Quantitative estimates of species composition and abundance of fishes, and fish species/habitat associations in St. Croix, U.S. Virgin Islands

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ABSTRACT

Reef fish communities around St. Croix, U.S. Virgin Islands were studied by visual census methods in order to identify fisheries-habitat links, to document the role of local coral reefs as essential fish habitat, and to provide a baseline for monitoring studies. Seven reef sites were surveyed by stationary fish censuses during spring and fall of 2002. In general, the fish communities were similar across sites and survey periods: all reefs supported a diverse and abundant fish assemblage that was largely replicated between spring and fall surveys. Planktivorous fish (primarily labrids and pomacentrids) dominated the fauna numerically. Herbivorous fish (acanthurids and scarids) were common and abundant at all sites. Piscivores and other specialized feeders were least abundant. Serranids were common and relatively diverse, however most observed fish were of larger size, but less common, less abundant, and less diverse than serranids. Very few large reef-associated piscivorous species were seen, and the significance of this observation is discussed.

Some variation in fish assemblages was observed among reefs. Comparison of species richness and diversity (H') among reefs showed a suggestive positive relationship to vertical relief, but no obvious relation to percentage live coral cover or percentage turf alga cover. Planktivorous pomacentrids predominated at the two reef sites with the highest coral cover. Acanthurids and scarids, while both nearly ubiquitous, showed a reciprocal density relationship, with scarids predominating on well-developed reefs. Chaetodontids were more abundant and diverse near a submarine canyon (Salt River). Lutjanids were not observed at Lang Bank – an offshore platform with sparse coral cover.

These results imply that at least some members of reef fish communities respond to presently unidentified biotic or abiotic differences among the coral reef habitats of St. Croix, and that the source of this variation warrants additional investigation. Additional studies are recommended to monitor changes in these reef fish communities over time, to improve assessments of rare (but recreationally and commercially important) species, and to further elucidate critical fish-habitat links.

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INTRODUCTION

Coral reefs of the U.S. Virgin Islands support a diverse assemblage of fishes. In addition to their ecological roles on reefs, these fish have economic importance to local recreational and commercial fisheries (Appledoorn et al. 1992).

Management of reef fish resources depends upon sound information about the status of local populations, and knowledge of critical links between habitat and fish life-history (i.e. essential fish habitats). Thus a first step is to simply establish the fine-scale patterns of fish distribution among habitats. A descriptive study, such as this one, can provide valuable information about habitat-species associations, which may ultimately lead to identification of critical links.

A second objective of management must be to monitor resources, so that the trajectory of populations through time can be evaluated. A thorough and descriptive baseline survey, whether it represents a natural or disturbed community (Jackson 1997), is the essential starting point for any monitoring program. On St. Croix, for example a proposed Marine Protected Area (MPA) will encompass the nearshore, eastern end of the island. Implementation of a broad "No-Take" zone may conceivably influence the structure of entire reef fish communities located in this area. Monitoring will be instrumental in gauging the effects of this proposed MPA on fish communities. Alternatively, on a scale of individual species, monitoring may allow managers to determine whether specific fisheries regulations, such as localized closures to protect spawning aggregations, are effective at restoring depleted stocks (sensu Tobias et al. 1988).

METHODS

Description of Study Sites

Seven reef sites around the island of St. Croix, U. S. Virgin Islands were selected for this study (see Figure 1): Lang Bank (LB), Jacks and Isaacs Bay (JI), East Wall (EW) of Salt River Canyon, West Wall (WW) of Salt River Canyon, Eagle Ray (ER) on Long Reef, Cane Bay (CB), and Sprat Hole (SH). Each of these reefs is surveyed annually by the Center for Marine and Environmental Studies, University of the Virgin Islands, as part of their coral reef monitoring program. Those studies provide much of the descriptive information on sessile reef biota, as presented in Table 1 (Nemeth and Herzlieb 2002). Detailed geological, biological, and spatial descriptions of these reef sites have been made previously, either in a general sense (Hubbard 1989a), in detail (at CB - Hubbard 1989b; at EW and WW - Hubbard 1989c) or at comparable nearby reefs (at JI - Hubbard 1989d). Briefly, the seven reef sites all represent shallow water (< 15 m depth) hard bottom substrates situated on the insular shelf of St. Croix. Despite geographic proximity, there is considerable variation among reefs in terms of benthic flora and fauna, physical structure, exposure to prevailing currents and wave forces, and adjacent habitats (to name but a few of the variables). For example, the development of scleractinian coral communities varies considerably among sites, from about 5% living coral cover at LB to >24% at SH (Nemeth and Herzlieb 2002). Some of the reefs have previously been classified (Hubbard 1989a-d) as barrier-type reefs (ER), fringing reefs (JI), shelf edge reefs (CB, SH), or submarine

hardgrounds (LB). In the present study, only those attributes presented in Table 1 were considered in relation to reef fish community structure.

Visual Census Methods

The stationary fish census method (Bohnsack and Bannerot 1986) was used to assess reef fish community structure. Compared to other visual census methods (belt transects, timed random swim methods), the stationary count offers the advantage of estimating fish community structure as a function of density per unit area for each observed species, while enabling size (length) estimates of individuals. Generally, results from stationary point counts are comparable to results obtained from belt transects (e.g. Bortone et al. 1989), and the two methods differ primarily in duration (belt transects are faster) and area surveyed per replicate. A typical belt transect of 30 m x 2 m yields 60 m² whereas a 15 m wide stationary census (used in this study) yields 176 m² per replicate. However neither of these two methods is likely to enumerate all of the species present within a given area (i.e. to generate a species list) - that purpose is best served using replicated timed random diver swims (Kimmel 1985) or related methods (see Rogers et al 2001).

The census protocol is only slightly modified from Bohnsack and Bannerot (1986), and a brief description is provided here. A 15 m diameter census "cylinder" was defined by transect tape with the observer positioned in the center (7.5 m mark). Fish within this cylinder were censused as follows. During an initial 5-minute "listing" period, the names of all observed fish species were recorded onto pre-printed data forms. At the end of the listing period, the observer began enumerating all individuals of each species, working from the bottom of the list upward and making one 360° sweep. Strict adherence was made to the 5-minute listing period. New species observed during the enumeration period (e.g. fish that swam into the cylinder after 5 minutes of listing) were not included in the stationary count data. Divers estimated fish total length to the nearest cm, using a measuring "T-bar" for underwater visual reference. Maximum, minimum, and average size was recorded for each species. Divers also recorded a brief description/sketch of habitat features within the census area. All fish were identified to species, however gobies (Gobiidae) and blennies (Blenniidae) were excluded from census counts. To insure that our fish census areas coincided with ongoing UVI coral surveys, but that replicates did not cover overlapping areas, census stations were marked with a small piece of rebar driven into nonliving reef substrate.

Surveys were conducted during two sampling periods: Spring (May – June, 2002) and Fall (September, 2002). For each reef site, six replicate censuses were made [this is a level of replication thought to adequately sample the species representing > 90% of all individuals at a site (Bohnsack and Bannerot 1986)] except for LB (Spring) where only four replicate censuses were conducted due to unfavorable weather conditions. Six replicate censuses surveyed a total area of 1,056 m² per reef site. A summary of census dates, number of replicates, and census duration is presented in Table 2.

Data from this study were analyzed using Microsoft Excel software.

RESULTS

A total of 35,322 fish were sighted during the surveys (Table 3). More fish were observed in fall (16,859) than spring (18,463). The number of fish observed at each site ranged from 1,385 (JI, fall) to 5,443 (CB, fall). A total of 85 fish species representing 27 families were sighted (Table 3; Appendix 1). More species were seen during fall (77 species) than during spring (72 species; Table 3). The number of species observed at each site during spring or fall ranged from 24 (LB, spring) to 42 (WW, ER, CB; all fall) and the cumulative number of species observed at each reef site ranged from 32 (LB) to 52 (ER).

In general, fish assemblages present at each reef site were similar between spring and fall. Average fish abundance (Figure 2A) remained relatively constant at 6 of the reef sites. At CB, an increase in average abundance in fall was due to a large influx of small (~ 3 to 5 cm TL) creole wrasses (*Clepticus parrae*; see Appendix 2F). Average species richness also remained relatively constant between spring and fall (Figure 2B). However the Shannon-Weiner diversity index (H'), computed as an average per census, showed greater variability between survey periods (Figure 2C; LB and ER), suggesting that community composition had changed in some cases. At LB, change was attributed to a large (30%) decrease in abundance of the numerically dominant species, the bluehead wrasse, *Thalassoma bifasciatum*, and a 3-fold increase in bicolor damselfish (*Stegastes partitus*) abundance. At ER, the fall increase in diversity corresponded to a 40% decrease in abundance of the bluehead wrasse and the appearance of large schools of brown chromis, *Chromis multilineata* (an increase from 1.7 to 43.3 fish/census; Appendix 2E).

In contrast to temporal comparisons (i.e. spring vs. fall), comparisons across reef sites showed greater dissimilarity in fish assemblages (Figure 2). Average abundance (Figure 2A) was highest at CB and SH, sites with the highest coral cover, but also at LB where coral cover is sparse. Average species richness varied from ~15 to ~22 species observed/census (Figure 2B) and LB had the fewest species while ER, CB and SH had the most. Diversity indices showed a similar trend (Figure 2C).

The 25 most abundant species observed in this study are present in Table 4. The bluehead wrasse alone accounted for 38.6% of all fish sightings. The five most abundant species were the bluehead wrasse, creole wrasse, bicolor damselfish, brown chromis, and blue chromis (*Chromis cyanea*) - all primarily planktivorous species. Together, they accounted for 87.2% of all fish sightings. Despite comparably high abundance levels shared among these five species, their distribution and frequency of occurrence were different (Table 4). While the strongly reef-associated bluehead wrasse and bicolor damselfish were ubiquitous (present at each reef site) and common (frequency > 97% of censuses), the schooling creole wrasse and brown chromis were more patchy in distribution (Appendix 1) and less common (frequency < 45% of censuses).

A detailed account of species is beyond the scope of the present work (see Appendix 2A to G). Here, an analysis of reef fish community composition is presented based upon taxonomic divisions (families) that delineate eight commercially, recreationally or ecologically important fish groups. These families are: Labridae (wrasses), Pomacentridae (damselfishes), Acanthuridae (surgeonfishes), Scaridae (parrotfishes), Serranidae (groupers), Lutjanidae (snappers), Haemulidae (grunts), Chaetodontidae (butterflyfishes) and Pomacanthidae (angelfishes). The latter two families were combined as a single group (butterflyfish and angelfish) for these analyses. Use of these taxonomic divisions is justified because: (1) each family loosely represents a trophic (ecological) group, and (2) the families collectively represented over 95% (usually >98%) of fish observed at each reef site (e.g. Table 4; Appendices 2A to G).

Fish abundance by family is summarized in Figure 3, where data were pooled from all seven reef sites. Average fish abundance was similar between spring and fall, however abundance varied considerably among families. Labrids and Pomacentrids were over 10 times more abundant than all other families (~ 100 fish observed/census). Acanthurids and scarids had similar abundance levels of ~ 10 fish/census. The abundance of serranids, lutjanids, haemulids, chaetodontids and pomacanthids was generally low (1 to 4 fish/census) and typically quite variable within and among sites (see below).

To examine fish community structure across the seven reef sites, the same eight fish families were utilized as a basis for analyses (Figure 4). Labrids were abundant at all sites (average 242 fish/census) but highly variable within and among sites (Figure 4a) [as noted above, an exceptionally high abundance of creole wrasses was recorded at CB in spring]. Pomacentrids were also abundant (average 148 fish/census), and showed the greatest variation among sites. The highest abundances were seen at CB and SH, where > 300 fish/census were recorded in spring and fall (Figure 4B). Blue chromis and brown chromis were the most abundant pomacentrids at CB and SH (Appendix 2F and G). Herbivorous fish were less abundant than planktivores. The abundance of acanthurids (average 10.7 fish/census) and scarids (average 9.6 fish/census) was also variable across the reef sites (Figures 4C and D). Acanthurids had their highest abundance at SH.

Predatory fishes (piscivores, carnivores) are represented by the serranids, lutjanids and haemulids. As a family, serranids had low abundance (average 4 fish/census) that showed little variation among reef sites (Figure 4E). Serranid diversity was variable among reef sites. The coney, *Cephalopholis fulvus*, was uniformly distributed across reefs (Appendix 1) and relatively common (Appendix 2A-G), however the graysby, *C. cruentatus*, was more frequent in habitats of high topographic complexity (ER, CB, SH). The red hind, *Epinephelus guttatus*, was observed only infrequently at 4 sites (Appendices 1 and 2). Hamlets (genus *Hypoplectrus*) also showed highest diversity levels at SH, ER, EW and WW but not CB. In contrast to serranids, lutjanids showed greater variation in abundance and distribution. The yellowtail snapper, *Ocyurus chrysurus*, and the mahogany snapper, *Lutjanus mahogoni*, were the most common and abundant snappers, however the schoolmaster, *L. apodus*, and the mutton snapper, *L. analis*, were also observed (Appendix 1). No lutjanids were recorded at LB. Haemulid abundance was relatively uniform (average 2.4 fish/census) across reef sites (Figure 4G).

The combined group of Chaetodontidae and Pomacanthidae represent long-lived reef residents with specialized feeding habits (e.g. feeding on cnidarians, sponges). Abundance and diversity of this group varied among reef sites (Figure 4H) and was generally low (2.3 fish/census). Chaetodontids were most frequent and abundant at EW, WW and ER. It is interesting that EW and WW had the highest diversity of butterflyfish (4 and 3 species, respectively) whereas other

reef sites had 2 or 1 species. Only the banded butterflyfish, *Chaetodon striatus*, was recorded from LB and JI, whereas only the foureye butterflyfish, *C. capistratus*, was recorded from CB and SH (Appendix 2).

DISCUSSION

The reefs investigated in this study supported diverse and abundant fish communities. This is not surprising - previous studies have documented well over 200 reef-associated species in St. Croix waters (Clavijo et al. 1980), and over 100 species may occur on a single patch reef (Gladfelter and Gladfelter 1978). For the following discussion, it is important to note that the stationary visual census method does not capture total reef fish diversity (i.e. Appendices 2A to G do not represent complete species lists). Rather, these are quantitative data on the most conspicuous and abundant components of each fish community. The absence of a given species from our observations should be considered "relative" absence. Nonetheless, the average number of species observed per census is a quantitative estimate of community species richness, and a useful measure for comparing reef sites.

