in seagrass areas to hide from predators (16)	
Nursery grounds mangrove and seagrass communities (19)			
Prefer to stay in reefs with high coral cover and in water with low turbidity (17)			

Summary table of fish species

Summary table of Four-eye butterflyfish (<i>Chaetodon Capistratus</i>) associations and interactions with environmental and habitat variables are listed with citations (Cont.)									
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships	
Spawning adults	Spawning seen in April (13)	Shelf edge (13)	PRS:Guánica Punta Jorobado (13)					Food	Predators
References	Specific site	Coordinates latitude	Coordinates longitude	Potential utilization					
	La Parguera Turrumote	17°56.2'N	67°1.2'W						
13	PRS:Guánica Punta Jorobada shelf edge	17°53.86'N	66°57.35'W	Spawning ground					
14	Peñuelas, Barrio Encarnación	17°59'00"N	66°42'20"W						

Literature review Fourey butterflyfish *Chaetodon capistratus*

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3. Rooker, J.J. and G. Dennis. 1991. Diel Lunar and seasonal changes in a Mangrove fish Assemblage off south western Puerto Rico. Bull. Mar. Scien. 49(3) :684-698 [Source: Dr. Richard Appeldoorn collection]
4. **Boulon R.H. 1992. Use of Mangrove Prop Root habitats by Fish in the Northern U.S. Virgin Islands. 41th Proc.Gulf Carib. Fish. Inst. St. Thomas. Pp.189-205 [Source: Dr. Appeldoorn Library]
5. **Turnigan, R.G. and A.B. Acosta. 1994. An analysis of the fish assemblages on a Coral Patch Reef in Puerto Rico. pp. 242-263 In: Proceedings of the 43rd Annual Gulf and Caribbean Fisheries Institute. 1990, Miami USA (Ed. By M.H. Charleston, South Carolina [Source Dr. Rich Appeldoorn])
6. Hixon M, and J. Beets. 1993. Predation, prey refuges, and the structure of coral reef fishes assemblages. Ecological Monographs 63 (1) pp. 77-101 [Source: Dr. Appeldoorn library]
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Summary table of Four-eye butterflyfish (<i>Chaetodon Capistratus</i>) (Cont.)			
Habitat associations and interactions			
Selection	Growth	Mortality	Production

Appendix B

Sealed
in Red Tish
Paper

Summary table of fish species

Summary table of Coney (<i>Cephalopholis fulva</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships		Habitat associations and interactions			
								Food	Predators	Selection	Growth	Mortalit	Production
Eggs													
Larvae													
Postlarvae													
Early juveniles		Filamentous algal growth on shallow artificial cement module reefs (6)					In 10 m (6)						
Late juveniles		Patch reefs (7)	STC:Perseverance Bay (7)				6 to 12m (7)			a	a		
Adults		Reefs(1,8,9,14);, rocky substrates(1);(A.palmata zone)(9**)(HR shoreward, LR slope(9**) HR shelf edge,HR,LR offshore)(5)rubble/sandy areas(5) and sand flats(1) in seagrassbeds	STC5 PRS:La Parguera (8);, PRS:Ponce Cayo ratones(9),STC: Salt River Canyon(14);				Up to 40m (1)	Fishes, shrimps, marine crabs, stomatopods, and crustaceans (3)			k=0.14-0.32 and L 292.7 425mm with ELEFAN length frequency analysis (5)		
Spawning adults	Spawning activity in January eleven days after full moon(4,19) and February(19) individuals with ripe gonads from September to March April (2,18,19) with peak on Dember and January (18) on April (17)	On Shelf edge (4)	PRS: Guánica Punta Jorobada shelf edge (4) PRW (17):PRW: Bajoale Cico (18)Abriir laa Sierra (19)a				1-35m (4,18)			Spawning aggregation go to the same spot of the red hind (18,19) very rare in silty areas close to river influx. they prefer sites with Hard and soft coral and sponges (18,19)			

Summary table of fish species

Summary table of Coney (<i>Cephalopholis fulva</i>) associations and interactions with environmental and habitat variables are listed with citations (Cont.)															
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships	Habitat associations and interactions						
Source	Specific site	Coordinates latitude e	Coordinates longitude e	Potential use				Food e	Predators	Selection	Growth e	Mortality	Production e		
	PRS:Guánica Punta Jorobada shelf edge			Spawning ground											
4		17°53.86'N	66°57.35'W												
9	Ponce Cayo Ratones	17°57'15"N	66°40'12"W												

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Summary table of fish species

Summary table of Red hind (<i>Epinephelus guttatus</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships	Habitat associations and interactions				
Eggs				Eggs hatch 27h at 26.5 °C and 31 hours at 25.5 °C in lab conditions (5)				Food	Predators	Selection	Growth	Mortality	Production
Larvae								Zooplankton feeders (5)					
Postlarvae		Settlement of larvae onto reef occurs 1-2 months following spawning (5)	PRS: La Parguera shelf edge (5)										
Early juveniles		Shallow sand and coral rubble areas (7); cement model reefs (29)	STC: Salt River Canyon (29)	Low temperature can retard growth in young individuals (8)			17m to 20m (29)						
Late juveniles		Patch reefs (17,33) Reef Base (33) Shallow rocky, rubble areas and sandy areas (1,12,11,33) Red Mangrove roots and Thalassia Beds (1)	STH: Perseverance Bay (17); PRS: La Parguera Reef El Palo (11,13); La Corona (11) and Margarita (11,13) STC: Tague Bay (33)				Up to 12m (17,33)	Crabs, fishes, stomatopods, shrimps, crustaceans and echinoderms (2)		Nursery ground: among clumps of ataghorn coral Acropora cervicornis and coral rubble areas (33)			
Adults		Rocky coral reef areas (1,11,12,13) Sand flats (15,16) and reef (15,16,25) forereef (17**); (A palmata zone) (19**); (HR shoreward, LR apron LR slope (17**, 19**) HR shelf edge, HR, LR offshore) (18) rubble/sandy areas (18) females more inshore than	PRW: Punta Ostiones (15,16); PRS: La Parguera (18); El Palo (11,13) La Corona (11) and Margarita (11,13); Turumote (17) Media Luna (17) San Cristobal (17) PRS: Ponce Cayo Berberia (19) Cayo Ratones (19) STJ: Little Lameshur Bay (24); STC: Salt River				Average adult depth 8m (11) to 60 feet (17**)	Crabs, fishes, stomatopods, shrimps, crustaceans and echinoderms (3,16)		Prote reefs with high complexity of structure for shelter (27)	Growth Coefficient in PR .101 and USVI 0.071 (8)		

Summary table of fish species

Summary table of Red hind (<i>Epinephelus guttatus</i>) associations and interactions with environmental and habitat variables are listed with citations (Cont.)													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships		Habitat associations and interactions			
								Food	Predators	Selection	Growth	Mortality	Production
Adults (Cont.) Spawning adults	Reproduction period from December to March with Peak on January and February. The spawning occurs two days after full moon (2,4,5,6,9,10,13,14,30,31,32)	Vicinity of the edge of the insular platform (4,5,9,10,13) reef areas with small plates of coral <i>M. annularis</i> (9) Shelf edge covered with dense scleratinian cover dominated by <i>Montastrea annularis</i> with large colonies 5 to 10m in height (10,14)	PRW: Mayaguez: Bajo el Cico, Tourmaline reef Abir la Sierra shelf edge (8,30,31,32) PRS: La Parguera shelf edge (5) : La Parguera: El Hoyo (4,13), La Iaja (13) STH: shelf edge 9 miles south (9,10,14)				Between depths of 10 and 50 fathoms (4,5,9,10)	Yellowtail snapper, Parrot fish, creole wrasse and creole fish (9)	Reef shark, blacktip shark, nurse shark, barracuda, and king fish. It is attributed that predator abundance specially sharks depleted grouper aggregation in some areas in St. Thomas (9); Cubera snapper (10)	Shelf edge with dense <i>Montastrea</i> cover Provided excellent habitat for shelter from predators (10,14) prefer hard bottom more than any other grouper (32)		There are predation induced mortality in breeding aggregations (9)	
Source	n	Specific site	Coordinates Latitude	Coordinates longitude	Potential use								
	5	La Parguera: el Hoyo	17°52.5'N	67°2.9'W	Spawning ground								
	10	STH: south	18°20'N	65°0.10'W	Spawning ground								
	10	STH: south	18°20'N	65°0.40'W	Spawning ground								

Summary table of fish species

Summary table of Red hind (<i>Epinephelus guttatus</i>) associations and interactions with environmental and habitat variables are listed with citations (Cont.)													
								Trophic relationships	Habitat associations and interactions				
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Food	Predators	Selection	Growth	Mortality	Production
15	PRW: Mayagüez Punta	18°55'N	67°17'20"W										
	PRW: Mayagüez Punta	18°55'N	67°17'20"W										
16													
17	La Parguera San Cristóbal	17°56.4'N	67°45'W										
19	Ponce Cayo Ratones	17°57'15"N	66°40'12"W										
19	Ponce Cayo Berberia	17°55'50"N	66°27'20"W										

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Summary table of fish species

Summary table of Nassau grouper (<i>Epinephelus striatus</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(p	Oxyge	Depth(m)	Trophic relationships		Habitat associations and interactions			
Eggs								Food	Predat	Selection	Growth	Mortality	Production
Larvae													
Postlarvae													
Early juveniles		Seagrass beds (5); and reefs (5) show more preference in artificial reefs (5)	STH: Perseverance Bay (5)					Small grunts5		Closely associated with the substrate specially in small burrows under reefs5	Growth = 1cm/month 5		
Late juveniles		Reefs and flats in seagrassbeds(1,19) show more preference in artificial reefs (5) mangroves (19)	STH: Perseverance Bay (5) PRS: Jobos Bay (19)							Nursery grounds: Mangrove-seagrass beds communities (19)			
Adults		Reefs(1,7,9**10**18)(A . Palmata Zone) (8**) (HR shoreward, LR apron, LR slope (8**9**10**) HR shelf edge, HR, offshore) (7) (exp.reef concrete) (16)e	PRS: La Parguera(7); PRS: Ponce Cayo Berberia (8); PRW: Mayaguez Punta Ostiones (9,10) STH: Perseverance Baye (16)ePRS: Jobose Bay (18)e				Up to 30m (1)	Fishes, crabs, stomatopods, cephalopods, shrimps, lobsters, gastopods, isopods, pelicipods (3)		Prefer reefs with the high complexity of structure for shelter (16)			

Summary table of fish species

Summary table of Nassau grouper (<i>Epinephelus striatus</i>) (Cont.)													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(p	Oxyge	Depth(m)	Trophic relationships		Habitat associations and interactions			
Spawning adults	Spawning season	Shelf edge (4)	STH:shelf edge 8 miles South STH (4) (recent reports indicate spawning aggregation in same site has vanished) (5)				40m (4)	Food	Predat	Selection	Growth	Mortality	Production
	January and February specially after full moon (2,4)								Reef sharks (4)				
Source	Specific site	Coordinates latitude	Coordinates longitude										
	Ponce Cayo	17°55'50"N	66°27'20"W										
	Berberia												
	PRW:	18°5'50"N	67°17'20"W										
	Mayagüez												
	Punta												
	Ostiones												

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SUMMARY

Summary table of Mutton Snapper (<i>Lutjanus analis</i>) associations and interactions with environmental and habitat variables are listed with citations												
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships	Predators	Habitat associations and interactions		
Eggs												
Larvae												
Postlarvae												
Early juveniles												
Late juveniles												
Adults		Seagrass (5, 14, 9, 16); Mangroves (5, 9, 14, 16, 18); reef (14) grass flats (17) Coastal lagoon (9, 18)	PRS: Ponce Cayo Ratones (5) PRS: Penueles, Encarnacion (14) PRS: Jobos Bay (16, 17) PRE: Ceiba lagoon (18) PRW: Joyuda lagoon (9)		Salinity range from 30 o/oo to 38.4 o/oo (18)	Oxygen concentration range from 1.4 mg/l to 6.2 mg/l (18)		gammarids, fish parts, Natantia shrimps (16)		Nursery Grounds: Mangrove and Seagrass communities (9, 16) coastal lagoon (9)		
		Sandy areas with algae (1, 3, 6); sea grass (3, 20**); bays, estuarine environments with red mangroves (1, 19**, 20**); and in reefs (1, 3, 4, 5, 6, 11) (A. palmata zone) (5) slope (5) (high relief shoreward and offshore, low relief apron, reef lagoon) (6)	PRS: La Parguera (6), Media Luna (4) San Cristobal (4), Ponce Cayo Ratones (5), and Cayo Berberia (5) STC Salt River Canyon (11) PRS: Jobos Bay (19** 20**) Guayanilla Bay (21**)	can tolerate temperature ranges from 25 to 40° C (21**)			0 to 60 feet (4, 11)	crabs, fishes, gastropods, hermit crabs, lobsters, stomatopods (3)				
Spawning adults	More abundant in spring when the spawning season comes (1)	males and females with ripe organs between March and June (2)										
Location: PRN=Puerto Rico Norte, PRS=Puerto Rico South PRE=Puerto Rico East PRW=Puerto Rico West STH=Saint												
HR=High relief, LR=Low relief, **= Unknown life stage												

Summary table o	
Life Stage	Production
Eggs	
Larvae	
Postlarvae	
Early juveniles	
Late juveniles	
Adults	
Spawning adults	
Location: PRN=Puerto Rico Norte, PRS=Puerto Rico South PRE=Puerto Rico East PRW=Puerto Rico West STH=Saint. HR=High relief LR	

Summary table o	
Life Stage references	Production
	4
	4
	5
	5
	14

SUMMARY

Summary table of Mutton Snapper (<i>Lutjanus analis</i>) associations and interactions with environmental and habitat variables are listed with citations												
Life Stage references	Season	Zonation	Specific site	Tempt	Salinity(ppt)	Oxygen	Trophic relationships		Habitat associations and interactions			
	Specific site	coordinates Latitude	coordinates longitude	Potential utilization			Depth(m)	Food	Predators	Selection	Growth	Mortality
4	La Parquera San	17°56'4"N	67°4.5'W									
4	La Parquera Media	17°56.4'N	67°2.6'W									
5	Ponce Cayo	17°57'15"N	66°40'12"W	Nursery								
5	Ponce Cayo	17°55'50"N	66°27'20"W	Nursery								
14	Penuelas,Barrio Encarnacion	17°59'00"N	66°42'20"W	Nursery ground								

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Summary table of fish species

Summary table of Silk snapper (<i>Lutjanus vivanus</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(	Oxyge	Depth(m)	Trophic relationships	Habitat associations and interactions				
								Food	Predat	Selecti	Growth	Mortality	Production
Eggs													
Larvae													
Postlarvae													
Early juveniles			PRW: Mayagüez ,Desecheo, (7)				Below 40 fathoms (7)						
Late juveniles													
Adults													
More abundant in April-June4		Close to the shelf edge at great depths(1,2,4), Mud,Rock,sand and coral rubble (4,5,9**)	STH,STC,STJ: shelfedge100fathomline (4,5,6,9**)PRW: PRS: 100fathom curve Ponce, Salinas, Guayama, Caja Muertos, La Parguera ,Margarita Cabo Rojo (2) PRW: Tourmarine (2,7) ,Abrir La Sierra, Mona.N and Desecheo(2,7) PRN Isabela Arecibo, San Juan,V: east and west(2)	Temperature distribution in USVI ranges from 27 to 29oC (6)			Commonly found at depth above 72m (2) To 378m (4,5,6,7,9**)	Feeds on invertebrates (crabs and shrimps)and fishes (1,6)					
Spawning adults													
More abundant in April-June4	Reproduction is all year around (2,3,6,8) with peaks in April-June and October - December (4) High number of Ripe females found during the year was on August (8)		PRN: San Juan Isabela (8)				Found on 125-150 fathom (8)						

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Summary table of fish species

Summary table of Shoalmaster (<i>Lutjanus apodus</i>) associations and interactions with environmental and habitat variables are listed with citations									
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships	
Eggs								Food	Predators
Larvae									
Postlarvae									
Early juveniles		Mangrove prop-root habitats (4,5,6,7,8)	PRS:Parguera shoreline mangrove close to Isla Cueva and Mangrove Keys Collado (5,6,8), Las Pelotas(4) Enrique(4) Papayo (7) PRS Guayanilla Bay (7,8) PRW:Mayaguez Guanajibo River (8) PRN Arecibo Caño Tiburones (8)	Optimum values found from 28-33°C (7)	Salinity range from 24o/oo to 46 o/oo (7)	Oxygen concentration range from 3.2 ppm to 8 ppm (7)	Below 1m (4,7,8)	Crustaceans, particularly, amphipods, Penaeid shrimps and crabs(4,7,8) gammarids, fish parts, ostracods, brachyuran crabs(22)	
Late juveniles		In littoral zones, sometimes in estuaries ¹ seagrass (11,16,20,22) Mangrove (5,6,7,11,16,20,22,24,28) and Reefs(1,4,9,20) Acropora Palmata extension usually associated with Juveniles(9) Coastal lagoon (16,24)	PRS:Parguera (4,5,6,7,9),Guayanilla Bay(7),PRW: Mayag Guanajibo (8) PRN Arecibo Caño Tiburones(8);PRS Ponce Cayo Berberia(11)Ratones(11)Peñuelas, Encarnación(20); PRS: Jobos Bay (22) PRE: Ceiba lagoon (24) PRW: Joyuda lagoon (16) STJ: Hurricane Hole (28)	Optimum values found from 27-33°C (7,8)	Salinity range from 30o/oo to 38.4 o/oo (24) from 4 ppt to 46 ppt (7,8)	Oxygen concentration range from 1.4 mg/l to 6.2 mg/l (24) and from 3.2 ppm to 8 ppm (7)	0 to 20m (9)	Fishes, crabs, stomatopods, shrimps, gastropods ^{3,4,7,8} gammarids, fish parts, stracods, brachyuran crabs (22)	
Adults		Reefs(1,4,9,10,11,12,17,21,26**) (High relieve shoreward, offshore, shelf edge low relieve offshore, apron, slope) (12) with Dominant species A palmata and Millepora (4,9,10,11) offshore reef dominant species: Diploria and Montastrea and Agaricia(4)	PRS:Parguera (1,12) shoreline Mangrove close to Isla Cueva Collado(5), Las Pelotas Inshore Reefs Enrique,Margarita(4),Laurel (10) San Cristóbal (9) MediaLuna (4,9) Turrumote (4,9) Ponce,Cayos Ratones(11), and Berberia (11) STC: Salt River Canyon (17)				0 to 60 feet ⁹	Fishes, crabs, stomatopods, shrimps, gastropods (3,4)	

Summary table of Shoalmaster (<i>Lutjanus apodus</i>)			
Habitat associations and interactions			
Selection	Growth	Mortality	Production
Nursery grounds: Mangrove and seagrass communities (16,22)			

[illegible]

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Summary table of fish species

Summary table of Grey snapper (<i>Lutjanus griseus</i>) associations and interactions with environmental and habitat variables are listed with citationsa									
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships	
Eggs								Food	Predators
Larvae									
Postlarvae									
Early juveniles	More abundant on late summer (5,6)	Mangroves (5,6,8),	PRS:La Parguera Shoreline mangroves and close to Islas Guayacan and Cueva(6,8), PRS: Guayanilla Bay (8) PRW: Mayagüez Punta Ostiones (5) Guanajibo River (8) PRN:Arecibo,Caño Tiburones (8)					Crustaceans mainly amphipods and copepods (8)	
Late juveniles		Coastal waters, specially estuaries(1); lagoons (1,17);, rivers(1), seagrass (10,20,21) shallow mangroves (5,7,10,17,20,22,27) and reefs1,20	PRS:Guayanilla Bay (7); PRS:Ponce Cayo Berberia (10); PRW:Mayaguez Punta Ostiones (5); PRS: Peñuelas,Encarnación (20); PRS: Jobos Bay (22) PRS: Joyuda lagoon (17) STJ: Hurricane Hole (27)					Feed on Thalassia beds, amphipods, shrimps, crabs copepods (3,8) gammarids, fish parts, ostracods, brachyuran crabs (22)	

Summary table of fish species

Summary table of Gray snapper (<i>Lutjanus griseus</i>) associations and interactions with environmental and habitat variables are listed with citations (Cont.)									
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships	
Adults		Mangrove (5,10,11,24**,25**,26**27) and reef (1,4,9,10,11,21) High relieve shoreward, low relieve slope, shelf edge (11) (A. Palmata Zone) (10) Embayment areas (21) Coastal lagoon(23**) seagrass (26**) tide chanel (26**)	PRS: La Parguera (11) Turrumote (9) San Cristóbal (9) Jobos Bay (21); Islote Berberia (4,10) PRW: Mayagüez Punta Ostiones (5) Guayanilla Bay (14**,27**) PRW Joyuda lagoon (23**) PRS: Jobos Bay (24**,25**,26**) STJ: Hurricane Hole (27)	Can resist temperatures closer to 37°C (24**). Can tolerate temperature ranges from 25°C to 40°C (27**)				Feeds on <i>Thalassia</i> beds and sandy bottoms. They consume primarily fishes (3) also on Red Mangrove roots. Possible prey <i>Jenkinsia</i> <i>Lamprotaenia</i> (4)	
Spawning adults	Male and Female with mature sex organs ready to spawn in August and September (2)								
Source	Specific site	Coordinates latitude	Coordinates longitude	Potential use					
9	La Parguera	17°56.4'N	67°4.5'W						
9	San Cristobal	17°56.2'N	67°1.2'W						
10	La Parguera	17°57'15"N	66°40'12"W						
10	Turrumote	17°55'50"N	66°27'20"W	Nursery ground					
10	Ponce Cayo Ratones	17°59'00"N	66°42'20"W	Nursery ground					
20	Ponce Cayo Berberia			Nursery ground					
	Peñuelas, Barrio Encarnación			Nursery ground					

Summary table of Gray snapper (*Lutjanus griseus*) (Cont.)

