METHODS FOR ASSESSMENT OF CORAL REEF FISH ASSEMBLAGES

Introduction

The objective of the working group concerned with non exploited reef fishes, was to devise a rapid method of assessing such populations of fishes to answer the following questions:

- Can reef fish assemblages from different areas of the same reef be objectively characterised?

- Do reef fish assemblages differ from one reef to another within a group of reefs at approximately the same latitude (for example: Do inshore and offshore reefs of Capricornia differ?).

- Are there latitudinal differences in reef fish assemblages in the Great Barrier Reef Region?

The answer to such questions were considered by the working party to be essential for the rational zoning of reefs and delineation of marine parks from a biological viewpoint, and subsequently monitoring is expected to identify changes in the system.

The techniques adopted were dictated by the following constraints:

- that the methods should be rapidly executed and be carried out using a minimum of man power and specialised equipment;

- that the information obtained be directly relevant to management and zoning problems.

With regard to the latter, two major requirements were identified:

- the need for at least semiquantitative assessment of diversity (i.e. an assessment of the species abundance and occurrence) which could be used to obtain a comparison between assemblages;

- the need to assess localised reef areas in terms of their 'special' values.

It was considered by the working group that such methods were unsuitable, because they either did not meet the requirements of large scale surveys, or were inapplicable in areas of high diversity. A modified semi-quantitative method of assessing reef fish assemblages was therefore considered most appropriate, by limiting the number of species to a 'core group'. Techniques developed by recording species observed along a fixed transect (Brock 1954), or in a fixed swim duration (Jones and Thompson 1978, Summerhays m.s.) were assessed, but due to the problems of identifying and counting such fishes in areas of high diversity even in a small area it was decided to restrict the list to selected species.

The species in Table 2 were chosen from species lists from One Tree Island and Lizard Island prepared by the Australian Museum using the following criteria:

- ease of identification underwater;
- their non-cryptic behaviour and ease of counting;
- their characteristic association with particular coral reef habitats;
- visually dominant species;
- widespread distribution in some regions of the Great Barrier Reef;
- restriction to certain parts of the Great Barrier Reef.

Where possible, whole groups of congenerics were included, because it is easier for the observer to remember and record all members of few genera rather than a few members of many genera. Secondly, because congenerics might also be expected to show habitat segregation on some scale. The list is considered to provide a basis of comparing fish assemblages in the Great Barrier Reef Region.

TABLE 2

ASSESSMENT OF CORAL REEF FISH ASSEMBLAGES - 'THE LOOKERS'

A. Species List

CHAETODONTIDAE:	CHAETODONTIDAE (CONT).
Chaetodon aureofasciatus	*C. lunula*
C. auriga	*C. melanotus*
C. chrysurus	*C. ornatissimus*
C. citrinellus	*C. pelewensis/punctatofasciatus*
C. ephippium	*C. plebeius*
C. ulietensis	*C. rainfordi*
C. flavirostris	*C. semeion*
C. kleini	*C. speculum*
C. lineolatus	*C. trifascialis*

TABLE 2 (CONT).

CHAETODONTIDAE (CONT).

Chaetodon trifasciatus
C. unimaculatus
C. vagabundus
C. bennetti
C. mertensi
C. rafflesi
C. reticulatus
C. baronessa
C. meyeri
Chelmon rostratus
C. morginalis
Forcipiger longirostris
F. flavissimus
Hemitaurichthys polylepis
Coradion altivelis
C. chrysozonus

ACANTHURIDAE

Naso unicornis
N. lituratus
N. annulatus
N. brevirostris
N. vlamingii
N. tuberosus
Zanclus canescens
Zebrasoma scopas
Z. flavescens
Z. veliferum
Acanthurus lineatus
A. dussumieri
A. hepatus
A. olivaceous
A. pyroferus
A. triostegus
A. glaucopareius
A. gahm/mata/xanthopterus

SIGANIDAE

Lo vulpinus
Siganus doliatus
S. puellus
S. lineatus
S. corallinus

LABRIDAE

Epibulus insidiator
Gomphosus varius
Lienardiella fasciata
Thalassoma amblycephalus
T. lunare
T. hardwicki
T. janseni
Thalassoma lutescens
Halichoeres centriquadrus
H. trimaculatus
Hemigymnus fasciatus
H. melapterus
Coris variegata *
C. gaimard
C. aygula

POMACENTRIDAE

Acanthochromis polyacanthus
Abudefduf coelestinus
A. whitleyi
A. saxatilus
A. sordidus
A. bengalensis
Chromis atripectoralis
C. caeruleus
C. atripes
C. lepidolepis
C. weberi (=opercularis)
C. nitida
C. retrofasciata
C. ternatensis

* Due to the difficulty in censusing this species and its ubiquitous habits, it is suggested that this species be dropped from future lists.

TABLE 2 (CONT).

POMACENTRIDAE (CONT.)

Dascyllus reticulatus
D. aruanus
D. trimaculatus
D. melanurus
Glyphidodontops cyaneus
G. rex
G. talboti
G. flavipinnis
G. rollandi
G. biocellatus

POMACENTRIDAE (CONT.)