The goal of the present study was to document, in an exploratory manner, species-habitat links of coral reef fish populations. This experimental design allows only a preliminary analysis of the relationship between individual fish species (or fish communities) and specific reef attributes (e.g. % live coral, vertical relief, benthic invertebrate community composition, wave exposure, prevailing currents, etc). When fish communities were compared across the seven reef sites, there was no obvious relation of average fish abundance to percentage live coral nor percentage turf algal cover (not shown). Planktivore abundance (blue chromis and brown chromis), on the other hand, may be positively related to percentage live coral cover (e.g. CB and SH; Figure 4B). Species richness showed a more suggestive positive relation to coral cover, although ER represents an important exception. At ER, coral cover is relatively low, but vertical relief is high (a spur and groove area formed of Montastraea skeletons). A relatively high number of fish species was observed at ER. This suggests that the richness of St. Croix reef fish communities may be influenced more by three-dimensional architecture (topographic complexity) of the reef than by the presence of living (versus dead) corals. This idea is not new (Roberts and Ormond 1987), and it has been suggested by results from long-term studies of fish populations at Buck Island, St. Croix (Gladfelter et al. 1992), where hurricane damage and disease permanently reduced live coral cover (Acropora palmata), but left habitat structural complexity relatively intact. Despite the loss of living coral, resident fish populations recovered to pre-hurricane densities.

Nemeth and Herzlieb (2002) suggested that reef sites along St. Croix's northern coast harbor a greater abundance of reef fish than the other reef sites. Our results did not corroborate this finding (see Figure 2 and Figure 4). Neither that study nor this one included sufficient replication of reef sites, adequate spatial coverage of insular reefs, nor control over confounding variables (e.g. topographic complexity) to reach a definitive conclusion. Nonetheless, previous studies indicate that recruitment patterns are highest on St. Croix's northwestern and southeastern shores (Caselle and Warner 1996, and Swearer 2002). Recruitment studies, in

conjunction with community assessments, may clarify a postulated relationship between larval supply and resident reef fish abundance.

Planktivores:

The reef fish communities were numerically dominated by labrids (bluehead wrasse, creole wrasse) and planktivorous pomacentrids (bicolor damselfish, blue chromis, and brown chromis), which were collectively 10 to 100-fold more abundant than all other species. The bluehead wrasse, perhaps the most abundant of all West Indian reef fishes, is a facultative planktivore, and the remaining species feed primarily on zooplankton (Randall 1968).

Large populations of planktivores form a major trophic link between coral reef habitats and open-water communities (e.g. Hobson 1991). Undoubtedly, a large number of these fish fall prey to resident and reef associated predatory fishes. Between spring and fall, bluehead wrasse abundance decreased by ~ 20%, which is suggestive of heavy predation. However we found no relation between planktivore abundance and piscivore abundance (compare Figure 4A and B with 4E and F). Some authors have argued that, rather than predation, the primary trophic link between planktivores and coral reefs is through production of feces, which is then consumed by a wide variety of reef fish and invertebrates (Robertson 1982). Nonetheless, the role of planktivores as forage for commercially and recreationally important species should be investigated further.

Herbivores:

Herbivorous fish were common, moderately abundant, and relatively diverse on all seven reefs. For acanthurids and scarids, average abundance was similar (9.6 fish/176 m² census and 10.7 fish /176 m² census, respectively). In 2001, Nemeth and Herzlieb (2002) censused fish from the same sites using belt transects. When normalized to $100m^2$, the density of acanthurids observed in our study was slightly lower than in theirs (6.0 vs 9.0 fish/100 m²) and the density of scarids observed in this study was substantially lower (5.5 vs 13 fish/100m²). The apparent decline in parrotfish populations is unexplained. Methodological differences between the studies may account for this discrepancy. Alternatively, scarid populations may be in decline due to overfishing – parrotfishes are actively sought by a local gillnet fishery. Given the important trophic role that scarids play in maintaining scleractinian coral growth and diversity (e.g. Pennings 1997), local parrotfish populations should be monitored carefully in the future.

In this study, parrotfishes (especially the redband parrotfish, *Sparisoma aurofrenatum*, and the princess parrotfish, *Scarus taeniopterus*) and surgeonfishes (ocean surgeonfish, *Acanthurus bahianus*, and blue tang, *A. coeruleus*) were nearly ubiquitous among the reef sites. Analysis of their abundance patterns (Figure 4C and D) suggests that their densities were reciprocal. Acanthurids were more abundant on low relief, low coral cover sites (LB, JI, EW, WW) while Scarids were more abundant on reefs with greater topographic complexity (ER, CB, SH). This pattern may arise from differences in feeding mode: acanthurids tend to browse over soft bottoms while scarids are scrapers of hardbottom substrates (e.g. Choat 1991).

Piscivores, Carnivores and Specialized Invertebrate Feeders:

A diversity of predatory fishes was recorded during censuses. The observed species varied in their degree of reef association. For example carangids (bar jack, *Carynx ruber*, and blue runner, *C. crysos*) and scombrids (cero mackerel, *Scomberomorus regalis*) were infrequently observed, in part due to their highly mobility and their loose association with reefs. On the other hand, the coney appears to represent a strongly reef-associated resident species that displayed no habitat preference. This species was the most abundant serranid, occurring with moderate to high frequency at all studied reef sites. The coney is important to both the recreational and commercial fishery of the USVI (Appledoorn et al. 1992; Bolden 1994). The graysby, another frequently observed serranid, showed habitat preference for reefs with a high degree of topographic complexity.

As adults, lutjanids are largely residents of reef habitats. However, the juveniles of many lutjanid species, as well as haemulids and chaetodontids, depend upon "nursery habitats" during their early post-settlement life. On St. Croix for example, Adams and Tobias (1993) documented the importance of an estuarine environment (Salt River) for juvenile schoolmasters (*L. apodus*), french grunts (*Haemulon flavolineatum*), and foureye butterflyfish (*C. capistratus*). Likewise, St. Croix embayments (comprised of patch reef, sand and seagrass habitats) appear to function as important nursery habitats for French grunts and yellowtail snapper (Mateo and Tobias 2001). In our study, adults of these species (but not juveniles) were commonly observed on reefs. For example, adult French grunts were among the most frequently observed fish (~ 80% of all censuses), but no juveniles were observed at these reef sites. For such species, these results serve to underscore the connectivity between adult populations on reefs and juvenile populations residing in nursery habitats.

Nonetheless, it is clear that many of the long-lived reef species were relatively rare. Commercially and recreationally important species such as the red hind (*E. guttatus*) or mutton snapper (*L. analis*) were observed only infrequently (6.1% and 3.7% of censuses, respectively). Some of the larger non-piscivorous reef species such as the french angelfish (*Pomacanthus paru*), queen angelfish (*Holacanthus ciliaris*), or puddingwife (*Halichoeres radiatus*) were also rare in our studies. Formerly, all of the above species were considered "common" on St. Croix reefs (Clavijo et al 1980). Overfishing is the likely explanation for the relative rarity of these species. Establishment of a marine protected area should augment populations of long-lived fish species with high susceptibility to fishing pressures (Bohnsack 1993), such as those discussed above.

Crosby and Reese (1996) have suggested that butterflyfish density is an indicator of reef health. In our study, butterflyfish reached their greatest abundance and diversity at Salt River canyon. This distribution pattern was unique among fishes in our study. Localized abundance at Salt River Canyon may be due to reduced fishing pressure in the immediate vicinity - chaetodontids are readily caught in fish traps (DFW, unpubl. SEAMAP study) or to the proximity of nursery habitat (Salt River Estuary; see Adams and Tobias 1993), which may augment local butterflyfish populations. Alternatively, the chaetodontids species may share a habitat preference for some unidentified feature of the submarine canyon itself.

Recommendations:

Continued monitoring of these seven reef sites should be conducted semi-annually. One or two additional reef sites should be added to include reef fish communities along the southern insular shelf of St. Croix. The visual census method used here is robust and reproducible and should therefore be used in future monitoring efforts. However, a second assessment method, such as the timed random diver swim (TRDS) method, should also be included in the protocol. Sufficient TRDS replicates (performed on an annual or biannual basis) would establish a species lists for each reef site and enable more powerful inferences regarding rare species.

Population assessments of large, resident reef fishes were compromised by the rarity of these fish. This is particularly troublesome because many are commercially and recreationally important species. However, for species such as the Nassau grouper (*Epinephelus striata*), goliath grouper (*E. itajara*), tiger grouper (*Mycteroperca tigris*), black grouper (*M. bonaci*), yellowfin grouper (*M. venenosa*), mutton snapper (*Lutjanus analis*), and cubera snapper (*L. cyanopterus*), populations are probably too low to adequately assess them by any of the aforementioned visual census methods. Instead, future monitoring efforts should be directed towards censusing these species during their annual spawning aggregations (e.g. Colin 1996). Aggregation sites are already known for at least two species on St. Croix (*L. analis* and *E. guttatus*) and these could be monitored using diver surveys or ROV.

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Figure 1. Map of St. Croix showing the seven reef sites where fish visual censuses were conducted. Abbreviations are as follows: Lang Bank (LB), Jacks and Isaacs Bay (JI), East Wall (EW) of Salt River Canyon, West Wall (WW) of Salt River Canyon, Eagle Ray (ER) on Long Reef, Cane Bay (CB), and Sprat Hole (SH).





Figure 2. Summary of fish community structure at seven St. Croix reef sites. A. B.



Species Richness



C.



Figure 3. Fish abundance by family at seven St. Croix reef sites. Error bars show range of average abundance values across sites.



Summary of Fish Abundance

Figure 4. Abundance of fishes representing 8 families at 7 St. Croix reef sites. Families are: A. Labridae (wrasses), B. Pomacentridae (damselfishes), C. Acanthuridae (surgeonfishes), D. Scaridae (parrotfishes), E. Serranidae (groupers), F. Lutjanidae (snappers), G. Haemulidae (grunts), and H. Chaetodontidae (butterflyfishes) and Pomacanthidae (anglefishes). Error bars represent standard deviation.







D.



Figure 4 (continued). Abundance of fishes representing 8 families at 7 St. Croix reef sites.
Families are: A. Labridae (wrasses), B. Pomacentridae (damselfishes), C.
Acanthuridae (surgeonfishes), D. Scaridae (parrotfishes), E. Serranidae (groupers), F.
Lutjanidae (snappers), G. Haemulidae (grunts), and H. Chaetodontidae
(butterflyfishes) and Pomacanthidae (anglefishes). Error bars represent standard deviation.



G.



H.



Reef Site	Lang Bank	Jack's & Isaac's	East Wall (Salt River)	West Wall (Salt River)	Eagle Ray (Long Reef)	Cane Bay	Sprat Hole
Abbreviation	LB	JI	EW	WW	ER	СВ	SH
Location	East	Southeast	North	North	North	Northwest	West
Latitude	N 17° 44.448'	N 17° 44.586'	N 17° 47.221'	N 17° 47.116'	N 17° 45.688'	N 17° 46.433'	N 17° 44.038'
Longitude	W 64° 32.186'	W 64° 34.310'	W 64° 45.445'	W 64° 45.564'	W 64° 41.929'	W 64° 48.810'	W 64° 53.722'
Min. Depth	44	36	32	24	22	24	30
Max. Depth	48	49	45	27	35	36	35
Avg. Depth	45.8	41.7	36.8	25.3	28.0	28.8	32.3
Reef Description ¹	Submarine Hardgounds	Fringing Reef	Sloping Cobble, Canyon Wall	Steep Canyon Wall	Barrier Reef	Shelf- Edge Reef	Shelf- Edge Reef
Vertical Relief	Low	Moderate	Moderate	Low & High	High	High	High
% Cover Live Coral ³	~ 5%	~ 9%	~ 12 %	~ 11%	~ 7%	~ 23%	~ 25%
% Cover Turf Algae ³	Cover Turf Algae 3 ~ 80%~ 50%~ 72%		~ 72%	~ 78%	~ 70%	~ 60%	~ 60%

Table 1. Description of St. Croix reef sites for fish census study.

*notes:

1. After Hubbard (1989a-d)

2. From diver observations (this study)

3. From Nemeth and Herzlieb (2002)

	LB	JI	EW	WW	ER	CB	SH					
Spring 2002												
	1		23. 28-	22. 23-								
Date of Censuses	29-May	11-Jun	May	May	3May	15-May	16-May					
No. of censuses	4	6	6	6	6	6	6					
Total Census Time (min)	91	195	187	190	233	242	255					
Avg Time / Census (min)	22.8	32.5	31.2	31.7	38.8	40.3	42.5					
Fall 2002												
					4 & 6-							
Date of Censuses	3-Sept	4-Sept	6-Sept	12-Sept	Sept	10-Sept	11-Sept					
No. of censuses	6	6	6	6	6	6	6					
Total Census Time (min)	197	179	225	254	309	294	285					
Avg Time / Census (min)	32.8	29.8	37.5	42.3	51.5	49.0	47.5					

Table 2. Fish census effort

					U				
Reef Site	Survey	LB	JI	EW	WW	ER	CB	SH	Total
No. of Fish	Spring '02	1,659*2	1,921	1,755	1,922	2,156	3,120	4,326	16,859
Observed	Fall '02	2,491	1,385	1,456	2,221	2,148	5,443	3,319	18,463
	Total	4,150	3,306	3,211	4,143	4,304	8,563	7,645	35,322
No. of Species	Spring '02	24	39	37	34	40	32	40	72
Observed	Fall '02	28	37	38	42	42	42	40	77
	Cumulative	32	47	47	48	52	44	49	85

Table 3. Total number of fish and species observed during stationary fish censuses^{*1}

Notes:

1. Values reported for Numbers of species are not additive because there is substantial overlap in species compositions among different reef sites and between sampling periods.