Habitat associations and interactions

Selection	Growth	Mortality	Production
Nursery ground: Mangrove and seagrass communities (17,22)			

Habitat associations and interactions

Selection	Growth	Mortality	Production
1. Selection - The process of choosing the best individuals from a population to breed. 2. Selection - The process of choosing the best individuals from a population to breed. 3. Selection - The process of choosing the best individuals from a population to breed. 4. Selection - The process of choosing the best individuals from a population to breed. 5. Selection - The process of choosing the best individuals from a population to breed. 6. Selection - The process of choosing the best individuals from a population to breed. 7. Selection - The process of choosing the best individuals from a population to breed. 8. Selection - The process of choosing the best individuals from a population to breed. 9. Selection - The process of choosing the best individuals from a population to breed. 10. Selection - The process of choosing the best individuals from a population to breed.	1. Growth - The increase in size or number of individuals in a population. 2. Growth - The increase in size or number of individuals in a population. 3. Growth - The increase in size or number of individuals in a population. 4. Growth - The increase in size or number of individuals in a population. 5. Growth - The increase in size or number of individuals in a population. 6. Growth - The increase in size or number of individuals in a population. 7. Growth - The increase in size or number of individuals in a population. 8. Growth - The increase in size or number of individuals in a population. 9. Growth - The increase in size or number of individuals in a population. 10. Growth - The increase in size or number of individuals in a population.	1. Mortality - The death of an individual in a population. 2. Mortality - The death of an individual in a population. 3. Mortality - The death of an individual in a population. 4. Mortality - The death of an individual in a population. 5. Mortality - The death of an individual in a population. 6. Mortality - The death of an individual in a population. 7. Mortality - The death of an individual in a population. 8. Mortality - The death of an individual in a population. 9. Mortality - The death of an individual in a population. 10. Mortality - The death of an individual in a population.	1. Production - The production of offspring in a population. 2. Production - The production of offspring in a population. 3. Production - The production of offspring in a population. 4. Production - The production of offspring in a population. 5. Production - The production of offspring in a population. 6. Production - The production of offspring in a population. 7. Production - The production of offspring in a population. 8. Production - The production of offspring in a population. 9. Production - The production of offspring in a population. 10. Production - The production of offspring in a population.

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Summary table of Yellow Tail snapper <i>O. chrysurus</i> Associations and interactions with environmental and habitat variables are listed with citations									
Life Stage	Season	Zonation	Specific site	Temp	Salinity (ppt)	Oxygen	Depth (m)	Trophic relationships Food	Predators
Eggs									
Larvae									
Postlarvae									
Early juveniles		seagrass beds with rocks and corals close to the shore nursery grounds: fore reef environment (5); sea grass/algal areas in back reef lagoon (28), Cement Model Reefs (18,27)	PRS La Parguera SanCristobal (5), STH Great ST James (18) STC Salt River Canyon (27) STC Tague Bay (28)				4.5m to 20m (18,27,28)		
	More abundance in Mangrove habitats in wet season (Oct/Nov) (9)	seagrass beds with rocks (6,15,26,30,34) and corals and move later to patch reefs (5,6,26,28), fore reef environment (5,27)	PRS La Parguera El collado (9), Shoreline mangrove close to Isla Cueva and guayacan (13), PRS La Parguera (6), Turrumote, San Cristobal Media Luna (5, 10), PRS Ponce Cayo Berberia Ratones (15), STJ Hurricane Hole (35)	survival is good between (24-30 °C) lower and upper thermal tolerance limits are 18 °C and 34 °C (10)	Salinity range from 30‰ to 38.4‰ (31)	Oxygen concentration range from 1.4 mg/l to 6.2 mg/l (31)	0 to 20 m (9,22,28)	principal diet components are Planktonic organisms (3), gammarids, fish parts, Cumacean, shrimps, Natantia shrimp, ostracods, brachyuran, crab, fish scales, copepods, prosobranchs, nematode, isopods, Fire ant, Caprellid, Thorassica, Errantia (30)	
Late juveniles		Mangrove habitats: intermediate life stage habitat (5,9,13,15,26,30,31,34,35); backreef slope/R/S areas (22); (experimental reef queen conch) (22); coastal lagoons (31)	STC Tague Bay (34) PRS Penuelas, Encarnacion (26) PRN Fajardo Playa Helionda (28) PRS Jobos Bay (30) PRE Ceiba lagoon (31) STJ: Hurricane Hole (35)						
		Present in Patch reefs (5,6,10,11,12,14,15,23,29, 32-33**) (reef lagoon High relieve shoreward, offshore shelf edge low relieve offshore, apron, slope) (6); Mangroves (6,35) and sea grass beds (6), embayment areas (29,33**)	PRW Punta Ostiones (11,12) PRS La Parguera (6) PRS La Parguera Turrumote (5), San Cristobal (5) Media Luna (5), Laurel (14) shelf edge (16), PRS Ponce Cayo Berberia (15), Cayo Ratones (15), Guayanilla Bay (20), STC: Salt River Canyon (23)				present in coastal waters from 10 to 70 m (1,5,9,23)	feeds on crabs, shrimps, fishes (3,28) and their larvae (3) fish eggs (16)	
Adults			PRS Jobos Bay (29,32-33**), STJ: Hurricane Hole (35)						
Adults (continuation)									

Summary table of Yellow Tail snapper *O. chrysurus* Associations and interactions with environmental and habitat variables are listed with citations

Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships Food	Predators
Spawning adults Location PRN=Puerto Rico Norte, PRS=Puerto Rico South PRE=Puerto Rico East PRW=Puerto Rico West STH=Saint Thomas STC=Saint Croix STJ=Saint John	Spawning period from April to June and in September (2) Reproductive season extends from February to October with a Peak from April to July (2,36)		PRS (2,36)						
HR=High relief, LR=Low relief, **= Unknown life stage									
References	Specific site	coordinates Latitude	coordinates longitude	Potential use					
11	Mayaguez Punta Ostiones	18°5'50"N	67°17'20"W						
S 12	Mayaguez Punta Ostiones	18°5'50"N	67°17'20"W						
5	La Parguera San Cristobal	17°56'4"N	67°51'5"W	nursery ground					
5	La Parguera Media Luna	17°56'4"N	67°51'8"W						
5	La Parguera Tumote	17°56'2"N	67°51'2"W						
15	Ponce Cayo Ralones	17°57'15"N	66°51'12"W	nursery ground					
15	Ponce Cayo Berberia	17°55'50"N	66°57'20"W	nursery ground					
	Penuelas, Barrio	17°59'00"N	66°51'20"W						
28	Encarnacion			nursery ground					

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Summary table of fish species

Summary table of White Grunt (<i>Haemulon plumieri</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(pps)	Oxygen	Depth(m)	Trophic relationships Food	Predators	Habitat associations and interactions Selection	Growth	Mortality	Production
Eggs Larvae Postlarvae		Cement Model Reefs (10), Thalassia blades (21), urchin spines (21), A. cervicornis clusters (21), fire coral (21).	STH Great St James (10) ² , PRS Collado (21), Enrique (21)				4-5-18m (10, 21)	Plankton (21)	Halocentrus edwardsianus (10)			R eels with High densities of predators can disperse Postlarval recruitment (14)	
Early juveniles		Cement Model Reefs (10) A cervicornis clusters in Thalassia (21,29) reef edges near Thalassia (21,29)	STH Great St James (10) PRS Collado (21,29), Enrique (21,29), Turumote (21,29)				4-5-18m (10, 21)		Halocentrus edwardsianus (14)			Mortality greatly influenced by predation for newly settled in reefs with high number of predators (14)	
Late juveniles	More abundant in dry season April/May (9)	Mangrove (6,9,23,24,27), Seagrass (6,21,23,11,29) reef-seagrass interface (21,29) reef rubble (21,29), medium relief with fire coral and A. palmata (21,29) coastal lagoon (24)	PRS Ponce Cayo Berberis (6) ² , PRS La Parguera, Collado (9,21,29), Enrique (21,29), Turumote (21,29) Jobos Bay (22,23) PRE Ceiba lagoon (24) STC Taguay Bay (11) STJ Hurricane Hole (27)		Salinity range from 30‰ to 38.4 ‰ (24)	Oxygen concentration range from 1.4 mg/l to 6.2 mg/l (24)	To 18m (21)	Amphipods, crabs, shrimps, crustace- ans, gastropods, ophiurids, polychaets, sipuncula (21) Gerrhards, Cumacean, ostracods, brachyuran crab, copepods prosobranchs, nematode polyplacophore (23)		Form large aggregation beneath <i>Dicoma antillarum</i> spines for protection (22) nursery grounds, Mangrove and seagrass communities (11,23)			
Adults		R eel (fore reef slope) (4,6,7,8,10,18), (A. palmata zone) (8) (HR shoreward, LR apron LR slope HR shelf edge (10), HR, LR offshore) (5) rubble/sandy areas (5,7,8) reef lagoon areas (5), mangrove (5,8) seagrass (5,8) (concrete model reef) (17)	PRS La Parguera (5), Turumote (4,10,21), Enrique (10,21), Collado (10,21), Medialuna (4), San Cristobal (4), PRS Ponce Cayo R. stones (8) Cayo Berberis (6) PRS Mayaguez Punta Oeliones (7,8), STJ Little Lameshur Bay (17), STC Salt R. Ives Canyon (18)				From 1-30 (4,10,21)	Crabs (3,8,21) xanthid and megal- crabs (10) shrimps (6,21,21) ontogenic changes in diet (70mm- 119mm gastropods, 120-159mm sipuncula, 160-249 amphipods and ophiurids) (10,21) crustaceans, polychaetes (21)		R eel diurnal shelter grassbeds Nocturnal feeding areas (1,10) mangroves and backreef areas settlement (10) little direct competition for space among species (10) prefer thicker grass for foraging (11)	34.8 37.8 for PR (length frequency analysis) (10)	Low risk of predation due to its ability to avoid predators by flee out of sight, has a great foraging distance (11)	
Adults (Cont.)		R eel (25,26) inshore reef edge habitat with moderate surge (21), Halimeda sand with gorgonian s(21), Offshore fore reef (21) high relief backreef areas (21), tide channels (26) sandy and muddy bottoms (26) bay and shore area (26)	PRS shelf edge (21) PRS: Jobos Bay (25,26)										
Spawning adults	Ripe individuals in March and April (2) Spawning all year around (28) but intensifies during months when the temperature is lowered (from January to May) (28)		PRW: Tourmaline R eel (28)					96 feet to 108 feet (28)					

Summary table of fish species

Summary table of White Grunt (<i>Haemulon plumieri</i>) associations and interactions with environmental and habitat variables are listed with citations									
Reference	Specific site	Coordinates latitude	Coordinates longitude	Potential use	Trophic relationships				
4	La Parguera San	17°56'4"N	67°4'5"W						
4	La Parguera Medea Luna	17°56'4"N	67°2'8"W						
4	La Parguera Turumote	17°56'2"N	67°0'2"W						
6	Ponce Cayo Ratonas	17°57'15"N	66°40'12"W	Nursery ground					
6	Ponce Cayo Barberis	17°55'50"N	66°27'20"W	Nursery ground					
7,8	PRW Mayaguez Punta Osolones	18°5'50"N	67°17'20"W						

Literature review white grunt *Haemulon plumieri*

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24. Gonzalez azar J. and Vilella M. 1975. Biología de Las Lagunas Costeras. 2do Simposio de Recursos Naturales. pp. 4-40. [Source:Dr. Manuel Velez library]

Summary table of fish species

Summary table of Banded butterfly fish (<i>Chaetodon striatus</i>) Associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp optimal temperature for eggs to hatch is at 26°C (9); eggs hatch in about 30 h (9)	Salinity(ppt)	Oxygen	Depth(m)	Tropic relationships		Habitat associations and interactions			
								Food	Predators	Selection	Growth	Mortality	Production
Eggs		Shelf edge (9)	PRS: Guánica Punta Jorobado (9)						Melichthys niger (9)				
Larvae		Shelf edge (9)	PRS: Guánica Punta Jorobado (9)										
Postlarvae													
Early juveniles													
Late juveniles													
Adults		Reef(1,7,10); (HRShoreward, LRApron, LRSlope, HR shelf edge,HR,LR offshore)(1)Rubble sandy areas(1) seagrass(1) Embayment areas (10) mangroves (11) coastal lagoons (11)	PRS: La Parguera(1); STC: Salt River Canyon (7) PRS Jobos Bay (10) PRE: Ceiba lagoon (11)		Salinity range from 30 o/oo to 38.4 o/oo (11)	Oxygen concentration range from 1.4 mg/l to 6.2 mg/l (11)	50 feet (7)						
Spawning adults	Spawning activity in February (9) and ripe individuals in March April, May, June suggested breeding season on April (12) ripe individuals all year around (13)	Shelf edge (9)	PRS Guánica Punta Jorobado (9) PRW (12,13)										

Summary table of fish species

Summary table of Banded butterfly fish <i>Chaetodon striatus</i> Associations and interactions with environmental and habitat variables are listed with citations (Cont.)													
								Tropic relationships		Habitat associations and interactions			
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Food	Predators	Selection	Growth	Mortality	Production
Reference	Specific site	Coordinates latitude	Coordinates longitude	Potential use									
9	PRS:Guanica Punta Jorobada shelf edge	17°53.86'N	66°57.35'W	Spawning ground (9)									

10. [Citation 10]
11. [Citation 11]
12. [Citation 12]
13. [Citation 13]
14. [Citation 14]
15. [Citation 15]
16. [Citation 16]
17. [Citation 17]
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Section 4

Appendix C

Scanned and Habitat Occurrence for 17
selected species

0 = Not present 1 = Present 2 = Present Day Only 3 = Present Night Only 4 = Present Day & Night 5 = Seasonally Abundant 9 = No Data		Seasonality (not applied to juvenile stages)												Habitat														Depth (m)						
														Zonation								Structure												
		Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Shoreline	Leeward*	Crest*	Windward*	Plain	Shelf Edge	Slope	Planktonic	Seagrass	Reef	Other Hard Bottom	Reef/SAV Interface	Mangrove	Algae	Sand	Mud	0-5.5	5.5-9	9-18.3
Coney	Eggs	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	9	9	9	9
Epinephelus	Larvae	4	4	4	4	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	9	9	9	9
fulvus	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	9	9	9	1	0	0	0	9	1	1	9	0	1	9	0	0	9	1	9	
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	9	9	9	1	0	0	0	9	1	1	9	0	9	9	0	0	1	1	9	
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	0	9	0	1	1	1	0	0	0	1	1	9	0	9	9	0	0	1	1	1	
	Spawners	4	4	0	0	0	0	0	0	0	0	0	0	0	9	9	9	9	4	0	0	0	4	4	9	0	9	9	0	0	9	4	4	
Red Hind	Eggs	4	4	4	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9	
Epinephelus	Larvae	4	4	4	4	9	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9	
guttatus	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	9	0	9	1	1	0	0	9	1	1	9	0	1	9	0	0	9	1	1	
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	9	0	9	1	1	0	0	9	1	1	9	0	9	9	0	0	9	1	1	
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	0	1	0	1	1	1	0	0	9	1	1	9	0	9	9	0	9	1	1	1	
	Spawners	4	4	4	4	4	4	4	4	4	4	4	4	0	9	9	9	9	4	0	0	0	4	4	9	0	9	9	0	0	9	4	4	
Nassau Grouper	Eggs	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	9	9	9	9	9	9	9	9	9	9	9	9	
Epinephelus	Larvae	4	4	4	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	9	9	9	9	9	9	9	9	9	9	9	9	
striatus	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	9	0	9	1	9	0	0	1	1	1	1	9	9	1	0	9	1	9	9	
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	9	0	9	1	9	0	0	1	1	1	1	1	9	9	0	1	1	9	9	
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	9	9	9	1	1	1	0	0	9	1	1	9	0	9	9	0	9	1	1	1	
	Spawners	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	9	9	4	9	0	0	4	4	9	0	9	9	0	9	9	4	4	

*=relative to emergent structure

0 = Not present 1 = Present 2 = Present Day Only 3 = Present Night Only 4 = Present Day & Night 5 = Seasonally Abundant 9 = No Data		Seasonality (not applied to juvenile stages)												Habitat														Depth (m)						
														Zonation								Structure												
		Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Shoreline	Leeward*	Crest*	Windward*	Plain	Shelf Edge	Slope	Planktonic	Seagrass	Reef	Other Hard Bottom	Reef/SAV Interface	Mangrove	Algae	Sand	Mud	0-5.5	5.5-9	9-18.3
Mutton Snapper	Eggs	0	0	4	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9	
Lutjanus	Larvae	0	0	4	4	4	4	4	9	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9	
analis	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	1	1	9	9	9	0	0	0	1	9	9	1	9	9	9	9	1	1	9	9	
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	1	1	9	1	1	0	0	0	1	1	1	0	1	1	1	9	1	1	9	9	
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	
	Spawners	0	0	5	5	5	5	0	0	0	0	0	0	0	9	0	9	1	1	9	0	0	1	1	9	0	9	9	9	0	9	1	9	
Schoolmaster	Eggs	4	4	4	4	4	4	9	4	4	4	4	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9	
Lutjanus	Larvae	4	4	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9	
apodus	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	1	1	9	1	1	0	0	0	1	9	1	1	1	1	1	0	1	1	9	9	
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	1	1	9	1	1	0	0	0	1	1	1	1	1	1	1	9	1	1	1	9	
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	9	1	0	1	9	1	1	0	0	1	1	1	1	1	1	1	9	1	1	1	1
	Spawners	4	4	4	4	4	4	4	4	4	4	4	4	9	1	1	1	1	1	9	0	9	1	1	1	9	9	9	0	9	9	1	1	
Gray Snapper	Eggs	0	0	4	4	4	4	5	5	5	4	9	9	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9	
Lutjanus	Larvae	9	9	4	4	4	4	5	5	5	4	4	9	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9	
griseus	Early Juv.	9	9	4	4	4	4	5	5	5	5	4	9	1	1	9	9	1	0	0	0	1	9	9	1	1	1	9	9	1	9	0	0	
	Late Juv.	4	4	4	4	4	4	4	4	4	4	4	4	1	1	9	1	1	0	0	0	1	1	1	1	1	1	1	9	1	1	9	9	
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	1	1	9	1	1	1	1	0	1	1	1	1	1	1	1	9	1	1	1	1	
	Spawners	0	0	4	4	4	4	5	5	5	4			0	0	0	9	1	1	9	0	0	1	1	9	0	9	9	0	0	9	1	1	

*=relative to emergent structure

0 = Not present 1 = Present 2 = Present Day Only 3 = Present Night Only 4 = Present Day & Night 5 = Seasonally Abundant 9 = No Data		Seasonality (not applied to juvenile stages)												Habitat																Depth (m)			
														Zonation								Structure											
		Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Shoreline	Leeward*	Crest*	Windward*	Plain	Shelf Edge	Slope	Planktonic	Seagrass	Reef	Other Hard Bottom	Reef/SAV Interface	Mangrove	Algae	Sand	Mud	0-5.5	5.5-9
Silk Snapper	Eggs	4	4	4	5	5	5	4	4	4	5	5	5	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
Lutjanus	Larvae	5	4	4	5	5	5	5	4	4	5	5	5	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
vivanus	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	0	0	9	9	9	9	0	0	9	9	0	0	9	9	9	0	0	9	1
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	0	0	0	0	1	1	0	0	1	1	9	0	9	1	9	0	0	9	1
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0	1	1	0	0	0	1	9	0	0	1	1	0	0	9	1
	Spawners	4	4	4	5	5	5	4	4	4	5	5	5	0	0	0	0	0	9	1	0	0	9	9	9	0	9	9	9	0	0	9	1
Yellowtail Snapper	Eggs	0	4	4	5	5	5	5	4	4	4	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	9	9	9	9	
Ocyurus	Larvae	0	4	4	5	5	5	5	5	4	4	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	9	9	9	9	
chrysurus	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	4	4	9	4	4	0	0	0	4	4	4	4	9	4	9	9	4	4	4	9
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	9	4	9	4	4	9	9	0	4	4	4	1	1	1	4	9	4	4	1	9
	Adults	4	4	4	4	4	4	4	4	4	4	4	1	9	4	9	4	4	4	9	0	4	4	1	1	9	9	9	9	1	4	4	4
	Spawners	0	1	1	5	5	5	5	1	1	1	0	0	0	0	0	9	9	1	9	0	0	1	1	9	0	9	9	0	0	9	1	1
White Grunt	Eggs	5	5	5	5	5	4	4	4	4	4	4	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	9	9	9	9	
Haemulon	Larvae	5	5	5	5	5	5	4	4	4	5	5	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	9	9	9	9	
plumieri	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	4	4	9	4	4	0	0	0	4	4	4	4	0	4	4	9	1	1	1	0
	Late Juv.	1	1	1	5	5	5	1	1	1	1	1	1	1	1	9	1	1	0	0	0	4	2	1	1	2	1	1	9	1	1	1	9
	Adults	4	4	4	4	4	4	4	4	4	4	4	1	9	1	9	1	1	1	1	0	3	1	1	1	9	1	1	1	1	1	1	1
	Spawners	5	5	5	5	5	4	4	4	4	4	4	4	0	9	9	9	1	1	9	0	0	1	1	9	0	9	9	0	9	9	1	1

*=relative to emergent structure

0 = Not present 1 = Present 2 = Present Day Only 3 = Present Night Only 4 = Present Day & Night 5 = Seasonally Abundant 9 = No Data		Seasonality (not applied to juvenile stages)												Habitat														Depth (m)					
														Zonation						Structure													
														Shoreline	Leeward*	Crest*	Windward*	Plain	Shelf Edge	Slope	Planktonic	Seagrass	Reef	Other Hard Bottom	Reef/SAV Interface	Mangrove	Algae					Sand	Mud
Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Shoreline	Leeward*	Crest*	Windward*	Plain	Shelf Edge	Slope	Planktonic	Seagrass	Reef	Other Hard Bottom	Reef/SAV Interface	Mangrove	Algae	Sand	Mud	0-5.5	5.5-9	9-18.3	18.3-183
Banded butterflyfish	Eggs	4	5	4	5	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
Chaetodon	Larvae	4	5	5	5	5	5	4	4	4	4	4	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
striatus	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	1	9	9	0	9	1	1	9	9	9	9	9	9	9	9	
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	1	1	9	9	0	9	1	1	9	9	9	9	9	9	1	1	9
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	0	1	9	1	1	1	1	0	1	1	1	9	1	9	1	9	1	1	1	9
	Spawners	4	5	4	5	4	4	4	4	4	4	4	4	0	0	0	0	0	1	0	0	0	1	1	9	0	0	0	0	0	0	1	1
Queen triggerfish	Eggs	9	9	4	4	4	4	4	4	4	4	9	9	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
Balistes	Larvae	4	4	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
vetula	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	0	0	9	9	9	0	1	9	0	1	9	9	9	
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	0	0	9	9	9	0	1		0	1	9	9	9	
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	0	9	9	9	1	1	9	0	0	1	1	9	0	0	9	0	0	9	1	9
	Spawners	9	9	9	4	4	4	4	4	4	9	9	9	0	9	9	9	1	1	9	0	0	1	1	9	0	0	9	0	0	9	1	9
Squirrelfish	Eggs	5	5	5	4	4	4	4	4	4	5	1	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
Holocentrus	Larvae	5	5	5	5	5	4	4	4	4	5	5	5	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
ascensionis	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	0	0	9	9	9	0	9	9	0	9	9	9	9	
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	1	9	9	0	0	9	9	9	0	9	9	0	9	9	9	9
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	9	9	9	9	1	9	9	0	0	1	1	9	0	9	9	0	1	1	1	1
	Spawners	5	5	5	4	4	4	4	4	4	5	4	4	9	9	9	9	9	9	9	0	0	1	1	9	0	9	9	0	9	9	9	9

*=relative to emergent structure

0 = Not present 1 = Present 2 = Present Day Only 3 = Present Night Only 4 = Present Day & Night 5 = Seasonally Abundant 9 = No Data		Seasonality (not applied to juvenile stages)												Habitat												Depth (m)							
		Zonation												Structure																			
Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Shoreline	Leeward*	Crest*	Windward*	Plain	Shelf Edge	Slope	Planktonic	Seagrass	Reef	Other Hard Bottom	Reef/SAV Interface	Mangrove	Algae	Sand	Mud	0-5.5	5.5-9	9-18.3	18.3-183
Sand Tilefish	Eggs	1	1	1	9	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
Malacanthus	Larvae	1	1	1	1	9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
plumieri	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	0	0	0	4	9	9	0	0	9	9	0	0	9	4	0	0	9	4	9
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	0	0	0	4	9	9	0	0	9	9	0	0	9	4	0	0	9	4	9
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	0	0	0	0	4	4	9	0	0	9	9	0	0	9	4	0	0	9	4	9
	Spawners	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	4	4	9	0	0	9	9	0	0	9	4	0	0	9	4	9
Spiny Lobster	Eggs	1	1	1	5	5	5	1	1	1	1	1	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
Panulirus	Larvae	1	1	1	1	5	1	1	5	1	1	1	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	9	9	9	9
argus	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	1	1	9	9	1	9	9	0	1	9	9	1	1	1	9	9	1	1	9	9
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	9	1	9	9	1	9	9	0	1	1	1	1	1	1	9	9	1	1	9	9
	Adults	4	4	4	4	4	4	4	4	4	4	4	1	9	1	9	1	9	1	1	0	1	1	1	1	9	9	9	0	1	1	1	1
	Spawners	1	1	1	5	5	5	1	1	1	1	1	1	9	9	9	9	9	1	9	0	9	1	9	9	9	9	9	0	9	9	1	1
Queen Conch	Eggs	0	0	0	4	4	5	5	5	4	4	0	0	0	4	4	0	4	0	0	0	4	0	0	9	0	0	4	0	4	4	4	4
Strombus	Larvae	0	0	0	4	4	9	5	5	5	4	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1	1	1	1	1
gigas	Early Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	4	4	9	4	9	0	0	4	0	0	9	0	0	4	0	4	4	4	9
	Late Juv.	9	9	9	9	9	9	9	9	9	9	9	9	0	4	4	9	4	9	0	0	4	4	4	9	0	0	4	0	4	4	4	4
	Adults	4	4	4	4	4	4	4	4	4	4	4	4	0	4	4	9	4	4	0	0	4	4	4	9	0	0	4	0	4	4	4	4
	Spawners	0	0	0	4	4	5	5	5	4	4	0	0	0	4	4	9	4	9	0	0	4	0	0	9	0	0	4	0	4	4	4	4

*=relative to emergent structure

Section 4

Appendix D - Spring Lobster

Summary table of Spiny lobster (<i>Panulirus argus</i>) associations and interactions with environmental and habitat variables are listed with citations ^a													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships Food	Predators	Habitat associations and interactions		Mortality	Production
Eggs													
Larvae		Pelagic environment from 6-12 months (20,21,22) Surface (0-20m) in August. Transported offshore to undergo development (25)	4-9 Km offshore Parguera (25)										
Postlarvae	Phyllosoma May (25) Year around recruitment with great influx in late summer early fall and smaller peak in spring (16)	Shallow coastal waters (19) Acanthophora clumps and Thalassia beds (16) Nomadic (22)	PRS La Parguera San Cristóbal Enrique, Caballo Blanco, Isla Cueva tres pelotas Burkholder Bay (16)	Die <10°C >35°C									
Early juveniles		Algal plains with red algae Laurecia spp.(23,24)	FI (23,24)										
Late juveniles		Seagrass beds (1,3,4,) Porites Reefs (1) mangrove prop roots (2,3,4) coral outcroppings, ledges, caves and crevices (3,4)	PRS Jobos Bay (1,2)					Mollusks, crustaceans, algae echinoderms, coelenterates, annelides, and sponges (3,4)					

Summary table of fish species

Summary table of Spiny lobster (<i>Panulirus argus</i>) (Cont.)												
Adults		Coral out-croppings, ledges, caves and crevices (3,4) Inshore - offshore migration (22).	Jamaica (5). Maintain home ranges.				From shallow waters into depths greater than 100m (3,4)	Mollusks, crustaceans, algae echinoderms, coelenterates, annelides, and sponges (3,4) Feeding takes place in seagrass beds (26)	Groupers, large snappers, sharks, skates, octopuses (10) dolphins, and loggerhead, turtles (10,5)		k=0.16-0.432 ,L _∞ =152-190 (5,6,7,8,9)	Natural mortality M ranges 0.14-.056 (5,11)
Spawning adults	Once a year in FL and Bahamas (between March and July)(12,13) all year around (3,5,10,14,15); In the Caribbean with seasonal peak from April to June in PR (15)	Shelf edge (17,18)								Gravid females commonly found at greater depths (17) prefer to spawn on shelf edge environment to take advantages of parallel oceanic currents for larval dispersal. (18)		

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Section 4

Appendix E

Queen Creek

SUMMARY

Summary table of Queen conch (<i>Strombus gigas</i>) associations and interactions with environmental and habitat variables are listed with citations									
Life Stage	Season	Zonation	Specific site	Temp.	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships Food	Predators
Eggs	Maximum number egg masses occur during highest temperatures	Sandy areas	Mostly enclosure experiments; site collections (e.g., La Parguera)				Benthic		
Larvae	Larvae (veligers) emerge after 5 days	Pelagic; retained where they are spawned; transported 43 km/day	18-40 days in water column					Small phytoplankton	Plankton feeding organisms
Early juveniles		Benthic, buried in sand						Plankton	Post metamorphic preyed on by polychaetes and crabs
Late juveniles		Benthic	Buried in sand during the day; mass emergence and migration to sea grass beds (El Negro off West Coast); nursery grounds no longer available La Parguera					Feed most actively at night on filamentous and unicellular algae.	
Adults	All year	Sandy bottoms; migration shallow water to deep water back to shallow waters to spawn; Seagrasses; gravel; coral rubble; Sandy algal beds; smooth-hard coral or beach rock bottoms.					Limited to waters where light penetrates and is sufficient for plant growth (250 ft.)	Epiphytic algae on <i>Thalassia testudinum</i> , (algae: <i>Cladophora</i> ; <i>Hypnea</i> ; <i>Polysiphonia</i>)	Man, gastropods, crustaceans, eagle ray, fish, <i>Caretta caretta</i> , sharks predators of young conch.
Spawning adults	May-Nov. (PR); Feb-Nov (USVI); May-Sep. (peak)	Migration to shallower areas	Egg masses produced in clean coral sand with low organic content; seagrasses	Highest egg mass production during times of highest temperatures (August), longest photoperiod					
Citations	FMP (1995)								

Summary table of Queen conch (<i>Strombus gigas</i>) (Cont.)			
Habitat associations and interactions		Mortality	Production
Selection	Growth		
Clear sand			
Water column up/down		Unknown rates suspected to be high	
Mass emergence from sand and migration to sea grass beds			
	Deterministic, shell length then shell thickness		

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Section 4

Appendix F

Core Life History

Summary table of Brereum asbestinum life history for Puerto Rico and the U.S.V.I.																		
Habitat associations and interactions				Trophic relationships				Life history parameters				Stressors						
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproduction type	Spawning season	Competitors	Sediment load	Nutrients	Diseases	Pollutants	Wave Impact
Eggs																		
Citations																		
Larvae		1-20m (1)	PRS: La Parguera:Laurel,La Gata, San Cristobal,La India (1)									larvae found in June and July (1)						
Citations																		
Juvenile																		
Citations																		
Adults		1to 20m(1)	PRS: La Parguera:Laurel,La Gata, San Cristobal,La India (1); FL (2)		upper thermal limits 38.2°C (2)						HBS(1)	June to July during Full Moons(1)						
Citations																		

Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious

Location: PR= Puerto Rico; N=North, S=South, E=East, W=West; V=Vieques, C=Culebra, M=Mona Island; STH=Saint Thomas; STC=Saint Croix; STJ=Saint John.

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Summary table of <i>Pseudopteroegneria rigida</i> life history for Puerto Rico and the U.S.V.I.																				
Habitat associations and interactions						Life history parameters													Stressors	
						Trophic relationships														
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproductive	Spawning season	Competitors	Sediment type	Nutrients	Diseases	Pollutants	Wave impact		
Eggs																				
Citations																				
Larvae																				
Citations																				
Juvenile																				
Citations																				
Adults		10m (1)	FL (1)	optimal salinity range (30-39.5 ‰) lower and upper tolerance limits (28.5-43.5°C) (1)	optimal temperature range (19-31.5°C) upper and lower tolerance limits (13.32°C) (1)															
Citations																				
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious																				
Location: PR= Puerto Rico, N=North, S=South, E=East, W=West, V=Vieques, C=Culebra, M=Mona Island, STH=Saint Thomas, STC=Saint Croix, STJ=Saint John																				

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Summary table of <i>Eunicea calyculata</i> life history for Puerto Rico and the U.S.V.I.																				
Habitat associations and interactions					Life history parameters														Stressors	
					Trophic relationships															
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproductive	Spawning s	Competition	Sediment Id	Nutrients	Diseases	Pollutants	Wave impact		
Eggs																				
Citations																				
Larvae																				
Citations																				
Juvenile																				
Citations																				
Adults		10 (1)	FL (1)	optimal salinity range (31-42.5 ‰) lower and upper tolerance limits (26.5, 43°C) (1)	optimal temperature range (19-31°C) upper and lower tolerance limits (17.5, 34°C) (1)															
Citations																				
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious																				
Location: PR= Puerto Rico, N=North, S=South, E=East, W=West, V= Vieques, C=Culebra, M=Mona Island, STH=Saint Thomas, STC=Saint Croix, STJ=Saint John.																				

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Summary table of <i>Muricea muricata</i> life history for Puerto Rico and the U.S.V.I.																		
Habitat associations and interactions						Life history parameters										Stressors		
						Trophic relationships												
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproductive	Spawning s	Competitors	Sediment lo	Nutrients	Diseases	Pollutants	Wave impa
Eggs																		
Citations																		
Larvae																		
Citations																		
Juvenile																		
Citations																		
Adults		10m (1)	FL (1)	optimal salinity range (30-42.5 o/oo) lower and upper tolerance limits (25.44°C) (1)	optimal temperature range (18.5-32°C) upper and lower tolerance limits (16.5,33°C) (1)													
Citations																		
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious																		
Location: PR= Puerto Rico, N=North, S=South, E=East, W=West, V=Vieques, C=Culebra, M=Mona Island, STH=Saint Thomas, STC=Saint Croix, STJ=Saint John																		

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Summary table of <i>Madracis decata</i> life history for Puerto Rico and the U.S.V.I.																		
Habitat associations and interactions									Life history parameters					Stressors				
Trophic relationships																		
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproduction type	Spawning season	Competitors	Sediment load	Nutrients	Diseases	Pollutants	Wave impact
Eggs																		
Citations																		
Larvae																		
Citations																		
Juvenile	east and west walls (1)	9-37m (1)	STC: Salt River Canyon (1)						optimal recruitment at 18m associated to low algal biomass and high grazing pressure by urchins and fishes (1)									
Citations																		
Adults																		
Citations																		

Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious
Location: PR= Puerto Rico; N=North, S=South, E=East, W=West; V=Vieques, C=Culebra, M=Mona Island; STH=Saint Thomas; STC=Saint Croix; STJ=Saint John.

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Summary table of <i>Acropora palmata</i> life history for Puerto Rico and the U.S.V.I.													
	Habitat associations and interactions									Life history parameters			
							Trophic relationships						
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproduction type	Spawning seas	Competitors
Eggs													
Larvae													
Juvenile		3-4 m (12)	PRE: Fajardo Cayo Diablo (12)							45-47mm/yr (12)			
Adults	<i>Acropora palmata</i> zone-mixed zone (8,4,21,22,23), base of reef (8,4,2), backreef (8,4,9,24), shallow (6), deep forereef (8,10); <i>Porites porites</i> zone (5,4,23), reef front (5,9), reefcrest (2,5,24)	1- 9m (4,5,8,10,11,20,21,23,24,26)	PRS: La Parguera: (3,7,1,9,2,23,24,25);STC:Buck Island (8,10,14);STH: Flat Cay (11), Tague Bay (10); PRE:(5,6,12,13),Cul, Pta. Tamarindo (4), PRS: (14,21,22) FL (16,26); Jamaica (17) PRW: Desecheo(20)		Upper thermal limit 35.8°C(16) High mortalities with temperatures between 14-16°C (26)				High mortality rates due to damselfish <i>Stegastes planifrons</i> (9) urchin <i>Ecinometra lucunter</i> (5); sponges (5); Coralivorous snail <i>Corallophila abbreviata</i> (13,21)	Linear growth 47-99 mm/yr growth rates are affected by horizontal position on the reef and temperature (8) growth rates are higher in warmer months (8) Growth rates are affected by sedimentation caused by strong currents (12);25-99mm/yr (17)	HS (1)	August (1)	Filamentous algae, <i>Halimeda opuntia</i> , sponges (9) <i>Erythropodium caribaeorum</i> (14); Boring sponge; <i>Anthosigmella varians</i> (20)
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious													
Location: PR= Puerto Rico; N=North, S=South, E=East, W=West; V= Vieques, C=Culebra, M=Mona Island, STH=Saint Thomas; STC=Saint Croix; STJ=Saint John.													