2. Total number of fish from 4 replicate censuses.

				Spring '02			Fall '02			
				Avg			Avg			
			Total No.	No.		Total No.	No.		Total	% of
			of Fish	Fish per	% Freq	of Fish	Fish per	% Freq	No.	All
Common Name	Species	Family	Observed	Census	(n=40)	Observed	Census	(n=42)	of Fish	Obs*
bluehead wrasse	Thalassoma bifasciatum	Labridae	7,790	194.8	97.5	5,830	138.8	97.6	13,620	38.6
creole wrasse	Clepticus parrae	Labridae	2,010	50.3	45	3,635	86.5	38.1	5,645	16.0
bicolor										
damselfish	Stegastes partitus	Pomacentridae	1,466	36.7	100	2,485	59.2	100.0	3,951	11.2
brown chromis	Chromis multilineata	Pomacentridae	1,661	41.5	40	2,172	51.7	40.5	3,833	10.9
blue chromis	Chromis cyanea	Pomacentridae	1,864	46.6	75	1,880	44.8	76.2	3,744	10.6
ocean										
surgeonfish	Acanthurus bahianus	Acanthuridae	367	9.2	97.5	287	6.8	97.6	654	1.9
yellowhead			1.62		50 5	1.40		01.0	211	
wrasse	Halichoeres garnoti	Labridae	162	4.1	72.5	149	3.5	81.0	311	0.9
black durgon	Melichthys niger	Balistidae	94	2.4	50	201	4.8	52.4	295	0.8
redband	<i>a</i> . <i>a</i>	a		2.4	0.0	100			202	0.0
parrotfish	Sparisoma aurofrenatum	Scaridae	144	3.6	90	139	3.3	83.3	283	0.8
princess	C	Coordoo	129	25	07 E	120	2.2	057	276	0.9
parroulish	Scarus taeniopterus	Scaridae	158	5.5	87.5	158	3.3	85.7	270	0.8
dusky damselfish	fuscus)	Pomacentridae	150	38	60	100	24	50.0	250	0.7
threespot	juscusj	1 onnacentricae	150	5.0	00	100	2.7	50.0	250	0.7
damselfish	Stegastes planifrons	Pomacentridae	111	2.8	22.5	94	2.2	21.4	205	0.6
coney	Cephalopholis fulvus	Serranidae	97	2.4	72.5	108	2.6	81.0	205	0.6
sergeant major	Abudefduf saxatilis	Pomacentridae	47	1.2	32.5	157	3.7	42.9	204	0.6
blue tang	Acanthurus coeruleus	Acanthuridae	89	2.2	87.5	106	2.5	90.5	195	0.6
french grunt	Haemulon flavolineatum	Haemulidae	93	2.3	82.5	85	2.0	78.6	178	0.5
vellow goatfish	Mulloidichthys martinicus	Mullidae	14	0.4	17.5	158	3.8	23.8	172	0.5
foureye	5									
butterflyfish	Chaetodon capistratus	Chaetodontidae	59	1.5	57.5	61	1.5	54.8	120	0.3
stoplight										
parrotfish	Sparisoma viride	Scaridae	36	0.9	55	62	1.5	64.3	98	0.3
yellowtail	Microspathodon									
damselfish	chrysurus	Pomacentridae	46	1.2	60	48	1.1	52.4	94	0.3

Table 4. The 25 most abundant fish species observed in this study.

				Spring '02	•		Fall '02			
				Avg			Avg			
			Total No.	No.		Total No.	No.			
									Total	% of
			of Fish	Fish per	% Freq	of Fish	Fish per	% Freq	No.	All
Common Name	Species	Family	Observed	Census	(n=40)	Observed	Census	(n=42)	of Fish	Obs*
	Scarus iserti (S.									
striped parrotfish	croicensis)	Scaridae	19	0.5	22.5	73	1.7	40.5	92	0.3
blackbar										
soldierfish	Myripristis jacobus	Holocentridae	45	1.1	35	43	1.0	33.3	88	0.2
yellowtail										
snapper	Ocyurus chrysurus	Lutjanidae	49	1.2	32.5	23	0.5	16.7	72	0.2
mahogany										
snapper	Lutjanus mahogoni	Lutjanidae	23	0.6	12.5	27	0.6	23.8	50	0.1
fairy basslet	Gramma loreto	Grammatidae	11	0.3	10	37	0.9	16.7	48	0.1
		Subtotal =	16,585		Subtotal =	18,098		Subtotal =	34,683	98.2

Table 4 (continued). The 25 most abundant fish species observed in this study.

* percent of all observations (n = 35,322)

		Lang Bank		Jacks		East Wall		West Wall		Eagle Ray		Cane Bay		Sprat Hole		
Common Name	Species	Family	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
ocean	Acanthurus															
surgeonfish	bahianus	Acanthuridae	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Acanthurus															
doctorfish	chirurgus	Acanthuridae	1	1	1	1	1			1		1	1	1		
	Acanthurus															
blue tang	coeruleus	Acanthuridae	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Aulostomus						1	1				1	1		1	1
trumpetfish	maculatus	Aulostomidae					1	I				1	1		1	1
queen triggerfish	Balistes vetula	Balistidae	1	1												
black durgon	Melichthys niger	Balistidae	1	1		1	1	1	1	1	1		1	1		
peacock flounder	Bothus lunatus	Bothidae								1						
	Caranx crysos (C.															
blue runner	fusus)	Carangidae			1											1
bar jack	Caranx ruber	Carangidae			1	1	1	1	1	1		1	1	1	1	1
longsnout	Chaetodon															
butterflyfish	aculeatus	Chaetodontidae					1	1	1	1						
foureye	Chaetodon															
butterflyfish	capistratus	Chaetodontidae					1	I	1	1	1	1	1	1	1	1
spotfin	Chaetodon	Character la sub-la s					1	1								
butterflyfisn	ocellatus	Chaetodontidae					1	I								
butterflufich	Chasto don stristus	Chastadantidaa	1	1	1	1	1	1	1			1				
vellowfin	Chaeloaon striatus	Chaetodontidae	1	1	1	1	1	1	1			1				
mojarra	Garras cinaraus	Gerreidae								1					1	
foiry basslot	Gerres cinereus Gramma lorato	Grammatidaa								1			1	1	1	1
Tally Dassier	Haemulon	Oraminatidae											1	1	1	1
tomtate	aurolineatum	Haemulidae			1	1										
tointate	Haemulon	Haemundae			1	1										
caesar grunt	carbonarium	Haemulidae		1	1	1						1		1	1	
euosui grunt	Haemulon	Thermulture		1	-	1						1		•	1	
smallmouth grunt	chrvsargvreum	Haemulidae			1									1		
	Haemulon				-									-		
french grunt	flavolineatum	Haemulidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1
white grunt	Haemulon plumieri	Haemulidae					1	1		1	1			1		

Appendix 1. Distribution of observations on 85 fish species across seven St. Croix reef sites.

			Lang Bank		Jacks		East Wall		West Wall		Eagle Ray		Cane Bay		Sprat 1	Hole
Common Name	Species	Family	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
bluestriped grunt	Haemulon sciurus Holocentrus	Haemulidae	1			1	1						1	1		
squirrelfish	adcensionis	Holocentridae		1		1		1	1	1		1	1	1	1	
squirrelfish blackbar	Holocentrus rufus	Holocentridae	1	1	1	1	1			1	1	1		1		
soldierfish longjaw	Myripristis jacobus Neoniphon	Holocentridae			1	1		1	1	1	1	1	1	1	1	1
squirrelfish	marianus	Holocentridae												1		
spanish hogfish	Bodianus rufus	Labridae		1	1	1	1				1	1	1	1	1	1
creole wrasse	Clepticus parrae Halichoeres	Labridae				1			1	1	1	1	1	1	1	1
slippery dick yellowcheek	bivittatus Halichoeres	Labridae	1						1							
wrasse vellowhead	cyanocephalus Halichoeres	Labridae		1								1				
wrasse	garnoti Halichoeres	Labridae	1	1	1	1	1	1	1	1	1	1	1	1	1	1
clown wrasse	maculipinna Halichoeres	Labridae	1	1		1										1
puddingwife	radiatus Thalassoma	Labridae			1											
bluehead wrasse	bifasciatum	Labridae	1	1	1	1	1	1	1	1	1	1	1	1	1	1
mutton snapper	Lutjanus analis	Lutjanidae										1				1
schoolmaster mahogany	Lutjanus apodus	Lutjanidae			1	1		1	1	1	1	1		1	1	1
snapper yellowtail	Lutjanus mahogoni	Lutjanidae			1	1								1	1	1
snapper	Ocyurus Chrysurus Malacanthus	Lutjanidae					1	1	1	1	1	1				
sand tilefish	plumieri	Malacanthidae			1	1									1	
scrawled filefish	Aluterus scripta	Monacanthidae			1					1						
orangespotted filefish	Cantherhines pullus	Monacanthidae		1			1	1		1			1	1		

Appendix 1 (continued). Distribution of observations on 85 fish species across seven St. Croix reef sites.

			Lang Bank		Jacl	s	East Wall		West Wall		Eagle Ray		Cane Bay		Sprat Hole	
Common Name	Species	Family	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
	Mulloidichthys															
yellow goatfish	martinicus	Mullidae				1	1	1		1	1	1	1	1	1	1
	Psuedupeneus															
spotted goatfish	maculatus	Mullidae					1			1	1	1				
	Gymnothorax															
spotted moray	moringa	Muraenidae														1
honeycomb	Acanthostracion															
cowfish	ploygonia	Ostraciidae			1	1		1			1				1	
	Acanthostracion															
scrawled cowfish	quadricornis	Ostraciidae	1													
	Lactophrys															
spotted trunkfish	bicaudalis	Ostraciidae										1		1		
	Lactophrys					_										
smooth trunkfish	triqueter	Ostraciidae				1		1				1				1
10.1	Holacanthus	D														
queen angelfish	ciliaris	Pomacanthidae	1													
11	Holacanthus	D (111	1	1	1	1		1	1	1		1			1	1
rock beauty	tricolor	Pomacanthidae	1	1	1	I		1	1	1		1			1	1
E	Pomacanthus	D					1									
French angelfish	paru Alex defdef	Pomacantnidae					1									
concept maion	Abuaejauj	Domocontridoo			1		1	1	1	1	1	1	1	1	1	
sergeant major	saxanns	Poinacentridae	1	1	1	1	1	1	1	1	1	1	1	1	1	1
blue chromis	Chromis cyanea	Pomacentridae	1	1	1	1	1	1	1		1	1	1	1	1	1
1	Chromis	D			1	1			1	1	1	1	1	1	1	1
brown chromis	muitiineata Mississen etherden	Pomacentridae			1	1			1	1	1	1	1	1	1	1
democlfish	Microspainoaon	Domocontridoo		1	1	1	1	1	1	1	1	1	1	1	1	
damsenisn	Chrysurus Stoggatos	Pomacentridae		1	1	1	1	1	1	1	1	1	1	1	1	
	siegusies adustus (S															
duaku damaalfiah	turens)	Domocontridoo			1	1			1	1	1	1	1	1	1	1
dusky damsemsn	juscus) Stogastas	Fomacentinuae			1	1			1	1	1	1	1	1	1	1
beaugragory	laucostictus	Pomacantridaa			1				1		1	1		1		
beaugregory	Stegastes	1 onnacchu idae			1				1		1	1		1		
bicolor damselfish	nartitus	Pomacentridae	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ofcolor damserfish	Parmus	1 onaccini idac	1 1	1	1	1	1	1	1	1	1	1	1	1	1	1

Appendix 1 (continued). Distribution of observations on 85 fish species across seven St. Croix reef sites.

Appendix 1 (continued). Distribution of observations on 85 fish species across seven St. Croix reef sites.

			Lang Bank		Jacks		East Wall		West Wall		Eagle Ray		Cane Bay		Sprat Hole	
Common Name	Species	Family	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
threespot	Stegastes															
damselfish	planifrons	Pomacentridae											1	1	1	1
	Stegastes															
cocoa damselfish	variabilis	Pomacentridae									1	1			1	
	Scarus iserti (S.															
striped parrotfish	croicensis)	Scaridae	1	1	1	1	1	1	1	1	1	1		1	1	1
	Scarus	0 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
princess parrotfish	taeniopterus	Scaridae	1	1	I	I	1	1	l	I	I	1	I	1	1	I
queen parrotfish	Scarus vetula	Scaridae			1				1	1	1		1		1	1
greenblotch	Sparisoma	G : 1						4								
parrotfish	atomarium	Scaridae						1								
un dhan dan annatfiala	Sparisoma	Cooridoo	1	1	1	1	1	1	1	1	1	1	1	1	1	1
redband parroulish	Sparisoma	Scaridae	1	1	1	1	1	1	1	1	1	1	1	1	1	1
redtail parrotfish	chrysonterum	Scaridae		1	1	1				1	1					
vellowtail	Sparisoma	Scandae		1	1	1				1	1					
parrotfish	ruhrininne	Scaridae								1						
stoplight parrotfish	Sparisoma viride	Scaridae	1	1	1	1	1	1	1	1	1	1	1	1	1	1
stophight puriotiish	Pareaues	beuridue	1	1	1	1	1	1	1	1	1	1	1	1	1	1
highhat	acuminatus	Sciaenidae				1										
0	Scomberomorus															
cero mackerel	regalis	Scombridae								1						
spotted	Scorpaena															
scorpionfish	plumieri	Scorpaenidae			1											
	Cephalopholis															
graysby	cruentatus	Serranidae					1	1			1	1	1	1	1	1
	Cephalopholis															
coney	fulvus	Serranidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Epinephelus	~														
red hind	guttatus	Serranidae		1	1		1	1				1				
11	Hypoplectrus	a : 1														1
yellowtail hamlet	chlorurus	Serranidae							1		1					1
shu homlet	nypopiectrus	Somonidaa					1			1					1	
sny namet	guilavarius Hypoplaatrus	Serranidae					1			1					1	
black hamlet	nigricans	Serranidae					1				1			1		1
DIACK HAIHIEL	nigricans	Serranuae			l		1		l		1			1		1

		·	Lang E	Bank	Jack	s	East W	Vall	West V	Wall	Eagle	Ray	Cane	Bay	Sprat I	Hole
Common Name	Species	Family	Spring	Fall	Spring	Fall										
	Hypoplectrus															
barred hamlet	puella	Serranidae								1					1	1
	Hypoplectrus															
butter hamlet	unicolor	Serranidae					1				1					
	Rypticus															
greater soapfish	saponaceus	Serranidae						1								
	Serranus															
tobaccofish	tabacarius	Serranidae						1			1					
harlequin bass	Serranus tigrinus	Serranidae	1	1			1	1	1	1	1	1		1	1	1
	Calamus															
jolthead porgy	bajonado	Sparidae									1					
	Synodus															
sand diver	intermedius	Synodontidae							1							1
	Canthigaster															
sharpnose puffer	rostrata	Tetraodontidae			1			1	1	1	1	1	1	1	1	1
porcupinefish	Diodon hystrix	Tetraodontidae														1
Grand Total =	85 species	Subtotal =	24	28	39	37	37	38	34	42	40	42	32	42	40	40

Appendix 1 (continued). Distribution of observations on 85 fish species across seven St. Croix reef sites.