Summary table of <i>Acropora palmata</i> life history for Puerto Rico and the U.S.V.I.				
		Stressors		
Sediment load	Nutrients	Diseases	Pollutants	Wave impact
Growth rates are affected by sedimentation caused by strong currents (12)				
High mortality of colonies due to suspended solid mater over 10mg/L to tolerance of 11.6 to 25.39mg/L(5) growth in perpendicular position due to high sedimentation rates(6) least resistant to high sedimentation:(up to 200mg/cm(7)		Bleaching event 1987 high temperatures and very clear waters (2); Bleaching event when temperature was 31.67°C (3); White Band disease (4,13,14,18)	Very tolerant of oily wastes and industrial effluents (22)	Normally found in strong wave areas (8,12) broken branches and shattered colonies caused by hurricanes (10,4,11,21,23); Pulling force needed to break branches and stems (23-50 kg/m ²) (24,25)

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Summary table of Agaricia agaricites life history for Puerto Rico and the U.S.V.I																			
	Habitat associations and interactions									Life history parameters						Stressors			
							Trophic relationships												
Life stage	Zonation	Depth (m)	Location	Salinity	Temp °C	Oxygen	Irradiance	Food	Predators	Growth	Reproduction type	Spawning season	Competitors	Sediment load	Nutrients	Diseases	Pollutants	Wave impact	
Eggs																			
Citations																			
Larvae																			
Citations																			
Juvenile	east and west	0-37m (3)	STC Salt River Canyon (3)						optimal recruitment at 18m associated with low algal biomass and high grazing pressure by urchins and fishes (3)										
Citations																			
Adults		2-37m (2,3,4,5,6)	PRS: La Parguera (1), Enrique (2) STC Salt River Canyon(3), PRE Fajardo Cayo Ahogado (5), Cayo Obispo (5), PRS Ponce, Cayo Ratones (6)						High mortality due to damselfish Stegastes planifrons (2)				filamentous algae, Halimeda opuntia, sponges(2), Gorgonian Erythropodium caribaeorum (6)	Low net productivities due to high sedimentation (4). Growth rates are affected due to sedimentation caused by strong currents(5)		Bleaching event when temperature was 31.67°C (1)			
Citations																			
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious																			
Location: PR= Puerto Rico, N=North, S=South, E=East, W=West, V=Vieques, C=Culebra, M=Mona Island, STH=Saint Thomas, STC=Saint Croix, STJ=Saint John																			

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Summary table of <i>Siderastrea radians</i> life history for Puerto Rico and the U.S.V.I															
Habitat associations and interactions							Life history parameters								
							Trophic relationships								
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproduction type	Spawning season	Competitors	Sediment load	Nutrients
Eggs															
Citations															
Larvae															
Citations															
Juvenile															
Citations															
Adults		<5m (2,3,4)	PR: La India (1); PRN:Humacao Playa Candelerio (2); PRN: Fajardo Cayo Obispo, Bahia Las Cabezas, Cayo Icacos, Cayo Zancudo (3); PRN:Punta Fraile (4); FL(5)		Upper thermal tolerance:38.5°C (5)	low turbidity below 5UNT could cause bleaching (2,4)				0.15-0.23 cm/yr (6)	DB (1)	year around (1)		Suspended solids beyond 25 mg/L could be detrimental to coral health (4)	
Citations															
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious															
Location: PR= Puerto Rico; N=North, S=South, E=East, W=West; V=Vieques, C=Culebra, M=Mona Island, STH=Saint Thomas; STC=Saint Croix; STJ=Saint John.															

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		Stressors		
Sediment load	Nutrients	Diseases	Pollutants	Wave impact
high mortalities due to terrigenous suspended sediments and domestic pollution from river runoff (11,13); Suspended solids beyond 25mg/L could be detrimental for coral health (12)		Bleaching event in 1993 due to low turbidity (7); Bleaching event in 1994-1995 due to increased water transparency (8) Cyanobacteria infection (9)		

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Summary table of Porites porites life history for Puerto Rico and the U.S.V.I.																			
Habitat associations and interactions				Life history parameters														Stressors	
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Trophic relationships			Growth	Reproduction type	Spawning season	Competitors	Sediment load	Nutrients	Diseases	Pollutants		
							Irradiance	Food	Predators										
Eggs																			
Citations																			
Larvae																			
Citations																			
Juvenile																			
Citations																			
Adults	backreef, (2, 1) reef crest (2) reef flat (4)	3-10m (2, 1)	PR: La Parguera (1), PRN: Humacao Bahía Demajagua (2), PRE: Fajardo Cayo Ahogado (3), Cayo Zancudo (4), Cayo Palominos (5), Cayo Icacos (6) PRS: Cayo Ratones (7), Jamaica (8), USVI (9)						severe degradation by urchin Echinometra lucunter, boring sponges (2, 6), Mithrax (9)	0.6-3.6 cm/yr (9)			zoanthids macroalgae (2)	Growth rates are affected due to sedimentation caused by strong currents (3)		Bleaching event when temperature was 31.67°C (1), another event 1992 due to extreme river runoff (4)	Ship groundings have reduced colonies due to abrasion (5)		
Citations																			
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious																			
Location: PR= Puerto Rico, N=North, S=South, E=East, W=West, V=Vieques, C=Culebra, M=Mona Island, STH=Saint Thomas, STC=Saint Croix, STJ=Saint John																			

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Summary table of <i>Diploria strigosa</i> life history for Puerto Rico and the U.S.V.I.																		
Habitat associations and interactions									Life history parameters					Stressors				
Trophic relationships																		
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproduction type	Spawning season	Competitors	Sediment load	Nutrients	Diseases	Pollutants	Wave impact
Eggs																		
Citations																		
Larvae																		
Citations																		
Juvenile																		
Citations																		
Adults	backreef and reefcrest (2)	3-14m (2,1.8)	PR: La India (1); PRN: Humacao Bahía Demajagua (2); Cayo Icacos(3) Jamaica (4); Bermuda (5); PRW: Desecheo (8)							growth can be altered due to environmental stress: suspended solid matter over 10mg/L (2); 0.35-1.0 cm/yr (4)	HS (1)	Mid August (1)	Boring sponge, <i>Anthosigmella varians</i> (8)			Black band (3,5); bleaching (5)	The effect of Oil 19 ppm is reduced photosynthesis (8)	
Citations																		
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious																		
Location: PR= Puerto Rico; N=North, S=South, E=East, W=West; V=Vieques, C=Culebra, M=Mona Island; STH=Saint Thomas; STC=Saint Croix; STJ=Saint John.																		

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Summary table of <i>Manicina areolata</i> life history for Puerto Rico and the U.S.V.I.																		
Habitat associations and interactions							Life history parameters							Stressors				
Trophic relationships																		
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproduction type	Spawning season	Competitors	Sediment load	Nutrients	Diseases	Pollutants	Wave impact
Eggs																		
Citations																		
Larvae																		
Citations																		
Juvenile																		
Citations																		
Adults	Sea grass beds (1)		PR= Guayanilla Bay (1), PRE= Fajardo Cayo Ahogado Cayo Otispo (2)											Growth rates are affected by sedimentation caused by strong currents (2)			significant numbers killed by thermal effluents (1), No. 2 fuel oil (3)	
Citations																		
Legend: B=brooder, S=spawner, A=asexual, H=hermaphrodite, D=dioecious																		
Location: PR= Puerto Rico, N=North, S=South, E=East, W=West, V=Vieques, C=Culebra, M=Mona Island, STH=Saint Thomas, STC=Saint Croix, STJ=Saint John																		

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Summary table of Montastrea annularis life history for Puerto Rico and the U.S.V.I.											
Habitat associations and interactions							Life history parameters				
							Trophic relationships				
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproduction type
Eggs											
Citations											
Larvae											
Citations											
Juvenile			PRE-Culebra (Punta de Maguey), Vieques, Puerto Diablo (36)								
Citations											
Adults	Commonly found in Mixed coral zone, massive coral zone and Agaricia- Montastrea zone (11,19,28); Commonly inhabits reef slope and deep for a reef (25) reef flat	3 meters in nearshore turbid waters and up to 60m in clear shelf edge waters (28,30,33,43)	PRS (27,38,26,43); STC: (2,3,16,17,4,5,29); STJ (15,30,31); PRN (32,33,34,35); PRE (37,39); PR (1,9,6,12,22,11,13,19,23,6,7, 24, 21, 20,25,26); Jamaica (41); Florida (40)		optimal temperature range is from 27°C to 29°C; Temperatures above 30°C are related to bleaching events (9,22,27) upper thermal limit 36 °C (40)		Variation in PAR levels depend on amount of suspended solids; water turbidity can influence photosynthetic pigment and corallite characteristics (11)		High mortality rates due to damselfish Stegastes planifrons (28, 32)	Linear growth varies from 0.4. to 1.2 cm/yr in USVI (2,3,16) and 0.59 to 0.99 cm/yr in PR. (11); rates of calcification are apparently light-mediated (11); better growth in the fore edge and slope (33); 0.1-2.4 cm/yr in Jamaica (41)	HS (1,38)
Continuation											

Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious

Location: PR= Puerto Rico; N=North, S=South, E=East, W=West; V=Vieques, C=Culebra, M=Mona Island; STH=Saint Thomas; STC=Saint Croix; STJ=Saint John.

Summary table of <i>Montastrea annularis</i> life history for Puerto Rico and the U.S.V.I. (Cont.)						
				Stressors		
Spawning season	Competitors	Sediment load	Nutrients	Diseases	Pollutants	Wave impact
Mid August to Mid September (1,38)	Corals: <i>Siderastrea siderea</i> , <i>Montastrea cavernosa</i> , <i>Stephanocoenia michelinii</i> , <i>Acropora cervicornis</i> , <i>Porites porites</i> , <i>Erythropodium caribbaeorum</i> (11); filamentous algae (31,28,37), <i>Halimeda opuntia</i> (28); sponges <i>Chondrilla nucula</i> (28)	Parguera :20-24 92mg/cm ² /d (11,12) and 1.11-150mg/cm ² /d (11,13) in the west coast of Puerto Rico. Responses to increased levels of calcareous sediments insitu are: 400 mg/cm ² /Temporary bleaching; 800mg/ cm ² /death of Tissue (14)		Black band disease (23,27) Bleaching event in 1987and 1990 due to light related phenomenon (9,23),other event 1993 due to low turbidity (34); other event,1994-1995 due to increased water transparency (35) other event,1995; high temperature 31 67°C (27)	Depressed calcification and density are documented in areas of major dredging and sewage activities (2) Increased P-3 levels inhibits calcification (2) P-3 (inorganic and total) pollution(4) Increased Pb levels on <i>M. annularis</i> skeleton are reported (5)	Immediate disturbances related to tropical storms are high wave enegy and fresh water input, evidence of abrasion attributed to storms (8,7); overturned colonies (29,43); Total living cover can be reduced (30,31)
		sedimentation affects growth rates (15,18); colony size (13);increases respiration and decreases photosynthesis (17); Decreased coral cover attributed to sedimentation induced by Plume influx (19)				

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Summary table of <i>Montastrea cavernosa</i> life history for Puerto Rico and the U.S.V.I																		
Habitat associations and interactions										Life history parameters				Stressors				
Trophic relationships																		
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproduction type	Spawning season	Competitors	Sediment load	Nutrients	Diseases	Pollutants	Wave impact
Eggs																		
Citations																		
Larvae																		
Citations																		
Juvenile																		
Citations																		
Adults	fore reef edge and steep slope (5)	1-14m (10)	PRS (1,6), STC Brewers west (2); PRE Playa Candelero (3), PRE Playa Hedionda (4), STC Salt River Canyon (5), PRW El Negro (7,11), FL(8), Jamaica (9), PRW Jobos (10), Desecheo (10) Guanajibo (10) Pta Higuero (10)		upper thermal limits 37-38°C (8)					Damselfish (3)	better growth in the fore edge and steep slope to prevent sedimentation effects (4), 0.29-0.45 cm/yr (5), 0.2-1.09 cm/yr (9)	DS (1,6)	July (6), Late Aug. (1,6), September (6)	Algal overgrowth due to damselfish feeding activities and boring sponges (3), Boring sponge, <i>Anthosigmella varians</i> (10)	high mortalities due to terrigenous suspended sediments and domestic pollution from river runoff (7,11)			overturned colonies due to hurricanes (2)
Citations																		
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious																		
Location: PR= Puerto Rico, N=North, S=South, E=East, W=West, V=Vieques, C=Culebra, M=Mona Island, STH=Saint Thomas, STC=Saint Croix, STJ=Saint John																		

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Summary table of Meandrina meandrites life history for Puerto Rico and the U.S.V.I																			
Habitat associations and interactions										Life history parameters						Stressors			
Life stage	Zonation	Depth (m)	Location	Salinity	Temp °C	Oxygen	Trophic relationships			Predators	Growth	Reproduction type	Spawning season	Competitors	Sediment load	Nutrients	Diseases	Pollutants	Wave impact
							Irradiance	Food											
Eggs																			
Citations																			
Larvae																			
Citations																			
Juvenile																			
Citations																			
Adults		8-40m (2,4)	PRS La Parguera(1), STC Salt River Canyon(2), PRN Humacao Playa Candelero (3); PRN Fajardo Cayo Obispo (3), Bahia Las Cabezas (3), Cayo Icacos (3), Cayo Zancudo (3), PRS Penuelas (4)				low turbidity below SUNT could cause bleaching (3)	Copepods, foraminiferans crab zoea and megalops, ostracods, gastropod larvae, nematods, polychaetes (2)							Bleaching due to a sediment plume caused by chronic flooding (4)		Bleaching event when temperature was 31.67°C (1), Bleaching event 1992, due temperatures above 30°C and low turbidity (<SUNT) (3)		
Citations																			
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious																			
Location: PR= Puerto Rico, N=North, S=South, E=East, W=West, V=Vieques, C=Culebra, M=Mona Island, STH=Saint Thomas, STC=Saint Croix, STJ= Saint John																			

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Summary table of <i>Dendrogyra cylindrus</i> life history for Puerto Rico and the U.S.V.I.																			
Habitat associations and interactions										Life history parameters						Stressors			
Trophic relationships																			
Life stage	Zonation	Depth (m)	Location	Salinity	Temp. °C	Oxygen	Irradiance	Food	Predators	Growth	Reproduction type	Spawning season	Competitors	Sediment load	Nutrients	Diseases	Pollutants	Wave impact	
Eggs																			
Citations																			
Larvae																			
Citations																			
Juvenile																			
Citations																			
Adults	reef crest (2)	1-15m (2,3)	PR: El Mario (1); Media Luna (3); Laurel (3); STC: Brewers West (2)								DS (1)	Mid Aug (1)						overturned colonies due to hurricanes (2,3)	
Citations																			
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious																			
Location: PR= Puerto Rico; N=North, S=South, E=East, W=West; V=Vieques, C=Culebra, M=Mona Island; STH=Saint Thomas, STC=Saint Croix; STJ=Saint John.																			

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Summary table of Eusmilia fastigiata life history for Puerto Rico and the U.S.V.I.																		
Habitat associations and interactions							Life history parameters							Stressors				
							Trophic relationships											
Life stage	Zonation	Depth (m)	Location	Salinity	Temp °C	Oxygen	Irradiance	Food	Predators	Growth	Reproduction type	Spawning season	Competitors	Sediment load	Nutrients	Diseases	Pollutants	Wave impact
Eggs																		
Citations																		
Larvae																		
Citations																		
Juvenile																		
Citations																		
Adults		15.2m (4)	PR=La Parguera (1); Enrique (2); FL (3); PRW: Desecheo (4)		upper thermal limit 38.4°C (3); Bleaching event when temperature was 31.67°C (1)				High mortality due to the damselfish Stegastes planifrons (2)				filamentous algae, Halimeda opuntia, and sponges (2); Boring sponge; Anthosigmella varians (4)			Bleaching event when temperature was 31.67°C (1)		
Citations																		
Legend: B=brooder, S=spawner, A=asexual, H=hermaphroditic, D=dioecious																		
Location: PR= Puerto Rico; N=North, S=South, E=East, W=West; V=Vieques, C=Culebra, M=Mona Island; STH=Saint Thomas; STC=Saint Croix; STJ=Saint John.																		

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Appendix A

Detailed listing of activities and water resources, including LPH, of managed systems.

Hydrologic activities

Hydrologic activities

Interstate channel construction/expansion

Canals and ditches

Dams and water control structures

Hydropower operations

Flood control

Water supply

Navigation

Water diversion

Levees, embankments, and impoundments

Water management

Wetland management

Aquaculture

Off-peak crossings and right-of-ways

Beaches, seawalls, and bridges

Alterations of freshwater inflow

Groundwater withdrawal

Injection transfers/surface water withdrawal

Section 5

Appendix A

Dredged material disposal and fill

Open water disposal

Placement of dredged material

Non-Fish

Excavation

Removal/alteration of wetlands and submerged bottoms

Minerals exploration and mining

Removal/alteration of wetlands and submerged bottoms

Placement of structures in the coastal environment

Industrial and Commercial

Offshore structures and production platform operations

Port development waterfront facilities

Offshore waterway control structures

Navigation

Seawalls

Appendix A.

Detailed listing of non-fishing activities that may adversely impact habitat, including EFH, of managed species.

Physical Alterations

Hydrologic modifications

- Navigation channel construction/expansion

- Canals and ditches

- Dams and water control structures

 - Hydropower operations

 - Flood control

 - Water supply

 - Navigation

 - Water diversion

- Levees, embankments, and impoundments

 - Water management

 - Wildlife Management

 - Aquaculture

- Utility crossings and right-of-ways

- Roads, causeways, and bridges

- Alteration of freshwater inflow

- Ground water withdrawals

- Interbasin transfers/surface water withdrawals

Dredged material disposal and fills

- Open water disposal

- Placement of confined/unconfined material in wetlands

Excavation

- Removal/alteration of wetlands and submerged bottoms

Minerals exploration and mining

- Removal/alteration of wetlands and submerged bottoms

Placement of structures in the coastal environment

- Industrial and Commercial

Petroleum exploration and production platform operations

- Port development waterfront facilities

- Municipal wastewater outfall structures

Navigation

- Breakwaters

Jetties

Anchorage/mooring areas

Recreational/Environmental Structures

Artificial reefs

Fishing piers

Beach Erosion Control Structures

Jetties

Groins

Bulkheads

Special purpose structures

Ocean dumping

Dredged materials

Hazardous materials

Municipal solid waste

Municipal wastewater/sludge

Introduction of exotic species

Pet and agriculture (including mariculture) related industries

Ship ballast water releases

Incidental relocation on vessels, machinery, and animals

Watershed land use practices

Agriculture

Silviculture

Erosion/Subsidence

Channel and shoreline erosion from vessel wakes.

Shoreline erosion caused by manmade structures

Jetties

Groins

Breakwaters

Faulting induced by ground water extraction

Relative sea level rise

Reduced sediment renourishment

Barrier islands and shorelines

Recreational boating impacts

Propeller scarring

Anchor scarring

Grounding

Trash

Oil and gasoline spillage

Boat wakes

Military Facilities

Degaussing facilities

Ordnance disposal areas

Special training areas, bombing ranges

Water Quality Issues

Non-point-source Pollution (Percent)

Agriculture

Urbanization

Silviculture

Point-source Pollution (PS)

Industrial discharges

Municipal wastewater discharges

Urban stormwater discharges

Vessel wastewater discharges

Thermal effluents from electric power generation facilities

Oil spills

Hydrocarbon pollution

Toxic substances in cleaning materials

Chemical contaminant spills

Air emissions

Ocean dumping

Salinity

Turbidity

Recreational boating impacts

Fuel/oil contamination

Overboard discharges

Prop and anchor damage to reefs/bottoms

OPTION PAPER

AMENDMENT NUMBER 3 TO THE MANAGEMENT PLAN FOR REEF FISHES
OF PUERTO RICO AND UNITED STATES VIRGIN ISLANDS

Section 5

Appendix B

Reef Fish And 3

CARIBBEAN FISHERY MANAGEMENT COUNCIL

OPTION PAPER

AMENDMENT NUMBER 3 TO THE FISHERY MANAGEMENT PLAN FOR REEF FISHES
OF PUERTO RICO AND THE UNITED STATES VIRGIN ISLANDS

AUGUST 1995

CARIBBEAN FISHERY MANAGEMENT COUNCIL

Options paper for Amendment 3 to the Reef Fish FMP: gill nets and trammel nets.