					Sprin	ng '02 Cer	isus					Fall	'02 Cense	us		
			%							%						
~			Freq	N	lo. of Fi	sh		Size		Freq	N	o. of Fis	sh		Size	
Common	Service	Esseiles	(- 1)	Tetal	A	C4Dara	A	Min	Man		Tatal	A	C4D	A	M:	Ман
Name	Agenthumug	Family	(n=4)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
ocean	Acanthurus	Aconthuridaa	100.0	20	75	26	145	11	17	100.0	61	10.7	20	1/0	10	20
surgeomisii	Acanthurus	Acaminundae	100.0	50	7.5	2.0	14.5	11	17	100.0	04	10.7	2.0	14.0	10	20
doctorfish	chirurgus	Acanthuridae	50.0	2	0.5	0.6	18.0	17	19	33.3	7	1.2	2.0	20.5	17	23
	Acanthurus			_												
blue tang	coeruleus	Acanthuridae	100.0	11	2.8	1.7	16.3	14	19	100.0	24	4.0	1.5	14.7	10	19
queen																
triggerfish	Balistes vetula	Balistidae	25.0	1	0.3	0.5	27.0	27	27	16.7	1	0.2	0.4	20.0	20	20
black durgon	Melichthys niger	Balistidae	100.0	15	3.8	4.2	22.0	20	26	83.3	58	9.7	11.1	21.0	15	30
banded	Chaetodon															
butterflyfish	striatus	Chaetodontidae	25.0	2	0.5	1.0	10.5	10	11	33.3	4	0.7	1.0	12.3	11	14
	Haemulon	TT 1'1	0.0	0	0.0	0.0				167	4	0.0	0.4	20.0	20	20
caesar grunt	carbonarium Haemulon	Haemulidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	20.0	20	20
french grunt	flavolineatum	Haemulidae	100.0	9	23	13	15.8	15	18	667	13	22	22	16.5	14	20
bluestriped	juvouncuum	Haemandae	100.0		2.5	1.5	15.0	15	10	00.7	15	2.2	2.2	10.5	14	20
grunt	Haemulon sciurus	Haemulidae	25.0	1	0.3	0.5	26.0	26	26	0.0	0	0.0	0.0	-	-	-
5	Holocentrus															
squirrelfish	acensionis	Holocentridae	0.0	0	0.0	0.0	-	-	-	50.0	6	1.0	1.3	15.8	10	20
longspine																
squirrelfish	Holocentrus rufus	Holocentridae	100.0	5	1.3	0.5	17.5	17	20	50.0	5	0.8	1.2	16.5	16	17
spanish		T 1 · 1	0.0	0	0.0	0.0				50.0	2	0.5	0.5	14.0	0	17
hogfish	Bodianus rufus	Labridae	0.0	0	0.0	0.0	-	-	-	50.0	3	0.5	0.5	14.3	9	17
alinnamy diak	Hallchoeres bivittatus	Labridaa	50.0	0	2.0	2.4	6.0	5	0	0.0	0	0.0	0.0			
vellowcheek	Halichoeres	Labildae	50.0	0	2.0	2.4	0.0	5	9	0.0	0	0.0	0.0	-	-	-
wrasse	cvanocenhalus	Labridae	0.0	0	0.0	0.0	_	_	_	333	2	03	0.5	18 5	12	25
vellowhead	Halichoeres	Eusilaue	0.0	Ŭ	0.0	0.0				55.5	2	0.5	0.5	10.5	12	25
wrasse	garnoti	Labridae	100.0	11	2.8	1.0	10.5	8	16	83.3	25	4.2	3.1	9.1	4	18
	Halichoeres															
clown wrasse	maculipinna	Labridae	25.0	2	0.5	1.0	9.5	8	11	33.3	15	2.5	4.0	5.5	3	9

Appendix 2A. Fish census data from Lang Bank

			••		Spring	'02 Cens	us		U			Fall	02 Censu	IS		
						_				_%						
G			% Freq	N	lo. of Fi	sh		Size		Freq	N	lo. of Fis	h		Size	
Common	Sanaina.	Escuits	(Tatal	A	C4D	A	Min	Man		Tatal	4	C4Dara	A	Min	Ман
Name	Species	Family	(n=4)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
bluenead	I halassoma	Labridae	100.0	1240	225 0	102 5	2.0	2	0	100.0	1405	224.2	96.2	4.2	2	10
wrasse	Difasciatum Canthanhinan	Labridae	100.0	1540	335.0	102.5	5.0	Z	9	100.0	1405	234.2	80.2	4.5	Z	10
filefish	Caninernines	Monaganthidag	0.0	0	0.0	0.0				22.2	2	0.5	0.8	21.0	17	25
arrowlad	Acanthostracion	Monacantinuae	0.0	0	0.0	0.0	-	-	-	55.5	3	0.5	0.8	21.0	17	23
cowfish	auadricornis	Ostraciidaa	25.0	1	03	0.5	22.0	22	22	0.0	0	0.0	0.0			
cownsii	Holacanthus	Ostractituae	25.0	1	0.5	0.5	22.0	22	22	0.0	0	0.0	0.0	-	-	-
angelfish	ciliaris	Pomacanthidae	25.0	1	03	0.5	25.0	25	25	0.0	0	0.0	0.0	_	_	_
angennsn	Holacanthus	Tomacantinuae	25.0	1	0.5	0.5	25.0	25	23	0.0	0	0.0	0.0			_
rock beauty	tricolor	Pomacanthidae	75.0	3	0.8	0.5	17.7	15	22	33.3	4	0.7	1.0	9.0	3	20
blue chromis	Chromis cvanea	Pomacentridae	75.0	7	1.8	1.5	4.0	3	7	83.3	45	7.5	4.4	4.8	2	8
vellowtail	Microspathodon			-				-							_	Ĩ
damselfish	chrvsurus	Pomacentridae	0	0	0	0	-	-	-	16.7	1	0.2	0.4	12.0	12	12
bicolor	Stegastes		-			-										
damselfish	partitus	Pomacentridae	100.0	171	42.8	18.6	4.0	2	6	100.0	721	120.2	25.6	3.8	2	6
striped	Scarus iserti (S.															
parrotfish	croicensis)	Scaridae	25.0	1	0.3	0.5	24.0	24	24	16.7	1	0.2	0.4	30.0	30	30
princess	Scarus															
parrotfish	taeniopterus	Scaridae	100.0	11	2.8	1.3	16.8	12	21	100.0	28	4.7	1.9	17.2	10	30
redband	Sparisoma															
parrotfish	aurofrenatum	Scaridae	75.0	7	1.8	1.3	14.7	12	18	83.3	16	2.7	1.8	17.0	10	20
redtail	Sparisoma															
parrotfish	chrysopterum	Scaridae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	22.0	22	22
stoplight																
parrotfish	Sparisoma viride	Scaridae	50.0	3	0.8	1.0	27.8	25	30	50.0	7	1.2	1.5	30.7	25	40
	Cephalopholis															
coney	fulvus	Serranidae	100.0	14	3.5	2.4	16.6	14	20	100.0	29	4.8	2.4	15.2	10	22
	Epinephelus			_												
red hind	guttatus	Serranidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	25.0	25	25
harlequin bass	Serranus tigrinus	Serranidae	50.0	3	0.8	1.0	8.3	6	10	16.7	1	0.2	0.4	7.0	7	7
			Total=	1659						Total=	2491					

Appendix 2A (continued). Fish census data from Lang Bank

					Spring	g '02 Cens	sus					Fall	'02 Censu	18		
			% Freq	N	lo. of Fi	sh		Size		% Freq	N	lo. of Fi	sh		Size	
Common										_						
Name	Species	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
ocean	Acanthurus															
surgeonfish	bahianus Acanthurus	Acanthuridae	100.0	74	12.3	5.5	15.0	7	20	100.0	32	5.3	1.2	13.7	6	20
doctorfish	chirurgus Acanthurus	Acanthuridae	50.0	5	0.8	1.2	19.0	17	21	16.7	1	0.2	0.4	18.0	18	18
blue tang	coeruleus	Acanthuridae	100.0	12	2.0	0.9	14.7	8	20	100.0	17	2.8	1.0	11.2	3	17
black durgon	Melichthys niger Caranx crysos	Balistidae	0.0	0	0.0	0.0	-	-	-	33.3	2	0.3	0.5	17.5	15	20
blue runner	(C. fusus)	Carangidae	16.7	1	0.2	0.4	30.0	30	30	0.0	0	0.0	0.0	-	-	-
bar jack banded	Caranx ruber Chaetodon	Carangidae	16.7	2	0.3	0.8	22.5	21	24	16.7	2	0.3	0.8	20.0	20	20
butterflyfish	striatus Haemulon	Chaetodontidae	16.7	4	0.7	1.6	11.0	10	12	16.7	2	0.3	0.8	9.0	8	10
tomtate	aurolineatum Haemulon	Haemulidae	16.7	1	0.2	0.4	19.0	19	19	16.7	2	0.3	0.8	14.5	14	15
caesar grunt smallmouth	carbonarium Haemulon	Haemulidae	16.7	1	0.2	0.4	19.0	19	19	16.7	1	0.2	0.4	16.0	16	16
grunt	chrysargyreum Haemulon	Haemulidae	16.7	3	0.5	1.2	12.0	12	12	0.0	0	0.0	0.0	-	-	-
french grunt bluestriped	flavolineatum Haemulon	Haemulidae	83.3	19	3.2	2.9	18.0	14	23	66.7	9	1.5	1.6	15.5	13	16
grunt	sciurus Holocentrus	Haemulidae	0.0	0	0.0	0.0	-	-	-	16.7	2	0.3	0.8	19.0	18	20
squirrelfish longspine	acensionis Holocentrus	Holocentridae	0.0	0	0.0	0.0	-	-	-	33.3	3	0.5	0.8	19.3	19	20
squirrelfish	rufus Myripristis	Holocentridae	83.3	7	1.2	0.8	19.6	18	22	33.3	2	0.3	0.5	16.5	16	17
soldierfish	jacobus	Holocentridae	66.7	7	1.2	1.2	16.4	16	18	33.3	6	1.0	2.0	13.5	12	15
hogfish	Bodianus rufus	Labridae	33.3	2	0.3	0.5	18.5	17	20	16.7	1	0.2	0.4	6.0	6	6
creole wrasse	Clepticus parrae	Labridae	0.0	0	0.0	0.0	-	_	-	33.3	13	2.2	4.8	10.0	4	15

Appendix 2B. Fish census data from Jacks & Isaacs Bay

Appendix 2B (continued). Fish census data from Jacks & Isaacs Bay

Dev Av		Size	
ev Av			
ev Av			
	Avg	Min	Max
6 9.	9.0	4	15
		-	_
2 3.	3.5	3	5
0			
0 -	-	-	-
c 1	1.0	2	10
.0 4.	4.0	2	10
4 20	20.0	20	20
8 18	18.0	15	20
4 25	25.0	25	25
0 -	-	-	-
0 18	18.0	16	20
4 20	20.0	20	20
8 17	17.0	15	20
4 18	18.0	18	18
~			
0 -	-	-	-
.3 4.	4.3	2	7
		~	
8 5.	5.5	5	6
0 12	12.2	10	12
9 12	12.3	12	15
1 9	8.0	8	8
- 0.	0.0	0	0
0 -	-	_	_
2. 3.). 9.).). 9.).). 9.).). 9.).). 9.). 0.	Dev A 2.6 6 3.2 0 9.6 4 8 1 0 0 2.0 1 0 0 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 1 1 2 1 3 1 3 1 3 1	Dev Avg 2.6 9.0 3.2 3.5).0 - 9.6 4.0).4 20.0).8 18.0).4 25.0).0 - 2.0 18.0).4 20.0).8 17.0).4 18.0).4 18.0).4 18.0).4 5.5).9 12.3).4 8.0).0 -	DevAvgMin 2.6 9.0 4 3.2 3.5 3 0.0 $ 9.6$ 4.0 2 0.4 20.0 20 0.8 18.0 15 0.4 25.0 25 0.0 $ 2.0$ 18.0 16 0.4 20.0 20 0.8 17.0 15 0.4 18.0 18 0.0 $ 9.3$ 4.3 2 0.8 5.5 5 0.9 12.3 12 0.4 8.0 8 0.0 $ -$

					Spring	g '02 Cens	sus					Fall '(02 Census			
			% Freq	N	lo. of Fi	sh		Size		% Freq	N	lo. of Fi	sh		Size	
Common			_							_						
Name	Species	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
bicolor																
damselfish	Stegastes partitus	Pomacentridae	100.0	446	74.3	22.5	5.1	3	7	100.0	400	66.7	31.1	3.8	2	6
striped	Scarus iserti (S.															
parrotfish	croicensis)	Scaridae	16.7	2	0.3	0.8	13.0	12	14	16.7	3	0.5	1.2	10.0	6	18
princess	Scarus															
parrotfish	taeniopterus	Scaridae	83.3	17	2.8	2.8	15.4	8	22	66.7	5	0.8	0.8	21.5	16	30
queen	~ .	~						• •								
parrotfish	Scarus vetula	Scaridae	16.7	2	0.3	0.8	21.0	20	22	0.0	0	0.0	0.0	-	-	-
redband	Sparisoma	a	100.0			1.0		-		100.0		•		1.6.0	10	
parrotfish	aurofrenatum	Scaridae	100.0	24	4.0	1.3	14.2	5	25	100.0	17	2.8	1.6	16.8	10	22
redtail	Sparisoma	G 11	16.7	10	•	1.0	22.0	10	24	1 < 7	1	0.0	0.4	22.0	22	22
parrouisn	chrysopterum	Scaridae	16.7	12	2.0	4.9	23.0	18	24	16.7	1	0.2	0.4	22.0	22	22
stoplight	C	Coordoo	((7	6	1.0	0.0	10.5	15	24	50.0	4	07	0.0	22.7	16	20
parrottish	Sparisoma viriae	Scaridae	66.7	0	1.0	0.9	19.5	15	24	50.0	4	0.7	0.8	22.7	16	30
highbot	Pareques	Saiaanidaa	0.0	0	0.0	0.0				167	2	0.2	0.8	115	0	15
inginiat	Seemaana	Schaemuae	0.0	0	0.0	0.0	-	-	-	10.7	2	0.5	0.8	11.5	0	15
scorpionfish	nlumieri	Scorpaonidaa	167	1	0.2	0.4	27.0	27	27	0.0	0	0.0	0.0			
scorpionitish	Cenhalonholis	Scorpaemuae	10.7	1	0.2	0.4	27.0	21	21	0.0	0	0.0	0.0	-	-	-
coney	fulvus	Serranidae	100.0	32	53	27	18.1	12	25	100.0	19	32	16	16.6	10	25
concy	Fninenhelus	Serraindae	100.0	52	5.5	2.1	10.1	12	25	100.0	17	5.2	1.0	10.0	10	25
red hind	outtatus	Serranidae	167	1	0.2	04	22.0	22	22	0.0	0	0.0	0.0	_	_	_
sharpnose	Canthigaster	Serraindae	10.7	1	0.2	0.1	22.0	22	22	0.0	Ŭ	0.0	0.0			
puffer	rostrata	Tetraodontidae	16.7	1	0.2	0.4	5.0	5	5	0.0	0	0.0	0.0	-	-	-
			Total =	1921						Total =	1385					

Appendix 2B (continued). Fish census data from Jacks & Isaacs Bay

					Spri	ng '02 Ce	nsus					Fal	1 '02 Cen	sus		
			%							%						
			Freq	N	lo. of Fi	sh		Size		Freq	N	lo. of Fi	sh		Size	
Common Name	Species	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
ocean	Acanthurus															
surgeonfish	bahianus	Acanthuridae	100.0	73	12.2	4.4	14.5	12	18	100.0	62	10.3	2.8	13.3	8	18
	Acanthurus															
doctorfish	chirurgus	Acanthuridae	33.3	3	0.5	0.8	20.3	19	23	0.0	0	0.0	0.0	-	-	-
	Acanthurus															
blue tang	coeruleus	Acanthuridae	83.3	18	3.0	0.9	15.4	14	18	100.0	20	3.3	1.6	15.0	10	20
	Aulostomus															
trumpetfish	maculatus	Aulostomidae	16.7	2	0.3	0.8	27.5	25	30	33.3	3	0.5	0.8	42.5	30	50
	Melichthys															
black durgon	niger	Balistidae	83.3	11	1.8	1.5	23.7	20	25	83.3	31	5.2	7.4	21.2	15	25
bar jack	Caranx ruber	Carangidae	33.3	4	0.7	1.0	21.0	14	20	16.7	2	0.3	0.8	19.0	18	20
longsnout	Chaetodon															
butterflyfish	aculeatus	Chaetodontidae	16.7	1	0.2	0.4	8.0	8	8	16.7	3	0.5	1.2	9.0	8	10
foureye	Chaetodon							_							_	
butterflyfish	capistratus	Chaetodontidae	100.0	16	2.7	1.8	9.3	7	11	83.3	18	3.0	2.4	9.0	5	11
spotfin	Chaetodon	~				o. (
butterflyfish	ocellatus	Chaetodontidae	16.7	1	0.2	0.4	16.0	16	16	16.7	1	0.2	0.4	13.0	13	13
banded	Chaetodon		50.0	-	1.0	1.1	10.5	0	10	167	•	0.0	0.0	11.0	1.1	11
butterflyfish	striatus	Chaetodontidae	50.0	6	1.0	1.1	10.5	8	12	16.7	2	0.3	0.8	11.0	11	11
C 1 /	Haemulon	TT 1'1	100.0	11	1.0	0.0	15.2	10	17	100.0	17	2.0	1.0	15 6	10	20
french grunt	flavolineatum	Haemulidae	100.0	11	1.8	0.8	15.3	12	1/	100.0	1/	2.8	1.2	15.6	10	20
	Haemulon	Ha annuli da a	50.0	2	0.5	0.5	22.2	20	25	167	1	0.2	0.4	20.0	20	20
white grunt	piumieri	Haemundae	50.0	3	0.5	0.5	22.3	20	25	10.7	1	0.2	0.4	20.0	20	20
blugstringd grunt	паетиюп	Haamulidaa	167	1	0.2	0.4	22.0	22	22	0.0	0	0.0	0.0			
bluesuiped grunt	Holocontrus	Haemunuae	10.7	1	0.2	0.4	22.0			0.0	0	0.0	0.0	-	-	-
squirrelfish	aconsionis	Holocentridae	0.0	0	0.0	0.0				167	3	0.5	1.2	10.0	18	20
longspine	Holocontrus	Holocelluluae	0.0	0	0.0	0.0	-	-	-	10.7	5	0.5	1.2	19.0	10	20
squirrelfish	rufus	Holocentridae	50.0	5	0.8	1.0	16.2	15	17	0.0	0	0.0	0.0	_	_	_
blackbar	Nyrinristis	Holocellulude	50.0	5	0.0	1.0	10.2	15	17	0.0	0	0.0	0.0			-
soldierfish	iacohus	Holocentridae	0.0	0	0.0	0.0	-	-	-	167	1	0.2	04	18.0	18	18
spanish hogfish	Rodianus rufus	Labridae	167	2	0.3	0.0	11 5	3	20	0.0	0	0.0	0.1	-	-	10
spanish nogrish	Douiunus rujus	Lauridae	10.7	4	0.5	0.0	11.5	5	20	0.0	0	0.0	0.0	-	-	-

Appendix 2C. Fish census data from East Wall, Salt River Canyon

					Sprin	ig '02 Cei	nsus					Fall	l '02 Cens	sus		
			%Freq	Ν	No. of Fi	sh		Size		%Freq	Ν	No. of Fi	sh		Size	
Common			_							_						
Name	Species	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
yellowhead	Halichoeres															
wrasse	garnoti	Labridae	50.0	8	1.3	1.5	9.8	5	14	100.0	22	3.7	2.6	8.6	4	14
bluehead	Thalassoma															
wrasse	bifasciatum	Labridae	100.0	1290	215.0	114.8	3.2	2	9	100.0	820	136.7	61.5	4.8	2	12
	Lutjanus															
schoolmaster	apodus	Lutjanidae	0.0	0	0.0	0.0	-	-	-	16.7	5	0.8	2.0	13.0	10	15
yellowtail	Ocyurus															
snapper	chrysurus	Lutjanidae	100.0	19	3.2	2.1	22.6	17	28	16.7	3	0.5	1.2	21.0	18	24
orangespotted	Cantherhines															
filefish	pullus	Monacanthidae	16.7	1	0.2	0.4	17.0	17	17	16.7	1	0.2	0.4	16.0	16	16
yellow	Mulloidichthys										_					
goatfish	martinicus	Mullidae	16.7	1	0.2	0.4	20.0	20	20	16.7	3	0.5	1.2	19.0	18	20
spotted	Psuedupeneus			_							_					
goatfish	maculatus	Mullidae	50.0	3	0.5	0.5	18.7	16	20	0.0	0	0.0	0.0	-	-	-
honeycomb	Acanthostracion			0	0.0	0.0				1.6 5			0.4	•		
cowfish	ploygonia	Ostraciidae	0.0	0	0.0	0.0	-	-	-	16.7	I	0.2	0.4	26.0	26	26
smooth	Lactophrys		0.0	0	0.0	0.0						07	0.5	150	15	17
trunkfish	triqueter	Ostraciidae	0.0	0	0.0	0.0	-	-	-	66.7	4	0.7	0.5	15.8	15	17
11	Holacanthus	D 111	0.0	0	0.0	0.0				22.2		0.0	0.5	17.5	10	22
rock beauty	tricolor	Pomacanthidae	0.0	0	0.0	0.0	-	-	-	33.3	2	0.3	0.5	17.5	13	22
french	Pomacanthus	D	22.2	2	0.2	0.5	24.5	22	26	0.0	0	0.0	0.0			
angeifisn	paru Abudalah	Pomacantnidae	33.3	2	0.3	0.5	24.5	23	26	0.0	0	0.0	0.0	-	-	-
concept maion	Abuaejauj	Domocontridoo	167	2	0.2	0.0	12.0	12	14	02.2	67	11.2	10.7	110	o	15
sergeant major	saxannis	Poinacentridae	10.7		0.5	0.8	15.0	12	14	03.3 50.0	07	11.2	10.7	11.0	0	15
blue chromis	Chromis cyanea	Pomacentridae	33.3	/1	11.8	24.0	3.0	2	4	50.0	65	10.8	13.9	4.3	3	/
yellowtall	Microspathoaon	D	02.2	F	0.0	0.4	10.4	10	12	<i>((</i> 7)	7	1.0	1.0	11 C	10	12
damselfish	<i>cnrysurus</i>	Pomacentridae	83.3	2	0.8	0.4	12.4	12	13	66.7	/	1.2	1.0	11.6	10	13
Dicolor domoclfich	Stegastes	Democratic	100.0	142	22.0	70	4.0	2	7	100.0	011	25.0	0.1	4.0	2	(
damsemsn	pariius Sogmus isogti (S	Pomacentridae	100.0	145	23.0	1.0	4.0	Z	1	100.0	211	55.2	0.1	4.0	Z	0
surped	scarus iserii (s.	Saaridaa	167	2	0.2	0.8	80	4	10	167	6	1.0	2.4	5.0	4	5
princess	Scarus	Scalluae	10.7	2	0.5	0.0	0.0	4	12	10.7	0	1.0	∠.4	5.0	4	5
princess	taoniontorus	Scaridae	83.3	15	25	21	17.0	14	25	83.3	21	35	23	171	7	25
pariouisi	ideniopierus	Scalluae	05.5	15	2.5	∠.1	17.0	14	23	05.5	<i>∠</i> 1	5.5	2.3	1/.1	/	23

Appendix 2C (continued). Fish census data from East Wall, Salt River Canyon

					Sprir	ng '02 Cei	nsus					Fal	1 '02 Cens	sus		
			%							%						
			Freq	N	lo. of Fi	sh		Size		Freq	N	lo. of Fi	sh		Size	
Common	a .		()													
Name	Species	Family	(n=6)	Total	Avg.	StDev	Avg	Mın	Max	(n=6)	Total	Avg.	StDev	Avg	Mın	Max
greenblotch	Sparisoma	a	0.0	0	0.0	0.0				1.6						
parrotfish	atomarium	Scaridae	0.0	0	0.0	0.0	-	-	-	16.7	4	0.7	1.6	14.5	14	15
redband	Sparisoma	G : 1	02.2	10		1 7	160	10	0.1	02.2	21	25	1.0	17.0		22
parrotfish	aurofrenatum	Scaridae	83.3	13	2.2	1.7	16.9	12	21	83.3	21	3.5	1.9	17.2	11	23
stoplight	Sparisoma	0 1	22.2	2	0.2	0.5	22.5	1.7	20		6	1.0	0.0	10.0	<i>(</i>	22
parrotfish	viride Combalanta lia	Scaridae	33.3	2	0.3	0.5	22.5	15	30	66./	6	1.0	0.9	19.8	6	32
	Cephalopholis	Comonido e	167	1	0.2	0.4	17.0	17	17	167	1	0.2	0.4	10.0	10	10
graysby	cruentatus Combalombolia	Serranidae	10.7	1	0.2	0.4	17.0	1/	17	10.7	1	0.2	0.4	18.0	18	18
200001	Cepnalopholis	Sarranidaa	100.0	15	25	16	16.4	14	10	02.2	15	25	1.0	179	0	24
coney	Juivus Eninankalus	Serrainuae	100.0	15	2.3	1.0	10.4	14	19	05.5	15	2.3	1.9	17.0	0	24
rad hind	Epinepheius	Sorranidaa	167	1	0.2	0.4	25.0	25	25	167	1	0.2	0.4	20.0	20	20
ieu iiiiu	guiiuius Hypoplectrus	Serrainuae	10.7	1	0.2	0.4	23.0	25	23	10.7	1	0.2	0.4	20.0	20	20
shy hamlet	auttavarius	Serranidae	167	1	0.2	0.4	13.0	13	13	0.0	0	0.0	0.0	_	_	_
sity namet	Hypoplectrus	Serraindae	10.7	1	0.2	0.4	15.0	15	15	0.0	U	0.0	0.0			_
black hamlet	nioricans	Serranidae	167	1	0.2	04	14.0	14	14	0.0	0	0.0	0.0	_	_	_
onder muniet	Hypoplectrus	Serraindue	10.7	1	0.2	0.1	11.0	11	11	0.0	Ŭ	0.0	0.0			
butter hamlet	unicolor	Serranidae	16.7	1	0.2	0.4	10.0	10	10	0.0	0	0.0	0.0	_	_	-
greater	Rypticus	Serrainoue	1017	-	0.2	011	1010	10	10	0.0	Ũ	0.0	0.0			
soapfish	saponaceus	Serranidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	15.0	15	15
1	Serranus															
tobaccofish	tabacarius	Serranidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	5.0	5	5
	Serranus															
harlequin bass	tigrinus	Serranidae	16.7	1	0.2	0.4	11.0	11	11	50.0	3	0.5	0.5	7.0	5	8
sharpnose	Canthigaster															
puffer	rostrata	Tetraodontidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	6.0	6	6
			Total=	1755						Total=	1456					

Appendix 2C (continued). Fish census data from East Wall, Salt River Canyon

					Spri	ng '02 Ce	nsus					Fal	ll '02 Cen	sus		
			%							%						
~			Freq	N	lo. of Fis	sh		Size		Freq	N	lo. of Fi	sh		Size	
Common		F 11		T 1							m 1					
Name	Species Name	Family	(n=6)	Total	Avg.	StDev	Avg	Mın	Max	(n=6)	Total	Avg.	StDev	Avg	Mın	Max
ocean	Acanthurus	A (1 1 1	100.0	0.6	16.0	()	12.6	0	17	100.0	10	0.0	4.2	14.0	7	22
surgeonfish	bahianus Acanthurus	Acanthuridae	100.0	96	16.0	6.3	13.6	9	17	100.0	49	8.2	4.3	14.8	1	22
doctorfish	chirurgus	Acanthuridae	0.0	0	0.0	0.0	-	-	-	33.3	3	0.5	0.8	16.5	12	21
	Acanthurus															
blue tang	coeruleus Melichthys	Acanthuridae	83.3	14	2.3	1.6	16.4	14	20	100.0	12	2.0	0.6	16.8	14	20
black durgon	niger	Balistidae	66.7	27	4.5	6.3	23.1	20	26	66.7	44	7.3	8.9	23.0	12	25
peacock				-												-
flounder	Bothus lunatus	Bothidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	12.0	12	12
bar jack	Caranx ruber	Carangidae	16.7	1	0.2	0.4	22.0	22	22	33.3	3	0.5	0.8	29.5	18	40
longsnout	Chaetodon															
butterflyfish	aculeatus	Chaetodontidae	33.3	3	0.5	0.8	6.3	6	7	33.3	3	0.5	0.8	8.0	7	10
foureye	Chaetodon															
butterflyfish	capistratus	Chaetodontidae	100.0	20	3.3	2.3	9.5	4	11	83.3	15	2.5	1.6	9.2	7	12
banded	Chaetodon															
butterflyfish	striatus	Chaetodontidae	50.0	5	0.8	1.0	11.5	11	12	0.0	0	0.00	0.0	-	-	-
yellowfin				_							_					
mojarra	Gerres cinereus Haemulon	Gerreidae	0.0	0	0.0	0.0	-	-	-	16.7	2	0.3	0.8	25.0	24	26
french grunt	flavolineatum	Haemulidae	100.0	17	2.8	1.0	13.8	9	17	83.3	15	2.5	2.4	17.2	15	20
	Haemulon															
white grunt	plumieri	Haemulidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	22.0	22	22
	Holocentrus															
squirrelfish	adcensionis	Holocentridae	33.3	3	0.5	0.8	17.3	15	20	16.7	1	0.2	0.4	18.0	18	18
longspine	Holocentrus															
squirrelfish	rufus	Holocentridae	0.0	0	0.0	0.0	-	-	-	33.3	2	0.3	0.5	16.5	16	17
blackbar	Myripristis															
soldierfish	jacobus	Holocentridae	16.7	1	0.2	0.4	14.0	14	14	16.7	1	0.2	0.4	15.0	15	15
	Clepticus	.		10.6	~~ ~		10 7	0			2.15		5 0 0	1.60	10	•
creole wrasse	parrae	Labridae	66.7	136	22.7	27.0	10.5	8	15	66.7	345	57.5	58.8	16.3	10	20