I. Introduction

The Fishery Management Plan for the Shallow-water Reef Fish Fishery of Puerto Rico and the U. S. Virgin Islands (FMP) became effective September 22, 1985. The FMP (and each of the amendments) was prepared by the Caribbean Fishery Management Council to establish a management system for the shallow-water reefish resources within the Exclusive Economic Zone (EEZ) and the water under the authority of the Commonwealth of Puerto Rico and the Territory of the U.S. Virgin Islands, from the shoreline to the edge of the insular platform.

The FMP that went into effect in 1985, established regulation to rebuild declining reefish species in the fishery and reduce conflicts among fishers. ⁽¹⁾ It established the criteria for the construction of fish traps; ⁽²⁾ required owner identification and marking of gear and boats; ⁽³⁾ prohibited the hauling of or tampering with another person's traps without the owner's written consent; ⁽⁴⁾ prohibited the use of poisons, drugs and other chemicals and explosives for the taking of reefish; ⁽⁵⁾ established a minimum size limit on the harvest of yellowtail snapper and Nassau grouper; ⁽⁶⁾ and established a closed season for the taking of Nassau grouper.

In November 1990, Amendment 1 to the FMP established the following regulations to rebuild declining reefish species: (1) it prohibited the harvest or possession of Nassau grouper; (2) closed an area in the EEZ southwest of St. Thomas, U.S. Virgin Islands to fishing during the spawning season for red hind; (3) increased minimum mesh size for traps to 2 inches; (4) defined overfishing; (5) revised the section on habitat description; (6) provided for the collection of socio-economic data through federal/state agreements already in existence.

In October 1993, Amendment 2 to the FMP incorporated the major species of the deep-water reef fish fishery and the marine aquarium finfish fishery into the reef fish management unit. This action was accompanied by a change in the FMP's original title and to the present the FMP is known as the Fishery Management Plan for the Reef Fish Fishery of Puerto Rico and the U.S. Virgin Islands. To protect important species and rebuild declining reefish species Amendment 2 prohibited the harvest or possession of jewfish; prohibited the harvest/possession/sale of certain species used in the aquarium trade; restricted the collection of marine aquarium fishes to hand-held dip nets and slurp guns; closed 2 additional red hind spawning aggregation areas from December through February; closed a spawning aggregation area for mutton snapper from March through June each

year in St. Croix, U.S. Virgin Islands; and changed the criteria for the construction of fish traps.

II. Statement of the Problem

Amendment 3 addresses the continuing and growing concerns by the Council over scarce resources and user conflicts.

It has been brought to the attention of the Council that fishers have been abandoning the use of traps, in favor of nets (gill and trammel nets) and other gears, to increase their catch. The concerns voiced at Council meetings include: (1) conflict among trap and net fishers regarding competition for the fish resources; (2) indiscriminate and increasing use of nets and the impact of nets in the established fisheries (e.g., parrotfish and bluefish fisheries of St. Croix); (3) a novel fishing practice developed in St. Croix whereby nets are used along with SCUBA divers who herd the fish onto the nets; (4) conflict between commercial and recreational fishers regarding both the destruction of fishing gear (nets, buoys, etc.) by the increasing recreational boating activity and the damage to recreational boats by the deployment of commercial fishing nets; and (5) the damage to coral reefs caused by gill and trammel nets.

Net fishing has been shown to be increasing (See Section IV. Background Information) in Puerto Rico. The trend has also been reported for the U.S.V.I.; in St. Croix nets are fished using SCUBA divers to herd fish into the nets. The decline in the trap fishery is probably the most important factor contributing to the increase in the number and use of nets (re-direction of the fishery). In addition, it has been reported that the use of nets has an adverse impact on coastal and reef fisheries and represent a navigational hazard (user conflict) where they are deployed. User conflict is reported from the recreational as well as the commercial sector. Commercial fishers argue that their gears are destroyed from the increase in recreational vessels and the indiscriminate use of all areas by recreational boaters and jet skiers. Recreational fishers report an increase in damage to propellers from the increase and indiscriminate deployment of gill and trammel nets. Nets are said to be fished around reef areas where the possibility of damaging coral is high. Thus, having a detrimental effect on commercial reef-based fisheries. However, nets have also been reported as catching larger size fish, most significantly larger fish than those caught in traps.

Nets have been banned in state waters in Florida (November 1994) and Louisiana through constitutional amendments. No net restrictions are in place in the U.S. Caribbean Federal waters.

III. Proposed Management Alternatives

Alternative 1: Ban the use of gill nets and trammel nets in the EEZ.

Rationale: The documented increase in the number of nets and in the proportion of the commercial catch nets represent are cause of concern. This increase in the landings of fish and shell fish caught with nets is taking place at the same time that the trap landings are decreasing. Taking into consideration that the overall declining trend in the commercial landings is well documented and that increasing effort has been the most common cause of the declining trends, a ban on the use of a specific gear could be considered as an alternative management measure.

These gears are size-selective according to the mesh size used in fishing. Acosta (1988), Matos Caraballo (1991), and Valdés Pizzini et al. (1992) have reported that for certain species (e.g., white grunt and lane snapper) nets capture, on average, fish of larger size than other gears and, in general, also capture a much broader size range for individuals of various species.

These gears are said to be destructive of the habitats in which they are deployed. However, there is no scientific study at the Council office documenting the type of destruction and the extent of the damage caused by net. Commercial fishers do report that their nets are torn by pieces of coral when they are retrieving the nets after fishing. Valdés Pizzini et al. (1992) report that gill nets are mostly fished in sand flats and Thalassia flats while trammel nets are mostly fished in reef areas.

They have been said to be a navigational hazard, specially to recreational boating, since they get entangled in propellers. An increase in the use of nets and an increase in the number of recreational boats have taken place concurrently. (See Alternative 4). Both activities seem to be taking place in the same areas thus creating competition among users.

Socio-economic data of the fishery indicate that most net fishers depend exclusively on fishing (Valdés Pizzini et al., 1992), though not necessarily exclusively on net fishing. The effect of a total ban needs to be considered in relation to the effect it would have on the commercial fishers as measured against the effect to the fishery, resource-user conflicts and habitat.

These gears are said to entangle turtles and marine mammals.

Alternative 2: Establish a mesh/length size for nets.

Rationale: Establishing a mesh size that allows for juvenile fish to escape could be a less drastic measure before banning these

gears completely.

Matos Caraballo (1991) reported that the size of the white grunt and the lane snapper were larger for fish caught with gill nets than for other gears. Other studies report that the size of the fish caught with nets is larger and that few juveniles are caught using these gears.

Valdés Pizzini et al. (1992) analyzed the possible effects of establishing a minimum mesh size larger than that used by commercial fishers at present. Eliminating the smaller mesh sizes would bring about a short-term decrease in the total catch. However, it would be the small size fish which would not be present in the catch allowing them to grow to a larger size and become part of the spawning adult stock (long-term benefit). These fish might not necessarily become part of the adult stock because other gears, such as traps and spears, are not regulated. Thus, known non-selective gear would still be operating.

However, Valdés Pizzini et al. (1992) also report that most fish caught with a mesh size of 7.6 cm (about the average size of mesh used in gill nets in Puerto Rico) are adults.

An alternative to this measure would be to establish a minimum size of capture for fish. However, this would require knowledge of the reproductive biology of each species caught with these gears. Some 80 species have been reported for these gears (Valdés Pizzini et al., 1992). The minimum size at capture would have to be established for each species separately.

Alternative 3: Allocate the gear for commercial use only.

Rationale: There is little information on the use of nets by recreational fishers in the U.S.V.I. (Olsen, 1979) and none for Puerto Rico. No information is available however regarding the number of gear units or the frequency of use of these gears (gill and trammel nets) by recreational fishers.

Alternative 4: Establish areas of no use (e.g., not allowed within 0.5 miles of the main reef areas) and/or time periods of no-use.

Rationale: Areas of no-use could include those identified as for example breeding grounds and nursery grounds (mangrove areas, seagrass beds), areas of critical habitat (coral reef areas) or areas assigned to other uses (e.g., recreational swimming or boating). Time periods of no-use could be established to allow for multi-use of areas (e.g., boating during the day, net fishing at night).

Migration of fish are well known by commercial fishers and this kind of knowledge pre-determines the times and areas for fishing.

Traditionally, most fishing with gill and trammel nets is done at night.

Valdés Pizzini et al. (1992) report that commercial fishers use gill nets in Thalassia flats, sand flats and coastal/mangrove areas with about the same frequency. Trammel nets are mostly used in reef areas and Thalassia flats.

Alternative 5: Establish a limited entry program allowing only the current users of nets to fish in the EEZ.

Rationale: Establish a licensing system for net fishers or set a cap on the number of gear units to be allowed in the fishery.

Alternative 6: No Action.

Rationale: This alternative would be non-responsive to the problem identified in the fishery. The potential increase in the movement of fishers into this fishery represents a possible increase in the rate of decline of reef species and habitat.

IV. BACKGROUND INFORMATION

I. Definitions

Nets (Figure 1) are defined as fishing implements comprised mainly of netting; an open-work fabric forming meshes of suitable size for catching fish (CEC, 1992). In general, nets are considered passive gear (gill nets, trammel nets) used in capturing fish by entanglement or entrapment since they are not (usually) actively moved while fishing (Hubert, 1983). Gill nets and trammel nets are both entanglement nets. These nets can be set at the surface, in mid water or flushed with the bottom.

II. Commercial landings

1. Puerto Rico

The use of nets in Puerto Rico (Figure 2) and the U.S.V.I. is increasing. The information on the number of gill nets, trammel nets and other nets for Puerto Rico is summarized in Table I. The number of gill nets in 1946, was 46 and the number of trammel nets was 19 (Kahn, 1949). In 1988, Matos Caraballo and Torres Rosado (1989) reported 894 gill nets and 426 trammel nets; about a twenty-fold increase. There was no catch information by these nets from either report.

Table I also shows the total catch reported by gear and the catch per unit effort (CPUE calculated per net) between 1972 and 1993. CPUE has decreased from an average of over 600 pounds per net per year in the 1970's to about 260 pounds per net per year in the

1990's. These numbers are subject to the known biases of the voluntary rendition of the commercial landing statistics, among others.

The total value of the catch by gill nets is also shown in Table I. The value has increased from an estimated \$13,000 in 1975 to \$370,000 in 1985. Overall price per pound for netfish has been reported for Puerto Rico to range between 48 cents per pound in 1975 to \$2.03 in 1993. The estimated value of the gill net catch for 1993 is \$505,470.

Historically, the species most commonly caught with gill nets as reported from the commercial catch have been the grunts, parrotfish and mulletts. Other species included among the top three species landed, depending on the year, are ballyhoo, mojarras and snook (snook ranked first in 1992, but in no other year appeared among the top three species landed).

Nets are definitively showing an upward trend in use and an upward trend in the percent of the total catch fish caught with nets represents. In fact, they have almost replaced traps in terms of the percentage of catch reported by gear (Figure 3) in Puerto Rico.

The information available regarding the number of gear units, length and mesh size of gill nets and trammel nets, frequency of use, soak time, etc. is summarized in Table II taken from Matos Caraballo and Torres Rosado (1989). Traditionally, most gill net activity occurs in the North coast of Puerto Rico. Mesh size as well as total length are very variable. There is no information on the number of gear units for each specific mesh size (0.5-6 inches) in the Matos Caraballo and Torres Rosado (1989) report. Acosta (1988) analyzed the commercial data from the west and south coasts of Puerto Rico for 1986 and 1987 for gill nets, trammel nets and beach seines. Fifty-nine and forty species were recorded for each year, respectively. The most common species, by number, caught with gill nets were Sparisoma viride (parrotfish) (in 1986 for both the south and west coast) and Calamus bajonado (porgy) (in 1987 on the south coast) and Haemulon plumieri (in 1987 on the west coast). Both gill and trammel nets show similar catch composition. Acosta (1988) determined size frequency distributions for a number of species caught with the three gears but no generalization can be made for all species. In most cases a much broader size range of individuals is captured with gill nets and at least for 5 of the 7 most common species the mean size of fish caught with gill nets is larger (but not significantly larger) than for the other two gears.

Matos Caraballo (1991) reports that at least for Haemulon plumieri (white grunt) and Lutjanus synagris (lane snapper) the majority of the fish caught commercially with gill nets are

larger than the minimum size at maturity (160 and 180 mm, respectively). More than 25% of the individuals of Ocyurus chrysurus (yellowtail snapper) were less than the minimum size at maturity (260 mm) in 1988 and 1989; more than 75% of those landed in 1990 were less than the minimum size (Table III).

Valdés Pizzini et al. (1992) sampled 3 areas (mangrove, inner and outer reef) between May 1990 and September 1991. A total of 132 net sets (30, 51, and 41 for each area, respectively) were made using 3-4 nets of 100-150 fathoms each which soaked for 4-6 hours (between sunset and sunrise). Table IV shows the percent catch per gear and mesh size. The most common species caught in the reef areas was the white grunt and the sea bream in the mangrove area. The sets were done in non-traditional fishing grounds. In addition, hanging ratio was also varied during the sampling time. The smaller mesh size used in the study was approximately 3 inches, the average mesh size use in Puerto Rico (Matos Caraballo and Torres Rosado, 1989). The smaller mesh size accounted, for gill nets, for the highest percentage by weight of the total catch.

None of the data analyses found in the literature present enough information to determine a minimum mesh size for gill nets.

2. U.S.V.I.

Table V shows the total pounds of netfish reported by month by the commercial fishers of the U.S.V.I. between 1981 and 1985. An increasing trend in the monthly landings for both St. Thomas/St. John and St. Croix was noted. Average CPUE for gill nets was 15 and 23 lbs/trip for 1981-1982 and 1984-1985, respectively. Although no additional information is available at the Council, it has been reported that there has been an increase in the use of monofilament nets (gill and trammel nets) used in combination with SCUBA divers to harvest reef fish in St. Croix. Targeted species include parrotfish, surgeon fishes and grunts (DPNR, 1993).

Table VI shows the commercial catch as percent of total fish landings for netfish between 1974 and 1991. However, there is no effort information associated with the total landings. That is, the total number of gear units (gill nets, etc.) are not reported. Clavijo et al. (1984) report that most of the netfish is caught using seine nets. In the 1985-1986 commercial fishery U.S.V.I. survey, cited by Clavijo et al. (1986), it is shown that gill nets are among the most commonly used gear in St. Thomas/St. John, but that although this is also true for St. Croix, no information was gathered during the survey.

Figure 4 and 5 show the per cent catch composition for St. Thomas/St. John and St. Croix, respectively. Additional information regarding species catch composition by gear is not

available at the Council's office. The increasing trend is observed in St. Croix. In St. Thomas/St. John the increase is not as marked.

The dollar value reported for fish in the U.S.V.I. was \$2.00 between 1982 and 1985. The 1990-1991 commercial landings report (Barshinger, 1991) shows that the value for netfish was \$2.50 per pound in St. Croix, but \$3.75 in St. Thomas.

Olsen (1979) reported that of the 33% of the respondents to the recreational fishing survey conducted in the V.I. in 1978, 1% used gill nets.

III. Additional Information

In a study conducted on the southwest coast of Puerto Rico, Acosta (1988) reports a maximum of 60 species caught with gill nets. The list of species caught by gill nets includes primarily parrotfishes and grunts (Figure 6) (Acosta, 1994). Landings data for Puerto Rico also show (e.g., for 1983-1987) that the two species most commonly caught by gill nets are parrotfishes and grunts (Matos Caraballo and Rivera, 1994). Targeting of specific species is not reported in Puerto Rico. However, in St. Croix, fishers are targeting parrotfishes and surgeon fishes.

The gill net is highly size selective (Figure 7). That is the size of the fish caught in gill nets is larger than for other gear. Among the nets, gill nets show the highest fish mean size (e.g., *H. plumieri* and parrotfish). The size selectivity is also related to the mesh size of the net, but not enough information is available to make specific recommendations.

The rate of catch for gill nets increases at the extremes of short and long soak times (Figure 8). Soak time on average is 5 hours for Puerto Rico (range 2-7) and 4 hours for St. Croix (Mr. Tobias, per. comm.). The efficiency of the gill net decreases as fish accumulate in it. Most fishers do not clean or gut the fish while they are at sea. In most cases gill nets are set in the afternoon/evening and fish are not processed or marketed until the next day. Specifically for St. Croix, fishers are setting 3 gill nets (two sets in V shape and a third at the base of the triangle formed by the first two nets) which soak for 4 hours. Schools of fish (spotlight and red tail parrotfish) are herded toward the net with the help of SCUBA divers. When the fishing is done, the fish are chilled and kept overnight for marketing the next day (Mr. Tobias, per comm.).

The relationship between soak time and fish quality has been reported as follows: the proportion of dead and spoiled fish increase with increasing soak time (Figure 9). The degree of spoilage determined by Acosta (1994) was based on texture of flesh and odor.

Acosta (1994) reports that 31% of the catch spoiled after 20 hrs. of soak, even after 6 hours there was a certain portion of the catch that had spoiled. He concludes that in La Parguera, with short soak times (4-6 hours), less than 5% of the finfish caught in gill nets are spoiled.

IV. Socio-economic Information

The scant information on social and economic aspects of gill nets and trammel nets users in the Caribbean has been reviewed by Valdés Pizzini et al. (1992).

Valdés Pizzini et al. (1992) report that 36.5% of the net fishers stated that their household income depends exclusively on fishing. Commercial fishers report that the increase in boat activity (recreational boating, jet skies, etc.) account for a high per cent of the gear destroyed while fishing. Valdés Pizzini et al. (1992) also report that the size of the fish caught with these gears is large and that most fishers use larger mesh size for fishing.

Net fishers are older than their peers; half the net fishers have an education less than 6th grade.

One quarter of the gill net fishers are "new comers" to the fishery (Valdés Pizzini CFMC meeting Nov 29-Dec 1, 1993, La Parguera). Many of the net users do not repair their own gear and depend on others for this service. Although not studied in detail, it seems that many more people are buying large numbers of nets (10-14) and subletting the net to fishers.

This gear has been reported by fishers to be very effective yielding high catches of large size fish. The nets are fished on average 3 days a week and other gears (e.g., lines, traps, etc.) the rest of time (multi-gear fishery).

V. User conflicts

Valdés Pizzini et al. (1992) report that commercial fishers complain that their nets are destroyed by jet skies and boats which have invaded the traditional fishing grounds. Commercial fishers and recreational boaters are thus competing for the same areas (different resources and uses). Recreational fishers however do compete with the commercial fishers for the same resources (fishing areas and fish species). The additional activities destroy habitat. Also, they complain that their gears are stolen both from the water and from storage areas on shore.

Competition from SCUBA divers was also reported by commercial fishers as a major source of concern for net fishers (Valdés Pizzini et al, 1992).

VI. Bans on nets

Nets have been banned in state waters in Florida. Regulations will most likely come into place in other states of the Southeast region of the U.S.A. (Two articles from the National Fisherman (May, 1995) are included in Appendix A.) A literature search of the rules and regulations regarding nets in the U.S.A. will be conducted in the near future.

The ban in Florida was approved by voters in November 1994. The ban outlaws gill and entangling nets that snag fish in their meshes, in state waters (Appendix B). Gill net restrictions have also been approved in Louisiana (Appendix B) but disapproved in Mississippi. Complete sets of regulations are being requested from these states.

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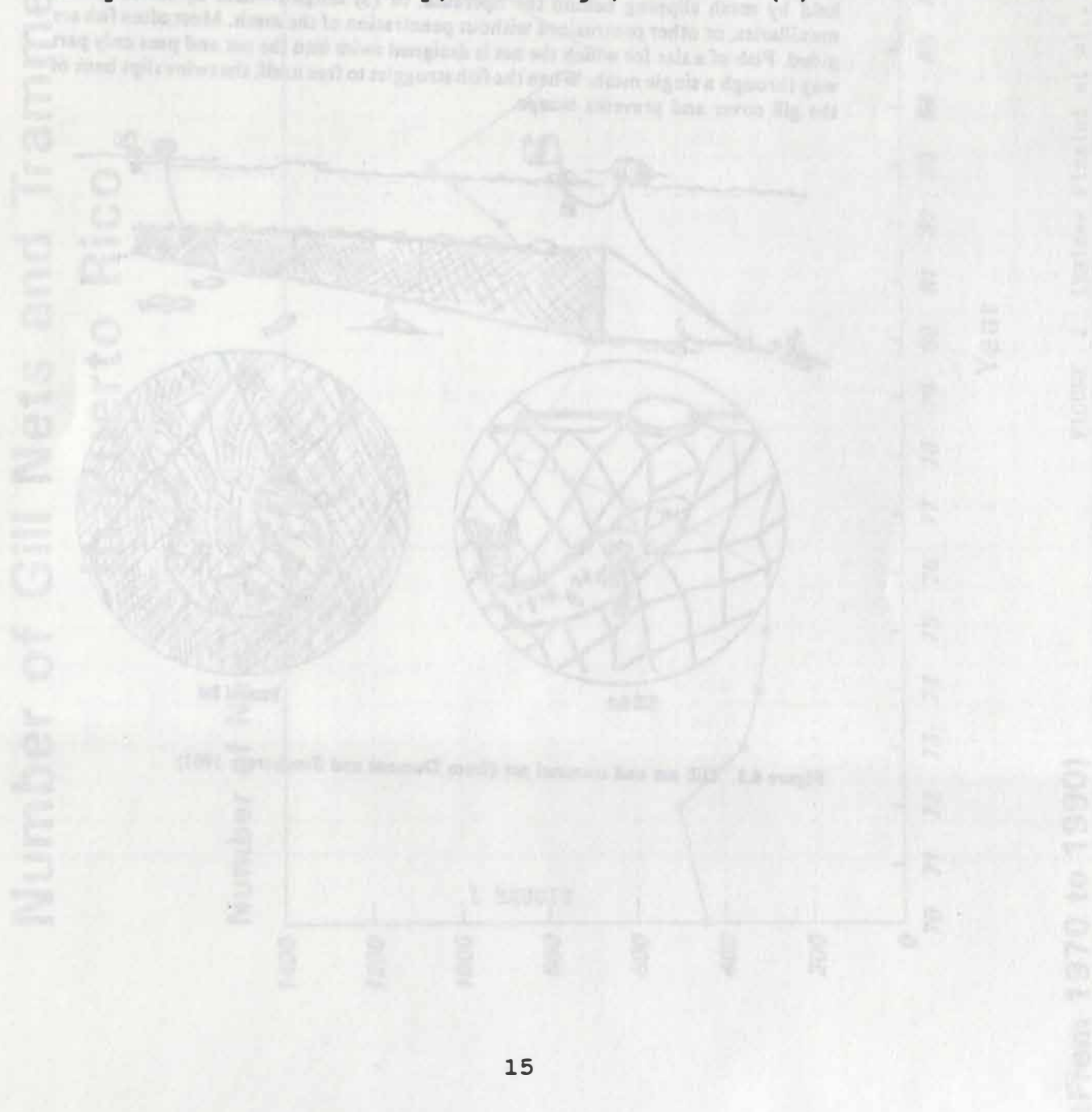
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6.2.1 Gill nets

Gill nets are vertical walls of netting normally set out in a straight line (Fig. 6.1). Capture is based on fortuitous encounter with the net. There are three ways in which fish are caught by gill nets: (1) wedged—held by the mesh around the body, (2) gilled—held by mesh slipping behind the opercula, or (3) tangled—held by teeth, spines, maxillaries, or other protrusions without penetration of the mesh. Most often fish are gilled. Fish of a size for which the net is designed swim into the net and pass only part way through a single mesh. When the fish struggles to free itself, the twine slips back of the gill cover and prevents escape.

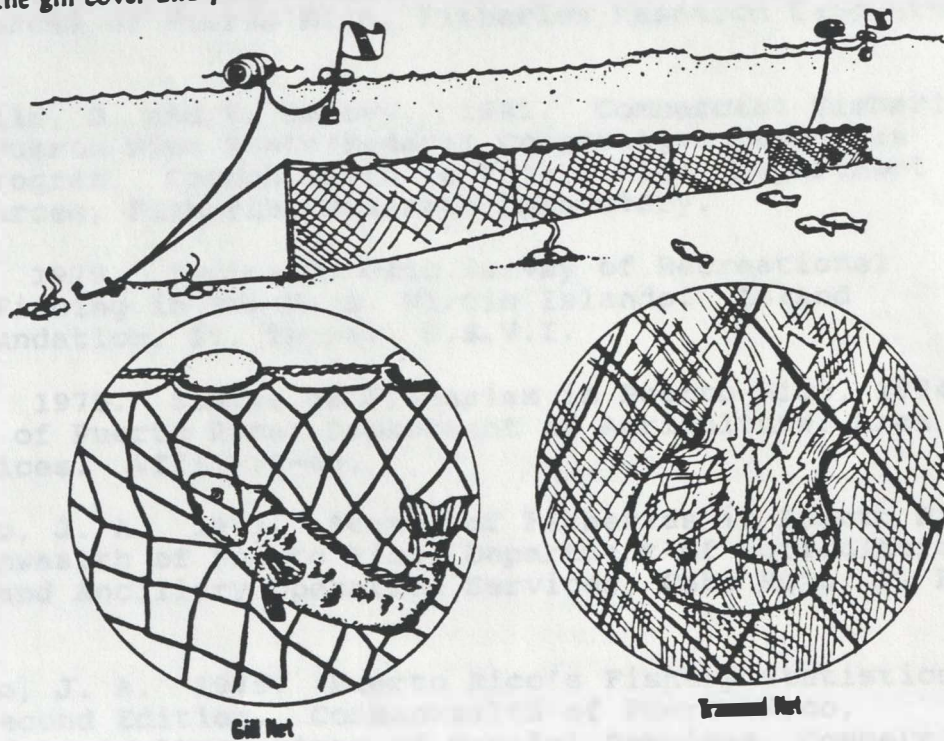
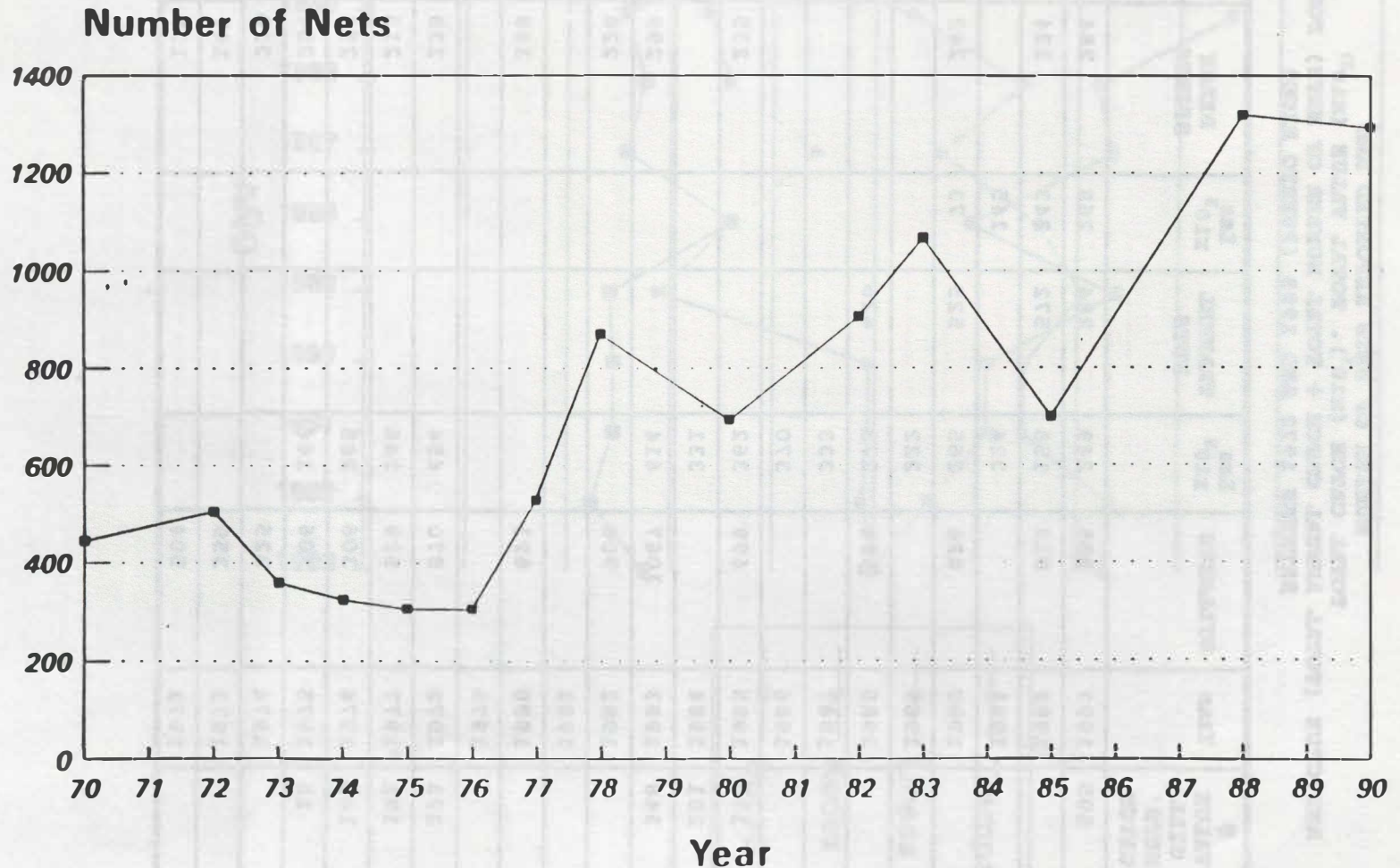


Figure 6.1 Gill net and trammel net (from Dumont and Sundstrom 1961).

Number of Gill Nets and Trammel Nets In Puerto Rico



(From 1970 to 1990)

FIGURE 2 (Valdes Pizzini et al., 1992)

TABLE 1

NUMBER OF NETS REPORTED AND
TOTAL CATCH ($\times 10^3$). TOTAL VALUE ($\times 10^3$)
AND CPUE (TOTAL ANNUAL CATCH $\div$ TOTAL NUMBER OF NETS) FOR GILLNETS
BETWEEN 1972 AND 1993 (PUERTO RICO)

CPUE FOR GILL NETS ONLY	\$ VALUE GILL NETS' CATCH	YEAR	GILLNETS	LBS $\times 10^3$	TRAMMEL NETS	LBS $\times 10^3$	BEACH SEINES	LBS $\times 10^3$	CAST NETS	LBS $\times 10^3$
291	505	1993	855	249	284	268	284	102	893	13
173		1992	912	158	572	243	224	84	813	15
		1991		324		145		122		17
321		1990	826	265	525	73	242	86	1009	7
		1989		222				102		9
305		1988	894	273	426			93		6
		1987		333				125		20
		1986		370				94		14
510	370	1985	699	362			235	99	717	19
	281	1984		331				139		18
388	348	1983	1067	414			299	213	1376	16
		1982	906				226			
		1981								
		1980	693				148			
		1979								
521	223	1978	870	454			238	425	827	27
654	181	1977	529	346			213	257	715	25
931	140	1976	306	285			254	229	478	16
536	13	1975	306	164			254	131	478	19
		1974	325				310		493	
		1973	359				147		561	
		1972	504				110		576	

REPORTADOS POR CATEGORIA DE ARTE EN PUERTO RICO DURANTE 1983-93.

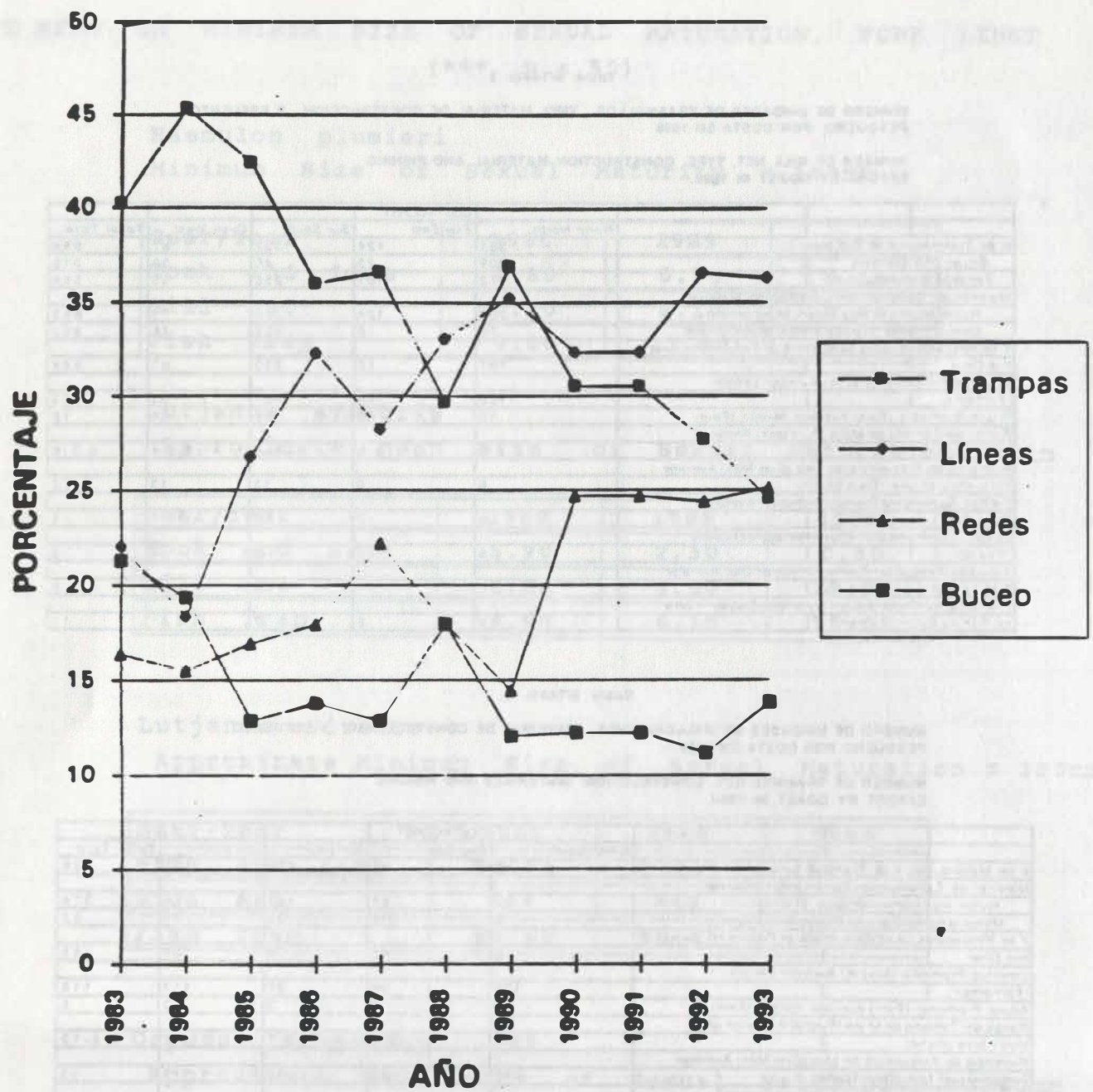


TABLE II

Tabla 5/Tabla 5

NUMERO DE UNIDADES DE TRASMALLOS, TIPO, MATERIAL DE CONSTRUCCION, Y ESFUERZO PESQUERO POR COSTA EN 1988

NUMBER OF GILL NET, TYPE, CONSTRUCTION MATERIAL AND FISHING EFFORT BY COAST IN 1988.

			COSTA COAST				
		North North	East East	South South	West West	Total Total	
# de Trasmallos # of Gill Nets		381	124	302	87	894	
Boya Drift Gill Nets		209	23	46	32	310	
Fondaco Bottom Gill Net		172	101	256	55	584	
Material de Construcción Construction Material							
Nylon Multilaminado Nylon Multilament		302	124	45	71	542	
Monofilamento Plástico Plastic Monofilament		79	0	257	16	352	
# de Pescadores Usan Este Arte # of Fishermen Using This Gear		157	50	250	67	544	
Longitud Promedio (Brazos) Average Length (Fathoms)		165	78	187	186	153	
Altura Promedio (Pies) Average Height (Feet)		10	9	9	11	10	
Rango del Tamaño de Malla (Pulgadas) Range of Mesh Size (Inches)		0.5-6	2-5	1-4	0.5-4	0.5-6	
Promedio de Frecuencia de Uso (Días Mes) Average Frequency of Use (Days Month)		8	6	13	13	10	
Tiempo Sumergido Promedio (Horas) Average Soak Time (Hours)		6	7	2	7	5	
Longevidad Promedio (Años) Average Longevity (Years)		5	2	3	4	3	
Actividad Pesquera Promedio (Horas Día) Average Fishing Activity (Hours Day)		7	11	9	9	9	
Promedio de Profundidad Pescando (Brazos) Average Fishing Depth (Fathoms)		16	8	7	11	11	

Tabla 6/Tabla 6

NUMERO DE UNIDADES DE MALLORQUINES, MATERIAL DE CONSTRUCCION, Y ESFUERZO PESQUERO POR COSTA EN 1988

NUMBER OF TRAMMEL NET, CONSTRUCTION MATERIALS AND FISHING EFFORT BY COAST IN 1988.