Appendix 2D. Fish census data from West Wall, Salt River Canyon

					Spri	ng '02 Ce	ensus					Fal	ll '02 Cen	sus		
			%							%						
			Freq	N	lo. of Fis	sh		Size		Freq	1	No. of Fi	sh		Size	
Common	C N.	E		T . (. 1		C(D)		NC.	M		T . (. 1	A	C/D		NC.	М
Name	Species Name	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
slipperv dick	hivittatus	Labridae	167	2	03	0.8	2.5	2	3	0.0	0	0.0	0.0			
vellowhead	Halichoeres	Laundae	10.7	2	0.5	0.8	2.5	2	5	0.0	0	0.0	0.0	-	-	-
wrasse	garnoti	Labridae	33.3	2	0.3	0.5	10.0	10	10	83.3	14	2.3	1.2	9.4	5	15
bluehead	Thalassoma	Luomaue	55.5	-	0.5	0.5	10.0	10	10	05.5	11	2.5	1.2	<i></i>	5	10
wrasse	bifasciatum	Labridae	100.0	1333	222.2	41.8	3.0	1.5	10	100.0	1235	205.8	130.2	4.6	2	10
	Lutjanus															-
schoolmaster	apodus	Lutjanidae	33.3	3	0.5	0.8	22.0	18	25	33.3	2	0.3	0.5	30.0	30	30
yellowtail	Ôcyurus	·														
snapper	chrysurus	Lutjanidae	33.3	20	3.3	5.2	25.0	20	30	50.0	15	2.5	2.8	26.0	21	30
scrawled																
filefish	Aluterus scripta	Monacanthidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	35.0	35	35
orangespotted	Cantherhines			_							_					
filefish	pullus	Monacanthidae	0.0	0	0.0	0.0	-	-	-	50.0	3	0.5	0.5	15.7	15	16
11	Mulloidichthys		0.0	0	0.0	0.0				167		0.7	1.6	17.0	1.6	10
yellow goatfish	martinicus	Mullidae	0.0	0	0.0	0.0	-	-	-	16.7	4	0.7	1.6	17.0	16	19
spotted	Psuedupeneus	Marilli da a	0.0	0	0.0	0.0				167	1	0.2	0.4	20.0	20	20
goatrish	<i>maculatus</i> Holacanthus	Mumdae	0.0	0	0.0	0.0	-	-	-	10.7	1	0.2	0.4	20.0	20	20
rock beauty	tricolor	Pomacanthidae	167	1	0.2	0.4	17.0	17	17	167	1	0.2	0.4	60	6	6
TOCK Deauty	Abudefduf	1 onnacantinuae	10.7	1	0.2	0.4	17.0	17	17	10.7	1	0.2	0.4	0.0	0	0
sergeant major	saxatilis	Pomacentridae	50.0	20	3.3	5.9	11.3	10	14	50.0	20	3.3	4.3	12.8	10	14
blue chromis	Chromis cyanea	Pomacentridae	167	3	0.5	12	4.0	3	5	0.0	0	0.0	0.0	-	-	_
olde ellionno	Chromis	1 onnacentridae	10.7	5	0.5	1.2	1.0	5	5	0.0	Ū	0.0	0.0			
brown chromis	multilineata	Pomacentridae	33.3	41	6.8	14.0	5.3	4	7	33.3	90	15.0	23.5	6.0	4	7
yellowtail	Microspathodon															
damselfish	chrysurus	Pomacentridae	100.0	14	2.3	0.8	10.0	5	12	100.0	17	2.8	1.2	12.1	2.5	15
	Stegastes															
dusky	adustus (S.															
damselfish	fuscus)	Pomacentridae	100.0	39	6.5	10.1	7.9	3	12	83.3	15	2.5	1.8	8.9	7	11
	Stegastes															
beaugregory	leucostictus	Pomacentridae	16.7	1	0.2	0.4	9.0	9	9	0.0	0	0.0	0.0	-	-	-

Appendix 2D (continued). Fish census data from West Wall, Salt River Canyon

					<u>Sprin</u>	<u>g '02 Cen</u>	isus					Fall	'02 Censu	15		
			%Freq	N	lo. of Fis	sh		Size		%Freq	N	lo. of Fi	sh		Size	
Common																
Name	Species Name	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
bicolor	Stegastes															
damselfish	partitus	Pomacentridae	100.0	52	8.7	8.7	5.3	1	12	100.0	220	36.7	10.8	4.4	2	8
striped	Scarus iserti (S.	~		_										• • •		
parrotfish	croicensis)	Scaridae	33.3	2	0.3	0.5	24.5	24	25	50.0	6	1.0	1.3	20.2	15	23
princess	Scarus	a :1		1.6	0.7	•	17.0	10	22	100.0	1.6	0.7	1.6	20.0	1.4	20
parrotfish	taeniopterus	Scaridae	66.7	16	2.7	2.9	17.8	10	22	100.0	16	2.7	1.6	20.9	14	30
queen	G . 1	0 1	167	2	0.5	1.0	24.0	10	21	167	1	0.0	0.4	10.0	10	10
parrotfish	Scarus vetula	Scaridae	16.7	3	0.5	1.2	24.0	18	31	16./	1	0.2	0.4	40.0	40	40
readana	Sparisoma	Saaridaa	100.0	10	2.0	1.0	155	6	20	02.2	20	2.2	20	156	5	22
parrouisn	aurofrenatum Smania ann a	Scandae	100.0	18	5.0	1.9	15.5	0	20	83.3	20	3.3	2.8	15.0	5	23
perrotfish	sparisoma	Scaridaa	0.0	0	0.0	0.0				167	1	0.2	0.4	23.0	23	23
vellowtail	Sparisoma	Scalluae	0.0	0	0.0	0.0	-	-	-	10.7	1	0.2	0.4	25.0	23	23
parrotfish	rubrininna	Scaridae	0.0	0	0.0	0.0				167	1	0.2	0.4	25.0	25	25
stoplight	Sparisoma	Searidae	0.0	0	0.0	0.0	_	-	-	10.7	1	0.2	0.4	25.0	25	25
parrotfish	viride	Scaridae	167	2	03	0.8	15.0	10	20	50.0	5	0.8	1.0	26.0	13	32
cero	Scomberomorus	Souridue	10.7	-	0.5	0.0	10.0	10	20	20.0	5	0.0	1.0	20.0	10	32
mackerel	regalis	Scombridae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	30.0	30	30
	Cephalopholis			-												
coney	fulvus	Serranidae	100.0	19	3.2	1.5	11.5	5	18	100.0	20	3.3	1.0	18.7	12	28
yellowtail	Hypoplectrus															
hamlet	chlorurus	Serranidae	16.7	2	0.3	0.8	12.5	10	15	0.0	0	0.0	0.0	-	-	-
	Hypoplectrus															
shy hamlet	guttavarius	Serranidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	11.0	11	11
barred	Hypoplectrus															
hamlet	puella	Serranidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	10.0	10	10
harlequin	Serranus															
bass	tigrinus	Serranidae	66.7	4	0.7	0.5	8.0	6	9	66.7	10	1.7	1.6	8.9	7	10
	Synodus															
sand diver	intermedius	Synodontidae	16.7	1	0.2	0.4	22.0	22	22	0.0	0	0.0	0.0	-	-	-
sharpnose	Canthigaster															
puffer	rostrata	Tetraodontidae	16.7	1	0.2	0.4	4.0	4	4	50.0	3	0.5	0.5	7.7	4	13
			Total =	1922						Total =	2221					

Appendix 2D (continued). Fish census data from West Wall, Salt River Canyon

					Spr	ing '02 C	ensus	0	2			Fall	'02 Censu	18		
			%		•	C				%						
			Freq	N	lo. of Fi	sh		Size		Freq	Ν	No. of Fi	sh		Size	
Common																
Name	Species	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
ocean	Acanthurus															
surgeonfish	bahianus Acanthurus	Acanthuridae	100.0	54	9.0	1.8	15	12	18	100.0	37	6.2	2.6	12.8	7	16
doctorfish	chirurgus Acanthurus	Acanthuridae	0.0	0	0.0	0.0	-	-	-	16.7	3	0.5	1.2	18.0	16	20
blue tang	coeruleus Aulostomus	Acanthuridae	66.7	6	1.0	0.9	15.625	12	18	83.3	14	2.3	1.8	13.7	8	18
trumpetfish	maculatus Melichthys	Aulostomidae	0.0	0	0.0	0.0	-	-	-	33.3	2	0.3	0.5	41.0	32	50
black durgon	niger	Balistidae	16.7	2	0.3	0.8	23	22	24	0.0	0	0.0	0.0	-	-	-
bar jack foureve	Caranx ruber Chaetodon	Carangidae	0.0	0	0.00	0.0	-	-	-	33.3	7	1.2	2.0	22.5	20	30
butterflyfish banded	capistratus Chaetodon	Chaetodontidae	83.3	11	1.8	1.0	9.2	7	12	83.3	13	2.2	1.2	10.1	9	12
butterflyfish	striatus Haemulon	Chaetodontidae	0.0	0	0.00	0.0	-	-	-	66.7	8	1.3	1.0	11.5	10	15
caesar grunt	carbonarium Haemulon	Haemulidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	30.0	30	30
french grunt	flavolineatum Haemulon	Haemulidae	83.3	10	1.7	1.8	15.8	15	17	100.0	13	2.2	1.0	14.8	12	18
white grunt	plumieri Holocentrus	Haemulidae	33.3	2	0.3	0.5	23	21	25	0.0	0	0.0	0.0	-	-	-
squirrelfish	acensionis Holocentrus	Holocentridae	0.0	0	0.0	0.0	-	-	-	50.0	6	1.0	1.3	19.0	17	31
squirrelfish	rufus Munimistis	Holocentridae	50.0	4	0.7	0.8	18.167	17	20	33.3	2	0.3	0.5	16.0	16	16
soldierfish	Myripristis jacobus	Holocentridae	50.0	19	3.2	4.8	15.167	12	17	83.3	18	3.0	3.6	13.8	10	18
spanish hogfish	Bodianus rufus	Labridae	16.7	1	0.2	0.4	20	20	20	66.7	5	0.8	0.8	11.4	5	25
creole wrasse	Clepticus parrae	Labridae	66.7	96	16.0	12.9	7	3	12	50.0	260	43.3	70.9	6.3	2	15

Appendix 2E. Fish census data from Eagle Ray

					Spr	ing '02 C	ensus					Fall	'02 Censu	18		
			%							%						
			Freq	Ν	lo. of Fi	sh		Size		Freq	1	lo. of Fi	sh		Size	
Common																
Name	Species	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
yellowcheek	Halichoeres															
wrasse	cyanocephalus	Labridae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	15.0	15	15
yellowhead	Halichoeres							_								
wrasse	garnoti	Labridae	100.0	18	3.0	1.4	8.3333	3	15	83.3	29	4.8	3.3	8.6	4	16
bluehead	Thalassoma		100.0						10	100.0					-	
wrasse	bifasciatum	Labridae	100.0	1460	243.3	36.1	4.25	2	10	100.0	805	134.2	75.7	4.6	2	12
mutton snapper	Lutjanus analis Lutjanus	Lutjanidae	0.0	0	0.0	0.0	-	-	-	33.3	2	0.3	0.5	35.0	35	35
schoolmaster	apodus	Lutjanidae	16.7	2	0.3	0.8	17	17	17	16.7	1	0.2	0.4	17.0	17	17
yellowtail	Ocyurus	-														
snapper	chrysurus	Lutjanidae	83.3	10	1.7	1.8	20.1	15	25	50.0	5	0.8	1.2	20.7	20	25
	Mulloidichthys															
yellow goatfish	martinicus	Mullidae	33.3	2	0.3	0.5	23.5	22	25	16.7	7	1.2	2.9	17.0	0	19
spotted	Psuedupeneus															
goatfish	maculatus	Mullidae	50.0	3	0.5	0.5	16.333	14	19	83.3	6	1.0	0.6	17.2	15	20
honeycomb	Acanthostracion										_					
cowfish	ploygonia	Ostraciidae	16.7	1	0.2	0.4	24	24	24	0.0	0	0.0	0.0	-	-	-
spotted	Lactophrys			0	0.0	0.0				1.6 7		• •		12.0	10	10
trunkfish	bicaudalis	Ostraciidae	0.0	0	0.0	0.0	-	-	-	16.7	I	0.2	0.4	13.0	13	13
smooth	Lactophrys	0 / 11	0.0	0	0.0	0.0				167	1	0.0	0.4	14.0	14	1.4
trunkfish	triqueter Holgografius	Ostraciidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	14.0	14	14
roals boouts	notacaninus tricolor	Domesenthides	0.0	0	0.0	0.0				167	1	0.2	0.4	17.0	17	17
TOCK beauty	Abudafduf	Fomacantinuae	0.0	0	0.0	0.0	-	-	-	10.7	1	0.2	0.4	17.0	17	17
sergeant major	savatilis	Pomacentridae	33.3	12	2.0	3 1	11.5	10	14	833	57	0.5	74	117	8	14
blue chromic	Chuomia oranoa	Pomacentri dae	100.0	12	2.0	12.0	11.5	2	0	100.0	200	9.J 22.2	7. 4 11.1	5.0	0	0
blue chionins	Chromis cyanea Chromis	Foinacentinuae	100.0	104	17.5	12.9	4.0007	Z	0	100.0	200	55.5	11.1	5.0	3	0
brown chromis	multilineata	Pomacentridae	167	10	17	4.1	3	3	4	66.7	260	13 3	68 /	3.6	3	6
vellowtail	Microspathodon	i omacentindae	10.7	10	1./	4.1	5	5	4	00.7	200	45.5	00.4	5.0	5	0
damselfish	chrvsurus	Pomacentridae	66.7	7	1.2	1.5	11.25	6	12	33.3	4	0.7	1.2	11.0	8	12