			COSTA COAST				
		North North	East East	South South	West West	Total Total	
# de Mallorquines # of Trammel Nets		32	87	178	129	426	
Material de Construcción Construction Material							
Nylon Multilaminado Nylon Multilament		32	81	142	119	374	
Monofilamento Plástico Plastic Monofilament		0	6	36	11	52	
# de Pescadores Usan Este Arte # of Fishermen Using This Gear		8	15	76	55	155	
Longitud Promedio (Brazos) Average Length (Fathoms)		172	99	80	117	116	
Altura Promedio (Pies) Average Height (Feet)		8	3	3	3	5	
Rango del Tamaño de Malla (Pulgadas) Range of Mesh Size (Inches)		0.5-7	3-6	2-7	0.5-12	0.5-12	
Promedio de Frecuencia de Uso (Días Mes) Average Frequency of Use (Days Month)		12	10	16	15	13	
Tiempo Sumergido Promedio (Horas) Average Soak Time (Hours)		3	6	3	10	5	
Longevidad Promedio (Años) Average Longevity (Years)		2	2	3	2	2	
Actividad Pesquera Promedio (Horas Día) Average Fishing Activity (Hours Day)		4	11	7	11	8	
Promedio de Profundidad Pescando (Brazos) Average Fishing Depth (Fathoms)		7	11	11	10	10	

TABLE III

THE MEAN OR MINIMUM SIZE OF SEXUAL MATURATION, FORK LENGTH
(*** n < 50)

Haemulon plumieri

Minimum Size of Sexual Maturity = 160mm

Gear/Year	1988	1989	1990
Hook and Line	0.80	0.70	0.14
Gill Net	2.20	6.10	0.30
Fish Trap	9.60	11.80	5.10

Lutjanus synagris

Approximate Mean Size of Sexual Maturation=180mm

Gear/Year	1988	1989	1990
Hook and Line	5.90	2.30	0.80
Gill Net	0.30	0.00	22.00
Fish Trap	3.90	4.10	15.00

Lutjanus vivanus

Approximate Minimum Size of Sexual Maturation = 380mm

Gear/Year	1988	1989	1990
Hook and Line	94.80	75.00	94.30
Gill Net	***	***	***
Fish Trap	98.60	98.60	95.60

Ocyurus chrysurus

Approximate Mean Size of Sexual Maturation = 260mm

Gear/Year	1988	1989	1990
Hook and Line	39.10	35.70	38.20
Gill net	26.30	26.30	76.60
Fish Trap	58.20	71.20	77.70

TABLE IV: PERCENT CATCH (BY WEIGHT) BY GEAR FOR EACH OF THE THREE (3) FISHING AREAS SAMPLED (VALDES PIZZINI, ET.AL., 1992)

Area	Mesh Size (cm)					Gear
	7.6	8.8	10.1	12.6	Total	
Outer Reef	44%		42%		146 kg	Gill
	35%			36%	1090 kg	Trammel
Inner Reef	51%	18%	17%		279 kg	Gill
		35.4%			547 kg	Trammel
Mangrove	45.5%				109 kg	Gill
	53.3%				237 kg	Trammel

draft

TABLE V: TOTAL POUNDS REPORTED FOR NETFISH¹ IN THE USVI

MONTH	ST THOMAS & ST JOHN					ST CROIX				
	1981	1982	1983	1984	1985	1981	1982	1983	1984	1985
JAN		3844	4978	4076	2029		812	129	416	1526
FEB		3310	2585	2875	3087		871	980	198	2072
MAR		4005	4648	2966	2561		855	959	265	2060
APR		3363	3062	6259	3641		498	276	237	1487
MAY		3028	6007	4349	2727		685	525	669	1585
JUN		4715	3642	2115	1877		581	445	330	1125
JUL	2934	6508	5148	1873		846	841	190	712	
AUG	3485	9607	4960	3671		649	857	278	1160	
SEP	2548	2670	4842	2126		743	822	274	1108	
OCT	1694	5399	5402	2278		591	372	139	766	
NOV	1947	3249	4056	3232		2405	562	418	1266	
DEC	1755	1906	3173	22034		492	444	80	1420	
TOTAL	14363	51604	52503	57854	15922	5726	8200	4693	8547	9855

1 No information available regarding the types of nets used.

TABLE VI
PERCENT CATCH COMPOSITION
OF COMMERCIAL LANDINGS
ST. THOMAS & ST. JOHN

Year	Potfish	Hookfish	Netfish	Spearfish	Reference
74/75	76.9	3.8	19.2	0.1	1
75/76	87.1	7.7	4.8	0.4	1
76/77	72.7	20.5	6.8	0	1
77/78	66.4	9.6	23.6	0.4	1
78/79	69.1	4.3	26.3	0.3	1
79/80	69.9	9.8	19.9	0.4	1
80/81	63.8	7.4	28.0	0.8	1
81/82	78.9	4.2	16.4	0.5	1
82/83	78.8	10.9	9.6	0.7	2
83/84	78.7	11.4	9.6	0.3	3
84/85	75.6	13.1	11.1	0.2	4
85/86					4
86/87					4
87/88					4
88/89					4
89/90	69.7	17.9	12.2	0.2	5
90/91	68.8	18.7	12.2	0.3	6
91/92	70.1	18.0	11.2	0.7	7
92/93					

1. Wood
2. Clavijo et al. 1984
3. Clavijo et al 1985
4. Clavijo et al. 1986
5. Barshinger, 1990-1991
6. Barshinger, 1991-1992
7. DPNR, St. Thomas, 1993

TABLE VI (cont.)
PERCENT CATCH COMPOSITION
OF COMMERCIAL LANDINGS
ST. CROIX

Year	Potfish	Hookfish	Netfish	Spearfish	Reference
75/76	82.9	4.5	12.0	0.6	1
76/77	58.3	41.2	0.0	0.5	1
77/78	76.4	13.0	3.6	7.0	1
78/79	73.7	18.5	5.2	2.6	1
79/80	84.6	10.5	1.6	3.3	1
80/81	76.3	9.4	12.7	1.6	1
81/82	64.4	31.1	3.2	1.3	1
82/83	80.9	14.4	4.0	0.8	2
83/84	57.2	39.5	0.9	2.3	3
84/85	52.3	37.9	4.3	5.4	4
85/86					4
86/87					
87/88					
88/89					
89/90	67.0	24.0	6.0	3.2	5
90/91	59.0	30.0	8.0	4.0	6
91/92	55.0	33.0	9.0	3.0	7
92/93					

1. Wood
2. Clavijo et al. 1984
3. Clavijo et al 1985
4. Clavijo et al. 1986
5. Barshinger, 1990/1991
6. Barshinger, 1991/1992
7. DPNR, St. Thomas, 1993

Percent of total catch by gear, St. Thomas

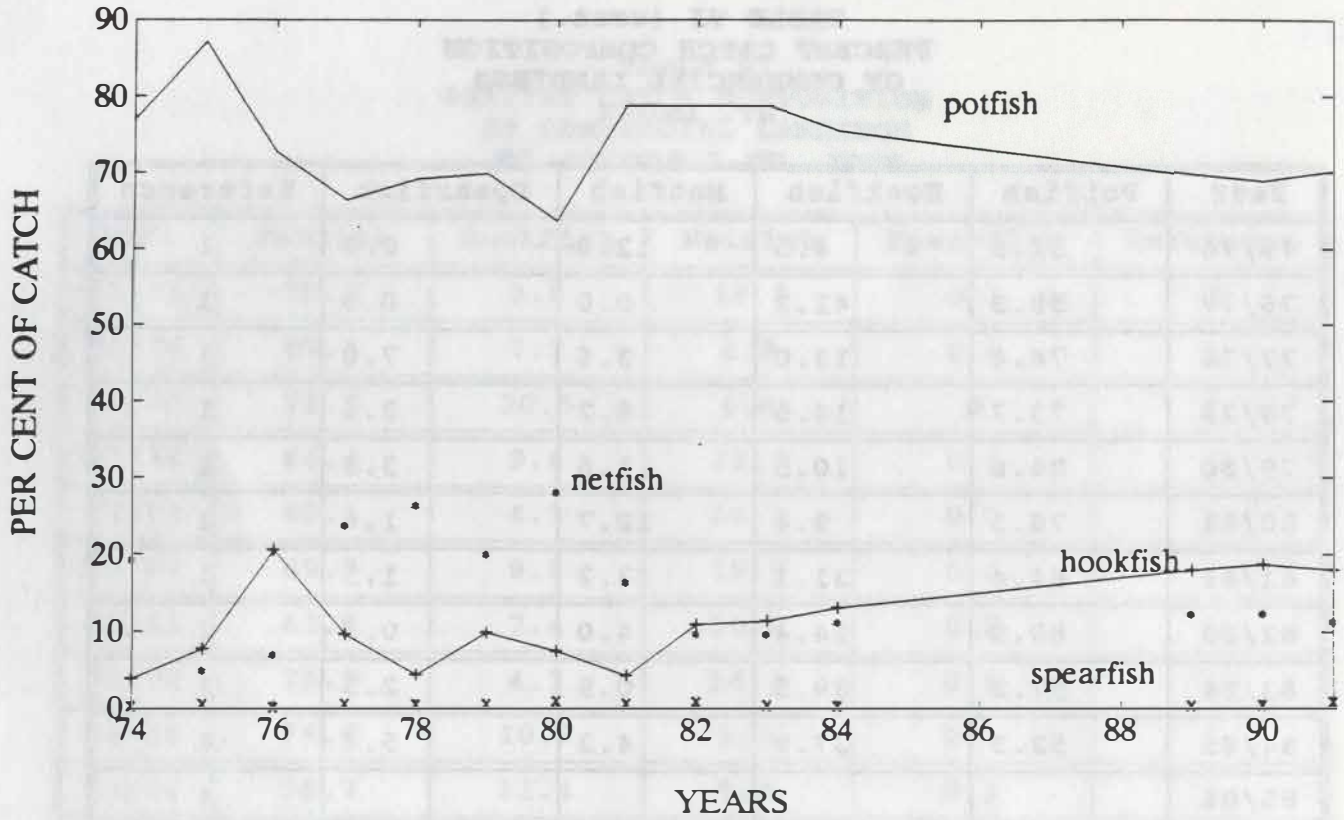


FIGURE 4

Per cent of total catch, St. Croix

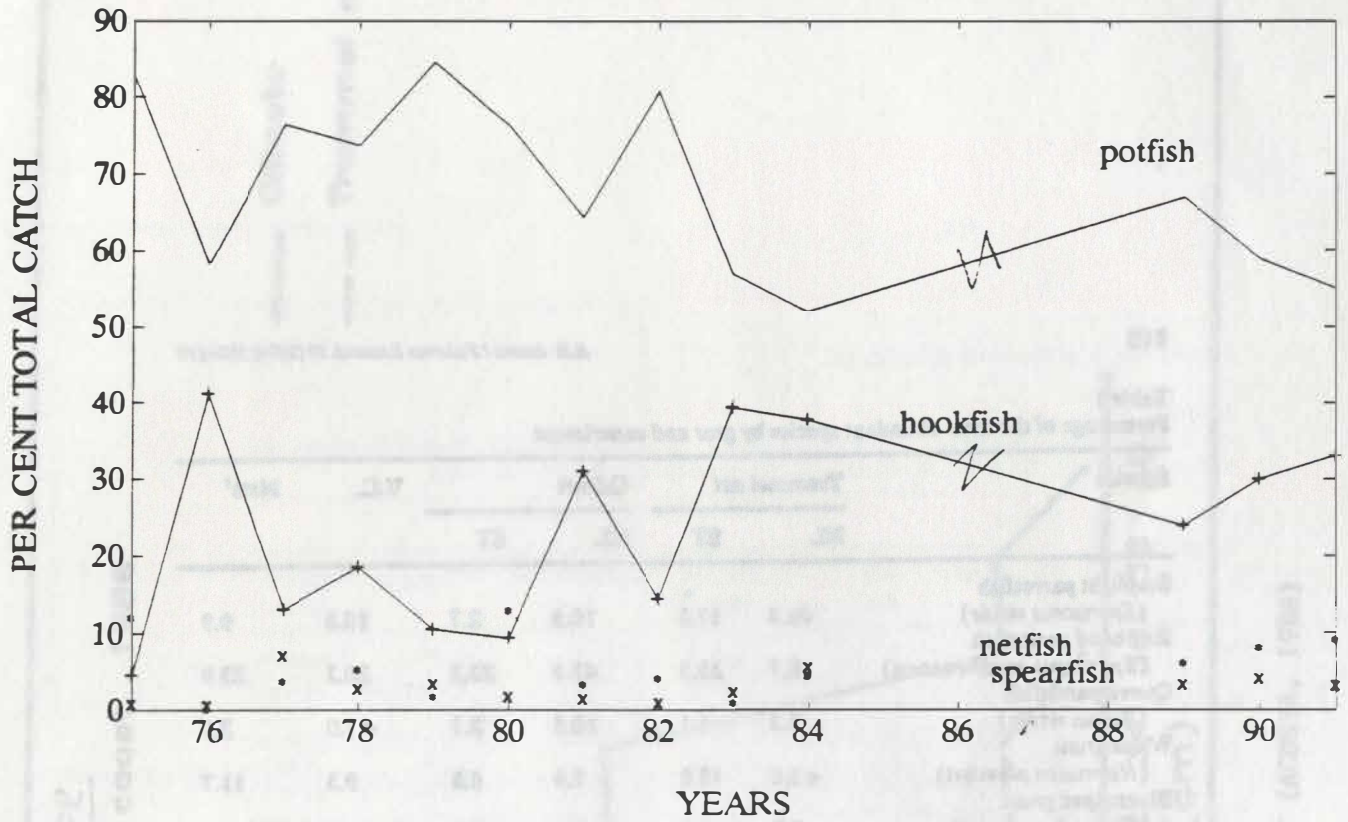


FIGURE 5

Table 1
Percentage of the most abundant species by gear and experiment

Species	Trammel net		Oillan		V.C.	Net ¹
	NL	ST	NL	ST		
Spotlight parrotfish (<i>Sparisoma viride</i>)	48.6	17.8	10.5	2.7	10.8	9.9
Red band parrotfish (<i>Sparisoma aurifrenatum</i>)	6.7	25.5	45.5	23.2	20.2	23.9
Queen parrotfish (<i>Scaevola vetula</i>)	3.3	1.1	10.5	2.7	<1.0	2.0
White grunt (<i>Hammulon plumieri</i>)	<1.0	18.8	7.9	6.8	9.3	11.7
Bluestriped grunt (<i>Hammulon sciurus</i>)	5.8	8.9	2.9	2.7	2.0	4.9
Smallmouth grunt (<i>Hammulon chrysoguttum</i>)	<1.0	2.0			5.0	<1.0
Jolthead porgy (<i>Calamus bajonado</i>)	1.0	2.2	<1.0	6.0	<1.0	4.5
Bar jack (<i>Caranx ruber</i>)	<1.0		6.9	9.1	1.5	5.4
Yellowfin mojarra (<i>Girella cinerascens</i>)	2.1		3.8	5.3		3.1
Ocean surgeon (<i>Acanthurus bahianus</i>)	4.2	8.9	1.6	3.0	15.5	5.4
Blue tang (<i>Acanthurus coeruleus</i>)	7.0		<1.0	3.8	6.0	2.3
Lane snapper (<i>Lutjanus synagris</i>)		3.3	2.6	14.4		9.9
Others	18.0	11.1	16.0	22.2	27.7	16.0
n	566	90	444	132	599	222

¹Gillnet and trammel nets for the soak time experiment.

V.C., visual census; NL, net length; ST, soak time.

FIGURE 6 (ACOSTA, 1994)

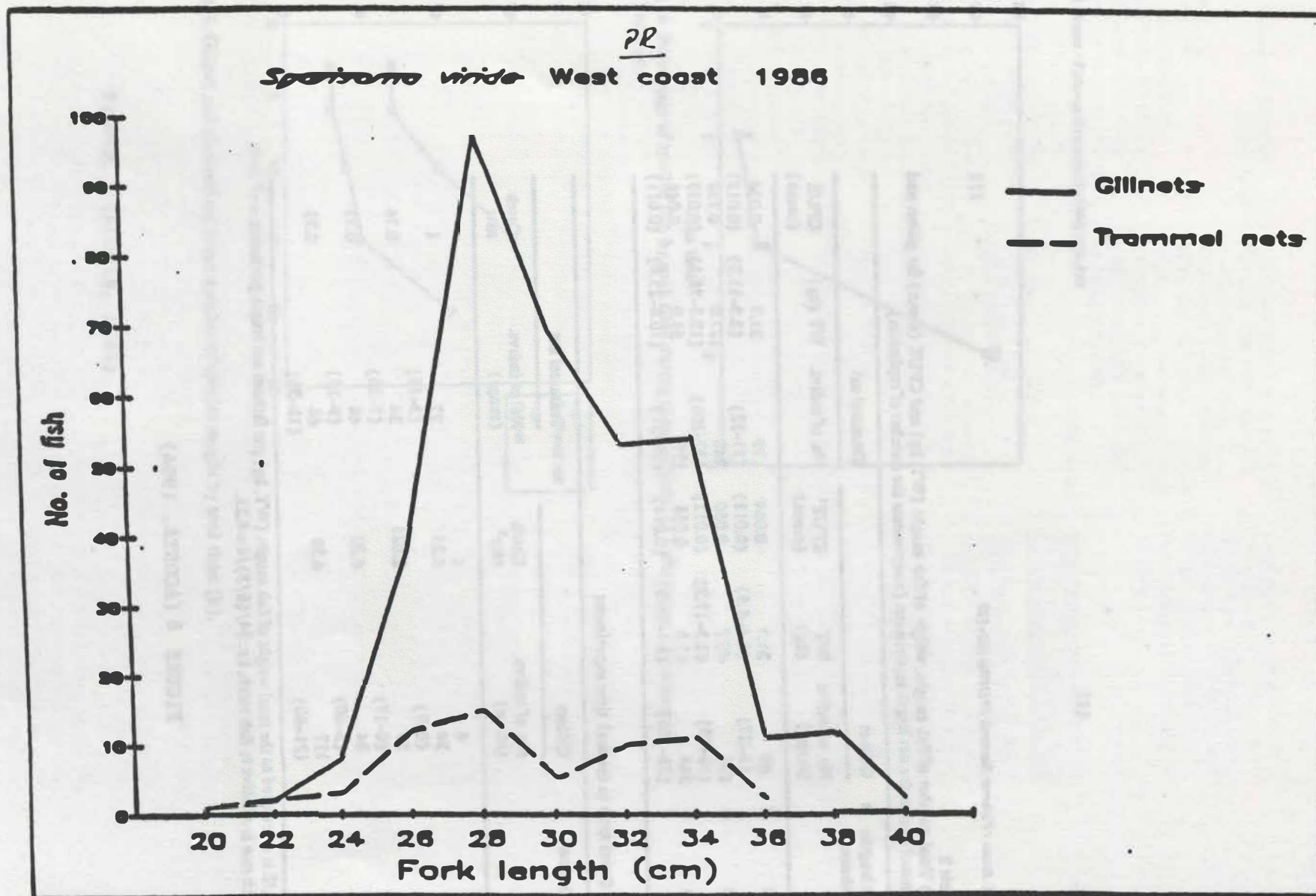


FIGURE 7 (ACOSTA, 1988)

Table 2

(a) Total number of fish caught, weight of fish caught (WT, kg) and CPUE (mean) for gillnet and trammel nets in the net length experimental (*n* represents the number of replicates)

Net lengths (fathoms)	<i>n</i>	Gillnet			Trammel net		
		No. of indivs (range)	WT (kg)	CPUE ¹ (mean)	No. of indivs	WT (kg)	CPUE (mean)
100	4	69 (3-27)	21.7 (0.5-6.5)	0.054 (0.013)	75	21.7 (2.5-11.2)	0.054 (0.013)
200	4	136 (10-79)	40.2 (2.3-17.2)	0.050 (0.012)	348	127.0 (12.5-78.5)	0.158 (0.039)
300	4	244 (33-106)	67.5 (8.1-26.3)	0.056 (0.014)	177	55.0 (10.8-25.4)	0.046 (0.011)

(b) Catch rates in the soak time experiment

Soak time (h)	Gillnet		Trammel net	
	No. of indivs (range)	Catch rate ²	No. of indivs (range)	Catch rate
3	4	1		
6	34 (0-9)	4.25	27 (3-15)	1
10	27 (0-17)	2.025	34 (7-20)	0.76
15	84 (3-60)	4.20	48 (9-15)	0.71
20	117 (21-60)	4.39	66 (18-35)	0.73

¹CPUE is calculated as the total weight of fish caught (WT, kg) per fathom net length per hour.

²Catch rate is relative to fish catch, i.e. $34/(6/3)/4 = 4.25$.

FIGURE 8 (ACOSTA, 1994)

Not just modifications

The Florida Marine Fisheries Commission in February announced results of its changes

A.R. Arnes / Fisheries Research 19 (1994) 103-119

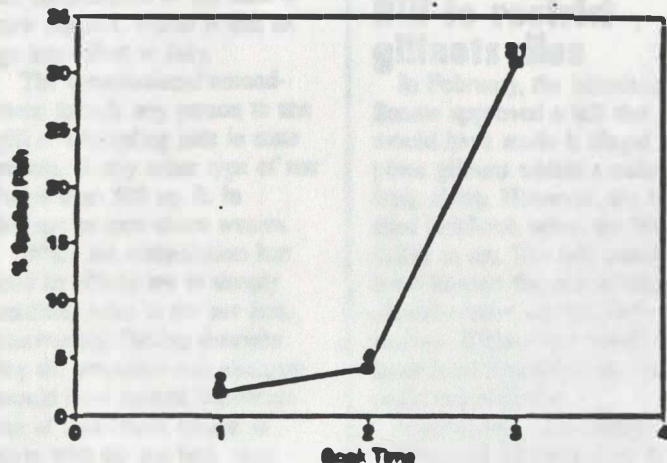


Fig. 4. Percentage of spoiled fish by soak time during three periods: (1) afternoon; (2) sunset; (3) sunrise.