Appendix 2E (continued). Fish census data from Eagle Ray

					Sprir	ng '02 Cei	isus					Fall '	02 Censu	s		
			% Freq	Ν	lo. of Fi	sh		Size		% Freq	N	lo. of Fi	sh		Size	
Common			-							-						
Name	Species	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
	Stegastes															
dusky	adustus (S.															
damselfish	fuscus)	Pomacentridae	83.3	31	5.2	4.0	7.2	5	10	83.3	22	3.7	2.2	8.2	6	12
	Stegastes															
beaugregory	leucostictus	Pomacentridae	66.7	9	1.5	1.5	6.5	4	9	33.3	7	1.2	1.8	9.5	10	12
bicolor	Stegastes															
damselfish	partitus	Pomacentridae	100.0	192	32.0	8.1	4.3333	2	7	100.0	251	41.8	19.6	3.8	2	6
cocoa	Stegastes															
damselfish	variabilis	Pomacentridae	16.7	5	0.8	2.0	6	5	8	33.3	6	1.0	1.7	9.0	5	12
striped	Scarus iserti (S.															
parrotfish	croicensis)	Scaridae	50.0	8	1.3	2.0	16.833	10	21	50.0	20	3.3	5.6	14.0	7	21
princess	Scarus															
parrotfish	taeniopterus	Scaridae	83.3	15	2.5	1.9	17.7	10	26	66.7	13	2.2	2.2	15.5	10	22
queen																
parrotfish	Scarus vetula	Scaridae	16.7	3	0.5	1.2	30	25	35	0.0	0	0.0	0.0	-	-	-
redband	Sparisoma															
parrotfish	aurofrenatum	Scaridae	83.3	21	3.5	2.7	16.9	8	24	83.3	26	4.3	3.1	16.9	10	22
redtail	Sparisoma															
parrotfish	chrysopterum	Scaridae	50.0	4	0.7	0.8	26.5	20	32	0.0	0	0.0	0.0	-	-	-
stoplight	Sparisoma			_				_			_				_	
parrotfish	viride	Scaridae	66.7	5	0.8	0.8	23	5	35	83.3	9	1.5	1.0	25.9	7	40
	Cephalopholis															
graysby	cruentatus	Serranidae	66.7	9	1.5	1.6	16.5	14	25	50.0	4	0.7	0.8	18.7	17	20
	Cephalopholis	~	7 0.0	_				4.0	. –							
coney	fulvus	Serranidae	50.0	7	1.2	1.3	14.667	10	17	66.7	11	1.8	1.6	17.6	12	21
	Epinephelus	a	0.0	0		0.0				1 4 5		• •	0.4	10.0	10	10
red hind	guttatus	Serranidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	18.0	18	18
yellowtail	Hypoplectrus	a	1.4 -		• •	0.4	10	10		0.0		0.0	0.0			
hamlet	chlorurus	Serranidae	16.7	1	0.2	0.4	12	12	12	0.0	0	0.0	0.0	-	-	-
	Hypoplectrus	a	167	1	0.0	0.4	10	10	10	0.0	0	0.0	0.0			
black hamlet	nigricans	Serranidae	16.7	1	0.2	0.4	13	13	13	0.0	0	0.0	0.0	-	-	-
1 1 1.	Hypoplectrus	a :1	167	1	0.0	0.4	11	11	11	0.0		0.0	0.0			
butter hamlet	unicolor	Serranidae	16.7	1	0.2	0.4	11	11	11	0.0	0	0.0	0.0	-	-	-

Appendix 2E (continued). Fish census data from Eagle Ray

					Sprir	ng '02 Cer	15115		<u> </u>			Fall ()? Censu	s		
			% Freq	N	Jo of Fi	ig 02 CCi	1505	Size		% Freq	N	Jo of Fi	sh	3	Sizo	
Common			70 1 1 Cq	1	0.0111	511		SIZC		70 1 1 Cq	1	0.0111	511		SIZC	
Common	C	E		T . (. 1				M	м.		T. (.1				NC.	M
Name	Species	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
	Serranus															
tobaccofish	tabacarius	Serranidae	16.7	2	0.3	0.8	4	4	4	0.0	0	0.0	0.0	-	-	-
	Serranus															
harlequin bass	tigrinus	Serranidae	16.7	3	0.5	1.2	8	7	9	50.0	6	1.0	1.3	6.3	5	8
1	Calamus															
iolthead porgy	bajonado	Sparidae	33.3	2	0.3	0.5	25.5	25	26	0.0	0	0.0	0.0	-	-	-
sharpnose	Canthigaster	1														
puffer	rostrata	Tetraodontidae	33.3	3	0.5	0.8	5.75	5	6	33.3	3	0.5	0.8	5.5	7	7
				0156							0140			•		

Appendix 2	2E (continued).	Fish census	data from	Eagle Ray
rr · ·	(

Total = 2156

Total = 2148

				ppononi	Spring	'02 Censi	16	- cuire	Duj			Eall '0	2 Census			
			0/2		Spring	02 Cellst	15			0/2		1 all 0	2 Cellous			
			70 Erea	N	lo of Fis	h		Sizo		70 Erea	N	lo of Fiel	h		Sizo	
Common			ricq	1	0.01112	511		SILC		ricq	Total	Δνα			SILC	
Name	Species	Family	(n-6)	Total	Δνσ	StDev	Δνσ	Min	Max	(n-6)	No	No	StDev	Δνσ	Min	Max
ocean	Acanthurus	1 annry	(11-0)	Total	11,6.	Sidev	1115	141111	WIUX	(11-0)	110.	110.	SiDev	1115	191111	WIUX
surgeonfish	hahianus	Acanthuridae	100.0	24	4.0	11	147	10	20	100.0	29	18	22	16.0	11	20
surgeomisii	Acanthurus	Acamulatidae	100.0	27	4.0	1.1	17.7	10	20	100.0	2)	 0	2.2	10.0	11	20
doctorfish	chirurous	Acanthuridae	167	1	0.2	0.4	15.0	15	15	50.0	5	0.8	1.0	17.0	15	20
doctorrish	Acanthurus	Acamulatidae	10.7	1	0.2	0.4	15.0	15	15	50.0	5	0.8	1.0	17.0	15	20
blue teng	acarulaus	Aconthuridaa	100.0	13	2.2	0.4	15.8	10	20	66 7	10	17	16	15.3	11	18
once tang	Aulostomus	Acamulatidae	100.0	15	2.2	0.4	15.0	10	20	00.7	10	1.7	1.0	15.5	11	10
trumpetfish	maculatus	Aulostomidae	167	1	0.2	0.4	35.0	35	35	0.0	0	0.0	0.0		_	_
orangespotted	Cantharhinas	Autostolilluae	10.7	1	0.2	0.4	55.0	55	55	0.0	U	0.0	0.0	-	-	-
filefish	nullus	Monacanthidae	33.3	3	0.5	0.8	12.8	12	14	33.3	3	0.5	0.9	15 5	1/	16
mensii	Pullus Melichthys	Wonacantinuac	55.5	5	0.5	0.0	12.0	12	17	55.5	5	0.5	0.7	15.5	17	10
black durgon	nigar	Balistidae	100.0	30	65	64	22.0	12	28	100.0	66	11.0	67	22.7	13	30
bar ioal	niger Canana mili an	Commaidae	160.0	1	0.5	0.4	17.0	12	17	100.0 92.2	11	1 0	1.5	22.7	10	20
bar jack	Caranx ruber Chaotodon	Carangidae	10.7	1	0.2	0.4	17.0	17	17	03.3	11	1.8	1.5	22.0	12	50
huttorflufish	Chuelouon	Chastadontidaa	667	o	12	1.0	11.2	0	15	50.0	5	0.8	1.0	0.7	0	10
butternynsn	capisiraius	Chaetodontidae	00.7	0	1.5	1.0	11.5	0	15	50.0	20	0.8	1.0	9.7	0	10
fairy basslet	Gramma loreto	Grammatidae	50.0	10	1./	2.1	2.7	1	3	66.7	32	5.5	4.6	4.0	2	5
	Haemulon	Ha annuli da a	0.0	0	0.0	0.0				22.2	2	0.2	0.5	21.5	10	25
caesar grunt	carbonarium	Haemulidae	0.0	0	0.0	0.0	-	-	-	33.3	2	0.3	0.5	21.5	18	25
smallmouth	Наетиюп	TT	0.0	0	0.0	0.0				167	2	0.2	0.0	145	14	15
grunt	chrysargyreum	Haemulidae	0.0	0	0.0	0.0	-	-	-	16.7	2	0.3	0.9	14.5	14	15
from all amount	Haemulon	Ha annuli da a	50.0	20	2.2	67	125	10	15	((7	12	2.2	2.2	16.0	10	20
french grunt	Javoineaium	паетипиае	30.0	20	5.5	0.7	15.5	12	15	00.7	15	2.2	2.2	10.0	12	20
white count	nlumion	Haamulidaa	0.0	0	0.0	0.0				167	1	0.2	0.4	19.0	10	19
white grunt	Hamulon	Haemunuae	0.0	0	0.0	0.0	-	-	-	10.7	1	0.2	0.4	16.0	10	10
onuesuiped	naemuion	Haamulidaa	167	2	0.5	1 2	22.0	20	25	167	4	07	16	24.0	20	25
grunt	Holocontrus	Haemunuae	10.7	3	0.5	1.2	22.0	20	23	10.7	4	0.7	1.0	24.0	20	23
aquirralfich	adaensionis	Holocontridao	167	1	0.2	0.4	12.0	12	12	167	2	0.5	12	19.0	16	20
longening	<i>uacensionis</i>	Holocelluluae	10.7	1	0.2	0.4	15.0	15	15	10.7	3	0.5	1.5	16.0	10	20
squirrelfish	rufus	Holocentridae	0.0	0	0.0	0.0				167	1	0.2	0.4	15.0	15	15
blackbar	rujus Myripristis	Holocenuluae	0.0	U	0.0	0.0	-	-	-	10.7	1	0.2	0.4	15.0	15	15
soldiorfish	igoobus	Holocontrideo	167	2	03	0.8	15.0	15	15	22.2	5	0.8	17	17.0	15	20
solulemsn	jucobus	noiocentridae	10.7		0.5	0.0	15.0	15	15	33.3	5	0.0	1./	17.0	15	20

Appendix 2F. Fish census data from Cane Bay

				```	Spring	'02 Censu	IS					Fall '02	2 Census			
			%							%						
			Freq	N	lo. of Fis	h		Size		Freq	N	lo. of Fisl	1		Size	
Common	a :	<b>F</b> 1		<b>T</b> 1				ъ <i>с</i>			Total	Avg.			ъ <i>с</i> :	
Name	Species	Family	(n=6)	Total	Avg.	StDev	Avg	Mın	Max	(n=6)	No.	No.	StDev	Avg	Mın	Max
longjaw	Neoniphon															
squirrelfish	marianus	Holocentridae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	13.0	13	13
spanisn	D - linun milin	Labridae	50.0	2	0.5	0.5	10.7	17	22	22.2	2	0.2	05	25.0	20	20
nogiisn	Clanticus	Labridae	50.0	3	0.5	0.5	19.7	17	22	33.3	Z	0.5	0.5	25.0	20	30
creole wrasse	narrae	Labridae	667	311	51.8	8/1 9	7.0	1	16	50.0	2332	388 7	<i>163 1</i>	4.0	2	18
vellowhead	Halichoeres	Lauridae	00.7	511	51.0	04.9	7.0	1	10	50.0	2332	500.7	405.4	4.0	2	10
wrasse	garnoti	Labridae	667	10	17	16	8.0	5	12	667	24	4.0	43	61	4	15
bluebead	Thalassoma	Labridae	00.7	10	1.7	1.0	0.0	5	12	00.7	27	4.0	7.5	0.1	-	15
wrasse	hifasciatum	Labridae	100.0	722	120.3	43.5	2.3	1	6	100.0	600	100.0	91.0	4.4	2	13
	Lutianus	20011000	10010		12010	1010	2.00	•	U	10010	000	10010	, 110		-	10
schoolmaster	apodus	Lutianidae	0.0	0	0.0	0.0	_	-	-	50.0	5	0.8	1.0	36.2	30	40
mahogany	Lutjanus			÷							-					
snapper	mahogoni	Lutjanidae	0.0	0	0.0	0.0	-	-	-	33.3	4	0.7	1.3	19.5	18	22
yellow	Mulloidichthys	0														
goatfish	martinicus	Mullidae	33.3	5	0.8	1.3	16.8	12	22	50.0	12	2.0	3.4	17.0	12	19
spotted	Lactophrys															
trunkfish	bicaudalis	Ostraciidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	18.0	18	18
sergeant	Abudefduf															
major	saxatilis	Pomacentridae	83.3	10	1.7	1.0	11.8	10	15	83.3	13	2.2	2.1	13.0	10	20
blue chromis	Chromis cyanea	Pomacentridae	100.0	682	113.7	79.0	3.7	1	10	100.0	642	107.0	62.3	5.0	2	10
brown	Chromis															
chromis	multilineata	Pomacentridae	100.0	901	150.2	101.7	4.3	1	8	83.3	1170	195.0	126.2	5.2	2	10
yellowtail	Microspathodon															
damselfish	chrysurus	Pomacentridae	83.3	12	2.0	1.1	9.9	4	14	83.3	13	2.2	1.2	13.3	4	20
	Stegastes															
dusky	adustus (S.							_							_	
damselfish	fuscus)	Pomacentridae	100.0	48	8.0	5.3	8.2	5	12	100.0	36	6.0	2.8	9.8	5	15
	Stegastes														_	_
beaugregory	leucostictus	Pomacentridae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	7.0	7	7
bicolor	Stegastes	D	100.0	227	27.0	14.0	27	1	7	100.0	205	17.5	26.0	1.5	2	0
damselfish	partitus	Pomacentridae	100.0	227	37.8	14.0	3.7	1	1	100.0	285	47.5	26.0	4.5	2	8

Appendix 2F (continued). Fish census data from Cane Bay

			**		Spring '(	02 Census	5					Fall '02	2 Census			
			% Freq	N	o. of Fis	h		Size		% Freq	N	o. of Fisl	h		Size	
Common											Total	Avg.				
Name	Species	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	No.	No.	StDev	Avg	Min	Max
threespot	Stegastes															
damselfish	planifrons	Pomacentridae	50.0	10	1.7	2.0	5.7	3	10	66.7	24	4.0	5.4	7.3	3	11
striped	Scarus iserti (S.															
parrotfish	croicensis)	Scaridae	0.0	0	0.0	0.0	-	-	-	50.0	11	1.8	2.4	8.7	5	25
princess	Scarus															
parrotfish	taeniopterus	Scaridae	100.0	18	3.0	1.1	16.9	10	22	83.3	20	3.3	3.2	19.3	5	30
queen											_					
parrotfish	Scarus vetula	Scaridae	16.7	1	0.2	0.4	32.0	32	32	0.0	0	0.0	0.0	-	-	-
redband	Sparisoma							_								
parrotfish	aurofrenatum	Scaridae	83.3	20	3.3	2.3	17.4	7	24	66.7	14	2.3	1.6	16.8	10	30
stoplight	Sparisoma	~	<b>T</b> O 0	_							. –	• •			_	
parrotfish	viride	Scaridae	50.0	5	0.8	1.2	20.7	6	35	83.3	17	2.8	2.3	27.0	5	35
	Cephalopholis	~		-												
graysby	cruentatus	Serranidae	33.3	2	0.3	0.5	20.0	18	22	83.3	11	1.8	0.8	18.3	15	23
	Cephalopholis	~	<b>T</b> O 0	_					10	<b>T</b> O 0	_					• •
coney	fulvus	Serranidae	50.0	6	1.0	1.1	14.8	12	18	50.0	5	0.8	1.2	17.0	15	20
	Hypoplectrus	a	0.0	0	0.0	0.0				50.0	2	0.5	0.5	0.0		10
black hamlet	nigricans	Serranidae	0.0	0	0.0	0.0	-	-	-	50.0	3	0.5	0.5	9.0	6	12
harlequin	Serranus	a	0.0	0	0.0	0.0				167	4	0.0	0.4	6.0		6
bass	tigrinus	Serranidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	6.0	6	6
sharpnose	Canthigaster		167	1	0.0	0.4	6.0	6		22.2	4	07	1 1			7
putter	rostrata	Tetraodontidae	16.7	1	0.2	0.4	6.0	6	6	33.3	4	0.7	1.1	5.5	4	1
			Total =	3120						Total =	5443					

Appendix 2F (continued). Fish census data from Cane Bay

				penan	Spring	'02 Conc	uuu mon	ii opiui	11010			Eo11 /	2 Concu	9		
			0/		spring	02 Cens	sus					Fall (	J2 Cellsu	8		
			% Erog		Jo of Fi	h		Sizo		0/ Erog		lo of Fi	h		Sizo	
Common			rieq	T	NO. 01 FI:	511		SIZE		% Fleq	1	NO. 01 F1	811		Size	
Namo	Spacias Nama	Family	(n-6)	Total	Ava	StDov	Ava	Min	Mov	(n-6)	Total	Ava	StDov	Ava	Min	Mov
Ivallie	A agenthumug	Failing	(II-0)	Total	Avg.	Sidev	Avg	IVIIII	Wax	(11-0)	Total	Avg.	Sidev	Avg	IVIIII	IVIAX
ocean	Acaninurus hahianna	Aconthumidoo	02.2	16	27	2.1	15 1	10	10	02.2	14	22	22	15 1	10	20
surgeomisii	A canthumus	Acammunuae	05.5	10	2.7	2.1	13.1	12	10	05.5	14	2.5	2.5	13.1	12	20
blue teng	Acumunus	Aconthuridaa	83.3	15	2.5	15	14.4	10	19	83.3	0	15	1.0	16.8	15	20
blue tang	Aulostomus	Acaminundae	65.5	15	2.5	1.5	14.4	10	10	05.5	7	1.5	1.0	10.0	15	20
trumpotfish	Mulosiomus	Aulostomidaa	167	1	0.2	0.4	50.0	50	50	50.0	3	0.5	0.5	247	15	34
uumpettisii	Carany crysos	Autostolliluae	10.7	1	0.2	0.4	50.0	50	50	50.0	5	0.5	0.5	24.7	15	54
blue runner	(C fusus)	Carangidae	0.0	0	0.0	0.0	_	_	_	167	1	0.2	0.4	30.0	30	30
bar jook	(C. Jusus) Canany muhan	Carangidae	22.2	5	0.0	1.6	28.0	26	20	16.7	2	0.2	0.4	21.0	20	20
four ava	Chrantedon	Caraligidae	55.5	5	0.8	1.0	28.0	20	30	10.7	2	0.5	0.8	21.0	20	22
butterflyfish	canistratus	Chaetodontidae	33.3	4	07	1.0	9.0	7	11	833	10	17	0.8	9.6	7	12
vellowfin	cupisiraias	Chaetodontidae	55.5	-	0.7	1.0	9.0	/	11	05.5	10	1.7	0.0	9.0	/	12
mojarra	Garras cinaraus	Gerreidae	167	2	03	0.8	18 5	17	20	0.0	0	0.0	0.0	_	_	
foim bosslot	Cramma loreto	Grammatidaa	16.7	1	0.5	0.0	2.0	2	20	50.0	5	0.0	1.0	4.0	2	5
Tally Dassiet	Haemulon	Graninatidae	10.7	1	0.2	0.4	2.0	2	2	30.0	5	0.8	1.0	4.0	5	5
caesar grunt	carbonarium	Haemulidae	16.7	2	0.3	0.8	17.5	15	20	0.0	0	0.0	0.0	-	-	-
	Haemulon															
french grunt	flavolineatum	Haemulidae	66.7	7	1.2	1.2	15.5	14	17	66.7	5	0.8	0.8	17.0	15	20
	Holocentrus															
squirrelfish	adcensionis	Holocentridae	16.7	1	0.2	0.4	17.0	17	17	0.0	0	0.0	0.0	-	-	-
blackbar	Myripristis															
soldierfish	jacobus	Holocentridae	83.3	16	2.7	2.9	14.2	10	17	50.0	12	2.0	2.3	15.7	14	21
spanish															_	
hogfish	Bodianus rufus	Labridae	16.7	1	0.2	0.4	22.0	22	22	50.0	6	1.0	1.3	15.2	5	25
creole	Clepticus		100.0										• • • •		-	
wrasse	parrae	Labridae	100.0	1467	244.5	252.7	5.5	1	14	66.7	685	114.2	240.1	9.0	2	16
yellowhead	Halichoeres	<b>T</b> 1 · 1	02.2	100	167	21.2	60	•	1.4		10		2.0			10
wrasse	garnoti	Labridae	83.3	100	16.7	31.3	6.3	2	14	66.7	19	3.2	3.0	7.6	4	12
clown	Halichoeres	T .11. 1.	0.0	0	0.0	0.0				167	1	0.2	0.4	11.0	11	11
wrasse	maculipinna Thalasasasa	Labridae	0.0	U	0.0	0.0	-	-	-	10.7	1	0.2	0.4	11.0	11	11
bluenead	I nalassoma	T also da a	02.2	(50)	100.2	70.6	27	1	10	02.2	205	512	21.0	4.0	2	10
wrasse	Difasciatum	Labridae	83.5	650	108.3	/9.0	2.7	1	10	85.5	323	54.2	51.8	4.0	2	10

Appendix 2G. Fish census data from Sprat Hole

					Sprin	g '02 Cen	isus					Fall	'02 Censu	18		
			%							%						
			Freq	1	No. of Fi	sh		Size		Freq	Ν	lo. of Fi	sh		Size	
Common	~					~ ~							~ ~			
Name	Species Name	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
mutton	<b>.</b>		0.0	0	0.0	0.0							0.4	<b>a</b> a a	•	20
snapper	Lutjanus analis Lutjanus	Lutjanidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	38.0	38	38
schoolmaster mahogany	apodus Lutianus	Lutjanidae	16.7	2	0.3	0.8	47.0	40	55	16.7	1	0.2	0.4	40.0	40	40
snapper	mahogoni Malacanthus	Lutjanidae	66.7	20	3.3	5.0	16.3	10	20	100.0	20	3.3	1.6	20.3	15	25
sand tilefish	plumieri Mullaidialathar	Malacanthidae	16.7	1	0.2	0.4	40.0	40	40	0.0	0	0.0	0.0	-	-	-
goatfish	martinicus	Mullidae	33.3	6	1.0	2.0	14.0	12	16	50.0	127	21.2	31.2	14.3	10	24
spotted moray	Gymnothorax moringa	Muraenidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	60.0	60	60
honeycomb	Acanthostracion															
cowfish smooth	ploygonia Lactophrys	Ostraciidae	16.7	1	0.2	0.4	30.0	30	30	0.0	0	0.0	0.0	-	-	-
trunkfish	triqueter Holacanthus	Ostraciidae	0.0	0	0.0	0.0	-	-	-	16.7	1	0.2	0.4	10.0	10	10
rock beauty sergeant	tricolor Abudefduf	Pomacanthidae	33.3	2	0.3	0.5	13.5	12	15	50.0	4	0.7	0.8	18.7	15	22
major	saxatilis	Pomacentridae	16.7	2	0.3	0.8	13.0	13	13	0.0	0	0.0	0.0	-	-	-
blue chromis	Chromis cyanea Chromis	Pomacentridae	100.0	800	133.3	48.9	2.8	1	7	100.0	789	131.5	61.9	4.7	2	9
chromis	multilineata	Pomacentridae	100.0	701	116.8	32.0	4.5	1	7	83.3	650	108.3	70.3	4.8	2	8
damselfish	chrysurus	Pomacentridae	16.7	2	0.3	0.8	10.0	10	10	0.0	0	0.0	0.0	-	-	-
dusky	adustus (S.															
damselfish bicolor	fuscus) Stegastes	Pomacentridae	83.3	29	4.8	3.8	6.4	4	10	66.7	26	4.3	4.4	10.3	7	15
damselfish	partitus	Pomacentridae	100.0	235	39.2	13.6	4.1	1	6	100.0	397	66.2	29.6	4.5	2	10
damselfish	siegasies planifrons	Pomacentridae	100.0	101	16.8	5.7	5.5	3	8	83.3	70	11.7	9.2	8.2	4	15

Appendix 2G (continued). Fish census data from Sprat Hole

					Spri	ng '02 Ce	nsus					Fall 'C	2 Census	5		
			%Freq	N	lo. of Fi	sh		Size		% Freq	N	lo. of Fi	sh		Size	
Common			_							-						
Name	Species Name	Family	(n=6)	Total	Avg.	StDev	Avg	Min	Max	(n=6)	Total	Avg.	StDev	Avg	Min	Max
cocoa	Stegastes															
damselfish	variabilis	Pomacentridae	16.7	1	0.2	0.4	5.0	5	5	0.0	0	0.0	0.0	-	-	-
striped	Scarus iserti (S.															
parrotfish	croicensis)	Scaridae	16.7	4	0.7	1.6	5.0	4	6	83.3	26	4.3	2.7	11.6	4	20
princess	Scarus															
parrotfish	taeniopterus	Scaridae	100.0	46	7.7	5.0	17.2	6	25	100.0	35	5.8	4.0	18.6	5	30
queen																
parrotfish	Scarus vetula	Scaridae	66.7	10	1.7	1.5	26.8	15	45	33.3	2	0.3	0.5	27.5	25	30
redband	Sparisoma															
parrotfish	aurofrenatum	Scaridae	100.0	41	6.8	1.9	16.2	10	25	83.3	25	4.2	2.7	16.0	3	25
stoplight	Sparisoma															
parrotfish	viride	Scaridae	100.0	13	2.2	0.8	21.6	6	40	66.7	14	2.3	2.6	13.5	4	25
	Cephalopholis			_							_					
graysby	cruentatus	Serranidae	66.7	9	1.5	1.4	14.9	12	19	66.7	7	1.2	1.0	16.5	10	22
	Cephalopholis	~							• •						-	
coney	fulvus	Serranidae	16.7	4	0.7	1.6	17.0	15	20	66.7	9	1.5	1.5	16.1	8	22
yellowtail	Hypoplectrus	a :1	0	0	0.0	0.0				167		0.0	0.0	0.0	0	10
hamlet	chlorurus	Serranidae	0	0	0.0	0.0	-	-	-	16.7	2	0.3	0.8	9.0	8	10
	Hypoplectrus	a	167		0.0	0.4	0.0	0	0	0.0	0	0.0	0.0			
shy hamlet	guttavarius	Serranidae	16.7	1	0.2	0.4	8.0	8	8	0.0	0	0.0	0.0	-	-	-
11.1.1.1	Hypoplectrus	C	0.0	0	0.0	0.0				50.0	2	0.5	0.5	10.0	0	11
black namlet	nigricans	Serranidae	0.0	0	0.0	0.0	-	-	-	50.0	3	0.5	0.5	10.0	9	11
barred	Hypopiectrus	Comonidoo	22.2	2	0.5	0.0	125	10	15	167	1	0.2	0.4	10.0	10	10
hamlet	puella S	Serranidae	33.3	3	0.5	0.8	13.5	10	15	10.7	1	0.2	0.4	10.0	10	10
hariequin	serranus	Comonidoo	167	1	0.2	0.4	10.0	10	10	22.2	2	0.2	0.5	7.0	6	0
Dass	Synodus	Serrandae	10.7	1	0.2	0.4	10.0	10	10	33.5	2	0.5	0.5	7.0	0	0
cand divor	synoaus intermedius	Synodontidaa	0.0	0	0.0	0.0				167	1	0.2	0.4	32.0	30	32
sharphose	Canthigaster	Synouonnuae	0.0	0	0.0	0.0	-	-	-	10.7	1	0.2	0.4	32.0	32	32
nuffer	rostrata	Tetraodontidae	33.3	3	0.5	0.8	12	3	5	50.0	6	1.0	13	15	4	6
puller	Diadan hystrix	Totraodontidae	0.0	0	0.5	0.0	4.2	5	5	167	2	0.3	0.8	35.0	+ 25	35
porcupinensn	Diodon nysirix	retraodonidae	0.0	0	0.0	0.0	-	-	-	10.7	Z	0.5	0.8	55.0	33	33

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Total= 4326

Total = 3319