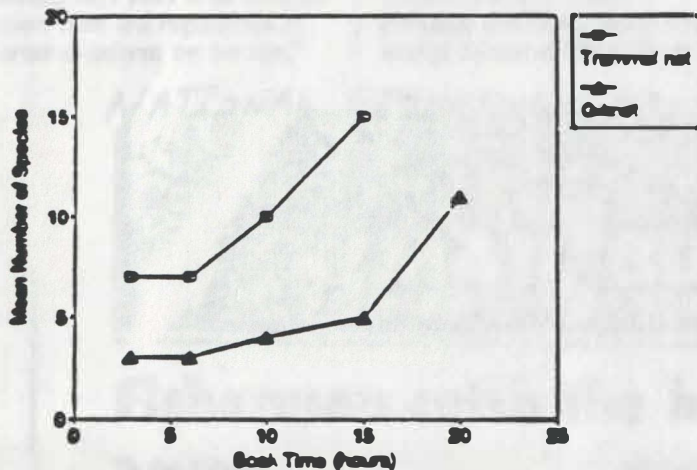


Fig. 5. Gillnet and trammel net mean number of species caught by soak time (h).

FIGURE 9 (ACOSTA, 1994)

According to the Florida Marine Fisheries Commission, the Florida Department of Natural Resources is currently conducting a study to determine the impact of various types of fishing gear on the fishery. The study is being conducted in the Gulf of Mexico, off the coast of Florida. The study is being conducted in the Gulf of Mexico, off the coast of Florida. The study is being conducted in the Gulf of Mexico, off the coast of Florida.

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MID-ATLANTIC REGION

Seafarers get nod to coastal striped catfish

Seafarers get nod to coastal striped catfish. The study is being conducted in the Gulf of Mexico, off the coast of Florida. The study is being conducted in the Gulf of Mexico, off the coast of Florida. The study is being conducted in the Gulf of Mexico, off the coast of Florida.

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APPENDIX A

from Louisiana's fisheries.

—David Krupp

* Not ban modifications

The Florida Marine Fisheries Commission in February scrapped some of its changes to proposed rules that the panel says would have made for easier enforcement of the state's new net ban, which is due to go into effect in July.

The constitutional amendment forbids any person to use gill or entangling nets in state waters, or any other type of net larger than 500 sq. ft. in inshore or near-shore waters.

While the commission has said its efforts are to simply conform rules to the net ban, commercial fishing interests say the proposed rule changes would have locked fishermen out of innovative efforts to cope with the net ban, says a Jerry Sansom, executive director of the Organized Fishermen of Florida. "The amendments clearly says there is no need for more rules and regulations in order to enforce the net ban," a

eliminated language that would have forbidden the mere possession of prohibited nets on certain small boats while transiting federal waters, locked or anchored in state waters. These exceptions, however, do not apply to any boat that is also carrying a cast net.

—Don Rivers

* Bill to restrict gillnets dies

In February, the Mississippi Senate approved a bill that would have made it illegal to place gillnets within a mile from shore. However, the bill died in March when the House failed to act. The bill would have banned the use of nets in closed waters, coastal bays and bayous. Gillnet use would also have been forbidden on weekends and holidays.

Restrictions were proposed by the state Commission on Marine Resources in January after the commission shot down a net-ban proposal. The state Department of Wildlife, Fisheries and Parks and recreational fishermen are in favor

the three state counties with Gulf shorelines — Hancock, Harrison and Jackson. In part of Hancock and all of Harrison County, gillnets would have been banned within a half-mile of shore.

—D.K.

MID-ATLANTIC

States get nod to boost striped catch

Fishery managers have fulfilled a promise to loosen the reins on striped bass fishermen once coastal stocks had recovered from historic lows of a decade ago. On March 8, the Atlantic States Marine Fisheries Commission ratified Amendment 5 to its striped bass management plan, allowing states to liberalize their fishing laws. The amendment also includes language that eventually will change how the health of coastwide bass stocks is gauged.

In most coastal states, commercial and recreational quotas will be permitted to increase

NATIONAL FISHERMAN MAY 1995

MAIL BUOY

Fishermen catch the brunt — again

To the Editor:

After being a commercial fisherman for many years, in listening to the ongoing plight of other men in this tough field of employment, I have been compelled many times to voice my opinions concerning laws imposed.

Two laws that have hit the books of late regarding TEDs and gillnetting bans in Florida and other states join these ludicrous acts. From my experience of at least 26,000 hours of dragging the rags, shrimp, I was witness to only 10 or so turtles caught and not one was dead. Some were a little sluggish, but we were able to allow all to revive themselves on deck before releasing them back to the ocean.

*Now some may say that I was not working where the turtles were, but after working in all bay and coastal grounds from Mexico to Key West out to 100 fathoms or so, it seems to me that if the shrimpers were

killing all the turtles, I'm quite sure that I would have seen such death and destruction first hand. Never, and I repeat never, have I seen a single dead turtle come aboard a vessel that I captained or crewed on.

Gillnetting is a whole story in itself. I must commend the lobbyists for the pleasure boat association, you have certainly screwed the poor old fisherman again! He gets up before your timed coffee pot even clicks to make your morning brew, dons his garb and is out trying to feed his family and your great playground by tangling a few fish in his nets. He's not even after your wonderful trolling species. I don't know how many sport fishermen that fish for such types of black snapper and grunts. You have indeed done a wonderful job. My hat's off to you. I hope that when you meet your maker, he points these things out to you.

Bruce P. Keller
Baltimore, Md.

Were fish nets left in protest?

TALLAHASSEE (AP) — A recreational boater got tangled in a huge, abandoned gill net in Santa Rosa County on Sunday, apparently a victim of the recently enacted net ban.

"The report is that the net is 4,000 yards in length," said Capt. Alan Richard of the Florida Marine Patrol. "It's a phenomenally large net."

Richard said the net could have floated in from the Gulf of Mexico or been mistakenly left behind. But he added: "It's just as easily a net left there intentionally as a protest."

Recreational boaters get tangled; nails litter boat ramp

statement "concerning the net ban."

It was virtually the only incident in an otherwise calm Sunday, the second day the ban was in effect.

"The fishermen are cooperating with law enforcement officials in a professional manner and we are very pleased," Lt. Col. Frank Feliciano, bureau chief of the Marine Patrol, said earlier Sunday in a statement.

The patrol turned four citations

Saturday — three off the Panhandle coast and one off Jacksonville.

Three nets were left floating where they would interfere with boat traffic in the Indian River near St. Lucie. Nails were strewn on a boat ramp and some private boats were vandalized with spray paint in the same area.

Another net was found abandoned off Fort Myers.

No arrests were made in those incidents but the vandalism was

thought to be net-ban related, said Feliciano.

In Sunday's case, Richard could not immediately confirm the size of the net since officers hadn't yet reached the scene, at the mouth of the East River, off Pensacola.

He said the Marine Patrol first learned of the net by an anonymous caller. The stranded boater radioed the Marine Patrol shortly afterward.

Ronald Fred Crum of Panama

20 WINTER 1991

predicted fishermen's anger might erupt. Many of the fishermen are facing the loss of livelihoods that have been passed down for generations.

"Wait until the morning came due ... someone pushes him on Saturday night, the bank's on him, his kids have no shoes," said Crum. "He's got the fishing equipment, he sees the fish, and he has to stay home."

"How far can you push someone?" he asked.

See NETS, Page 8A

NETS

From Page 1

The amendment, approved overwhelmingly last November by voters, doesn't totally ban net fishing. A 500-square-foot size limit on nets allows some shrimp in nearshore and inshore waters — those extending one mile out in the Atlantic and three miles out in the Gulf of Mexico.

But all gill and entangling nets, which snag fish in their meshes, are banned in all state waters, extending three miles into the Atlantic and nine miles into the Gulf.

The industry lost a court challenge Thursday to delay enforcement of the ban, but its constitutional challenge is still pending in state court in Tallahassee.

While commercial fishermen mourned the marking of an era Saturday, sports anglers praised

the net ban.

Dave Clark, 39, of Naples cast into the water off the Roccia Island Seaport Pier and contemplated the implications of the ban.

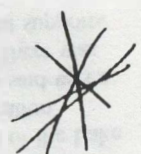
"I'll let you know in about a year," he said. "It'll take that long for the fish to come back. I like the ban. I've seen them (netters) come in and wipe out a whole bay. I think we need them, but we need restrictions."

Across the state, at Sandspit Park in Stuart, Skip Vorovina said he expected there would be a lot more Spanish mackerel this winter.

"I'm glad for it big time," he said of the ban.

Ervin Voltz, a plumber and lifetime resident of Stuart, approved of the ban even though he has friends and a brother who make their living net fishing.

"I know a lot of people who are going to be out of work," Voltz said. "But it will bring a lot of our fishing back."



NET BAN INVENTORY

Here are the basics of the net ban that took effect Saturday.

OUTLAWED

■ Gill and entangling nets that snag fish in their meshes, in state waters. (State waters extend three miles out in the Atlantic Ocean and nine miles out in the Gulf of Mexico.)

■ All nets — including shrimp trawls, seines or cast nets — of more than 500 square feet, in nearshore and inshore waters. (Nearshore and inshore waters extend one mile out in the Atlantic and three miles out in the Gulf.)

STILL LEGAL

■ Shrimp trawls and seines of less than 500 square feet in nearshore and inshore waters — out to one mile in the Atlantic and three miles in the Gulf.

■ Shrimp trawls and seines of more than 500 square feet in other state waters — one to three miles out in the Atlantic and three to nine miles out in the Gulf.

PENALTIES

■ 1st conviction: up to 60 days in prison, \$100 to \$500 fine, or both.

■ 2nd conviction within 12 months: up to 6 months in a prison, \$250 to \$1,000 fine, or both.

■ Over 100 pounds of finfish — additional \$5 per pound.

■ Over 1,000 pounds of finfish — additional penalty equal to wholesale value of fish.

EXCEPTIONS INCLUDE

■ Vessels that are docked.

■ Vessels using nets in aquaculture operations.

■ Vessels containing trawl nets as long as trawl doors or frame are not deployed in the water.

■ Vessels containing or transporting DRY nets rolled, folded or stored in sealed containers so as to make immediate use impractical.

Around the Coast

(Continued from page 12)

the next season begins in the summer of 1996.

— Bob Thane

GULF & SOUTH ATLANTIC

Fishermen battle net ban in court

Florida's three principal commercial seafood organizations, Organized Fishermen of Florida, Southeastern Fisheries Association and the Seafood Consumers and Producers Association, have retained a law firm to file a legal action that seeks to have the state's 1994 net ban constitutional amendment declared invalid.

The suit targets Florida officials and will try to prohibit enforcement of the ban. It will challenge the amendment based on protection provided by certain federal and Florida constitutional provisions, says attorney Frank Santry. "There are a variety of rights afforded to individuals under both constitutions that we contend the adoption of the net ban amendment violates," he says.

Santry says the suit will probably be filed in mid-June. The ban takes effect July 1.

— Dee Rivers

Gillnet restrictions approved

Louisiana commercial fishermen say that

recently passed gillnet legislation, though termed a compromise, really amounts to a total ban on fishing.

As the legislation stood at press time (the House and Senate were still determining final language), severe restrictions on everything from season lengths to mesh sizes have been placed upon the approximately 1,000 commercial fishermen in the state.

Among the most drastic measures are these:

- As of March 2, 1997, gillnets cannot be used to land speckled trout;
- Speckled trout, pompano and mullett seasons will be shortened;
- Fishermen will be limited to one 1,200' gillnet per vessel;
- Minimum mesh size for mullet and seatrout nets will increase from 3 1/2" to 4";
- Nets cannot be left in the water. Instead, strike netting must be used.

The state's commercial fishermen are deeply disturbed by the developments, which they say were orchestrated by a smear campaign and political pressure from the powerful recreational fishing lobby.

"We can't catch fish under this legislation," says Pete Gerica, president of the Lake Pontchartrain Fishermen's Association. "They threw a bill at us that they said was a compromise. It was a death bill. There was no biological data whatsoever [that supports the bill]."

Recreational fishermen catch about 9 million lbs. of spotted sea trout each year compared to the 1-million-lb. commercial quota.

Fishermen also say strike netting is not feasible in most state waters. "It can't work," Gerica says, "because in Louisiana

you can't see the fish. You need good clear water."

Gerica says his 150-member group, made up primarily of finfishermen, will band together with 14 other state commercial fishing organizations to fight the legislation. "We won't take it," he says. "We're gonna fight it legally and on the streets."

— David Krapf

Virus destroys farm-raised shrimp

A killer virus that appeared in Texas' Rio Grande Valley in May has caused substantial losses in farm-raised Pacific white shrimp, according to S.K. Johnson, extension fish disease specialist for the Department of Wildlife and Fisheries Sciences at Texas A&M Sea Grant.

The Taura virus, harmless to humans, causes typical pond losses reaching 80% to 90%, Johnson says. Losses in Cameron County ponds, he adds, are high.

How the virus infected the Texas ponds isn't known. Once established, it spreads via birds feeding on sickly shrimp, water bugs and possibly the wind.

There's no conclusive evidence that Taura syndrome poses no risk to native Texas brown and white shrimp. But limited studies by Dr. Don Lightner of the University of Arizona "indicate the natives are relatively unaffected," Johnson says. "Massive losses to wild stocks have not been reported from viral diseases," he says, "in spite of the development of aquaculture in certain regions."

— Lina Bedrosian

INTERNATIONAL

Northern cod stocks show signs of life

This spring, for the first time in several years, a mass of spawning-age codfish was discovered in the waters off Newfoundland.

Although no one is saying this marks a recovery in devastated northern cod stocks, the finding has raised hopes that this once-rich resource could rebound in the future.

Researchers from Canada's Department of Fisheries and Oceans (DFO) found 10,000 to 20,000 metric tons (m.t.) of cod, aged 7 to 10 years old, in Trinity Bay on Newfoundland's east coast. While the school is small (compared to the 400,000 m.t. that historically returned to Trinity Bay to spawn), researchers last year were unable to find any cod at all.

According to DFO's William Doubleday, "This is the largest aggregation of spawning cod we've seen in northeast Newfoundland since 1992. It's good news in that there is still a significant spawning stock in this area. But it doesn't mean the stock is bouncing back."

The discovery of mature fish in coastal waters offers hope to the 40,000 Newfoundland fishermen who have been out of work since the 1992 cod moratorium was imposed to try to save northern cod stocks. While the discovery is welcome news, fishermen in Canada's poorest province will not be catching any cod in the near future. The moratorium is expected to last until sometime into the next century.

— Ken Kelley

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L. scabra

Order Ostreoida

Family Spondylidae

Spondylus americanus

Class Cephalopoda

Order Octopoda

Family Octopodidae

Octopus spp. (except
the Common Octopus
(*O. vulgaris*)

Phylum Annelida

Class Polychaeta

Family Sabellidae

Sabellastarte magnifica

Sabellastarte spp.

Family Serpulidae

Spirobranchus giganteus

Phylum Arthropoda

Sub-phylum Crustacea

Order Decapoda

Family Stenopodidae

Stenopus hispidus

S. scutellatus

Family Hippolytidae

Lysemata spp.

Thor amboinensis

Family Palaemonidae

Periclimenes spp.

Family Alpheidae

Alpheus armatus

Family Diogenidae

Paguristes spp.

P. cadenati

Family Majidae

Mithrax spp.

M. sculptus

M. cinctimanus

Stenorhynchus seticornis

Family Grapsidae

Percnon gibbesi

Family Squillidae

Lysiosquilla spp.

Gonodactylus spp.

Phylum Bryozoa (Ectoprocta)

Phylum Echinodermata

Class Stellerioidea

Oreaster reticulatus

Linckia guildingii

Ophidiaster guildingii

Astropecten spp.

Ophiocoma spp.

Ophioderma spp.

Ophioderma rubicundum

Astrophyton muricatum

Davidaster spp.

Nemaster spp.

Analcidometra armata

Class Echinoidea

Diadema antillarum

Echinometra spp.

Lytechinus spp.

Eucidaris tribuloides

Tripeustus ventricosus

Class Holothuroidea

Holothuria spp.

Phylum Chordata

Subphylum Urochordata

Phylum Chlorophyta

Halimeda spp.

Penicillus spp.

Caulerpa spp.

Ventricaria ventricosa

Udotea spp.

Phylum Rhodophyta

Phylum Angiospermae

Thalassia testudium

Syringodium filiforme

Halophila spp.

Halodule wrightii

Ruppia maritima

Section 4

Appendix A - Reef Fish

43 Table for Reef Fish
 Info avail to Coastal

Summary table of fish species

Summary table of Jewfish (<i>Epinephelus itajara</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity	Oxyge	Depth	Trophic relationships		Habitat associations and interactions			
Eggs								Food	Predators	Selection	Growth	Mortality	Production
Larvae		Mangrove lagoon (3)	PRS: La Parguera Mangrove shoreward close to Isla Guayacán and Isla Cueva (3)										
Postlarvae													
Early juveniles													
Late juveniles		Red mangrove props (1,7), seagrass beds (7)	PRS: Jobos Bay (7)							Nursery grounds Mangrove and seagrass communities (7)			
Adults		Reef (5,6) reefs crevices (1) coastal lagoon (8**)	STC: Salt River Canyon (5) PRS: Jobos Bay (6) PRW: Joyuda (8**)				50feet (5)	Lobster (<i>Panulirus argus</i>) and <i>Scyllardes aequicinctus</i> , fishes, crabs, sea turtles (2)					
Spawning adults	Unknown in PR and USVI (1)												

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Summary table of fish species

Summary table of Rock hind (<i>Epinephelus adconsionis</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity(ppt)	Oxygen	Depth(m)	Trophic relationships		Habitat associations and interactions			
Eggs								Food	Predator	Selection	Growth	Mortality	Production
Larvae													
Postlarvae													
Early juveniles													
Late juveniles													
Adults		Rocky bottoms(1); reefs (4,5,8,11)(A pal mata zone) (5**)(HR shoreward, LR slope (5**) HR shelf edge,HR offshore) (4)	PRS:La Parguera (4), PRS Ponce Cayo Ratones (5**) Cayo Berberia (5**) PRS:Guayanilla Bay(6**) STC: Salt River Canyon (8); PRS: Jobos Bay (11)				From shallow waters to 30m (1)	Marine crabs, fishes, shrimps, crustaceans, gastropods, and chitons (3)				Mercury levels (petrochemical disposal) below critical limit 1.0g/gb not lethal, 6**	
Spawning adults	Ripe females with mature sex organs in December (2)												
References	Specific site	Coordinates latitude	Coordinates longitude										
5	Ponce Cayo Ratones	17o57'15"N	66o40'12"W										
5	Ponce Cayo Berberia	17o55'50"N	66o27'20"W										

Literature Rock hind *Epinephelus adencionis*

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Summary table of fish species

Summary table of Misty grouper (<i>Epinephelus mystacinus</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity	Oxyge	Depth(m)	Trophic relationships	Predators	Habitat associations and interactions			
Eggs								Food		Selection	Growth	Mortality	Production
Larvae													
Postlarvae													
Early juveniles													
Late juveniles													
Adults		Rocky substrates and reef (1) slab rocks or Large boulder (2)					600-900 feet (1,2)	Fish ,a Wenchmana (2)					
Spawning adults		Ripe individuals in January, April (3) and July (1)	PR: Shelf edge 100 fathom line (2)										

Literature review Misty grouper *Epinephelus mystacinus*

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Summary table of fish species

Summary table of Yellowedge grouper (<i>Epinephelus flavolimbatus</i>) associations and interactions with environmental and habitat variables are listed with citations													
Life Stage	Season	Zonation	Specific site	Temp	Salinity	Oxyg	Depth(m)	Trophic relation	Predat	Selecti	Growth	Mortality	Production
Eggs													
Larvae													
Postlarvae													
Early juveniles													
Late juveniles		Rocky substrates (1)	PRN (1),USVI (1)				To 100 to 200 fathoms (1)	Squid (2)					
Adults	Females sexually matures in July and August (1)		PRN:Arecibo (1)										
Spawning adults													