Neopomacentrus azysron
N. cyanamos
N. anabatoides
Pomacentrus amboinensis
P. australis
P. pavo
P. moluccensis (=popei)
P. coelestis
P. lepidogenys

TABLE 2B

ADDITIONAL SPECIES SUGGESTED FOR THE 'LOOKERS' LIST

MULLIDAE

Mulloidichthys samoensis
M. auriflamma
Parupeneus barbarinus
P. barbarinoides
P. bifasciatus
P. trifasciatus
P. indicus
P. porphyreus

SERRANIDAE

Anthias squamipinnis
Mirolabrichthys tuka

GOBIIDAE

Valenciennes longipinnis
V. strigatus
Ptereleotris evides
P. microlepis

POMACENTRIDAE

Amblyglyphidodon aureus
A. curacao
A. leucogaster
Chromis iomelas

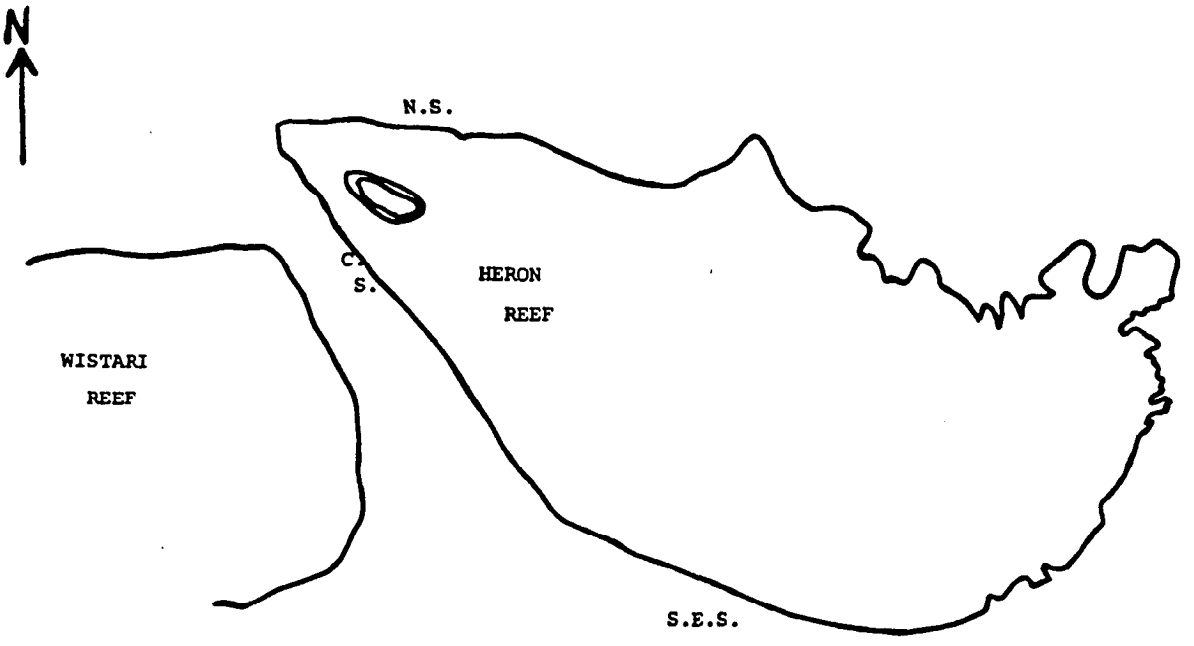
POMACENTRIDAE (CONT.)

Chromis margaritifer
C. lineata
C. vanderbilti
C. xanthura
Dischistodus perspicillatus
P. pseudochrysopocoelius
Paraglyphiododon melas (=melanopus)
P. nigrosis (=behni)
Plectroglyphidodon dickii
P. johnstonianus
Pomacentrus 'melanochir'
P. brachialis (=melonopterus)

LABRIDAE

Cheilinus chlorurus
C. diagrammus
C. fasciatus
C. trilobatus
Choerodon anchorago
C. schoenleini
C. venustus
C. transversalis
C. albigena
Cirrhilabrus temmincki

Fig. 1 - MAP OF HERON REEF SHOWING SAMPLING SITES CHOSEN FOR REEF FISH ASSEMBLAGE TESTING



N.S. NORTHERN SITE
C.S. CHANNEL SITE
S.E.S. SOUTH EAST SITE

5 KILOMETRES

Assessment of reef areas for visual value

Selected species (see Table 4) whose presence in a locality made it particularly appealing to snorkellers and skin divers etc., and which added to the overall 'impact' of an area would also be recorded.

TABLE 4

AESTHETIC APPEAL RATING

The families and species listed below provide an index of aesthetic appeal used in conjunction with the 'Reef Fish Assemblage' sampling techniques. Both are listed by the observer at the end of each 'Reef Fish Assemblage' sample and scored on a three point scale.

Exceptional Events	Appeal Value
Mantas	Serranids
Sharks	Fistularids
Giant Gropers	Aulostomids
Dolphins	Anthiids
Dugongs	Scorpaenids
Large Pelagic's	Pomacanthids
Turtles	Lutjanids
	Amphiprions
	Scarids
	Caesioids
	Ostraciontids

Listed on a scale: -

1	2	3
Rare	Abundant	Common

At the end of each sampling period, these species would be noted as 'rare', 'common' or 'abundant'. Areas of special topographic or other visual interest would also be noted. This information, in addition to the quantitative assessment of the fish assemblages, would be of value in the overall zoning and planning decision.

RESULTS

Initially, the method was tested to evaluate a time base, using presence/absence data only, and species-time counts graph constructed (Fig. 2). On the basis of this evidence, where an asymptote is reached after 40 minutes, a sample time of 45 minutes was identified.

Between site cumulative species were polotted against replicate number, in order to determine the necessary number of replicate samples at any one station. From these results (Figure 2) it was found the 95% of those species present on the list had been noted during five subsamples. Therefore it was considered that five subsamples should be used at each station.

FIGURE 2

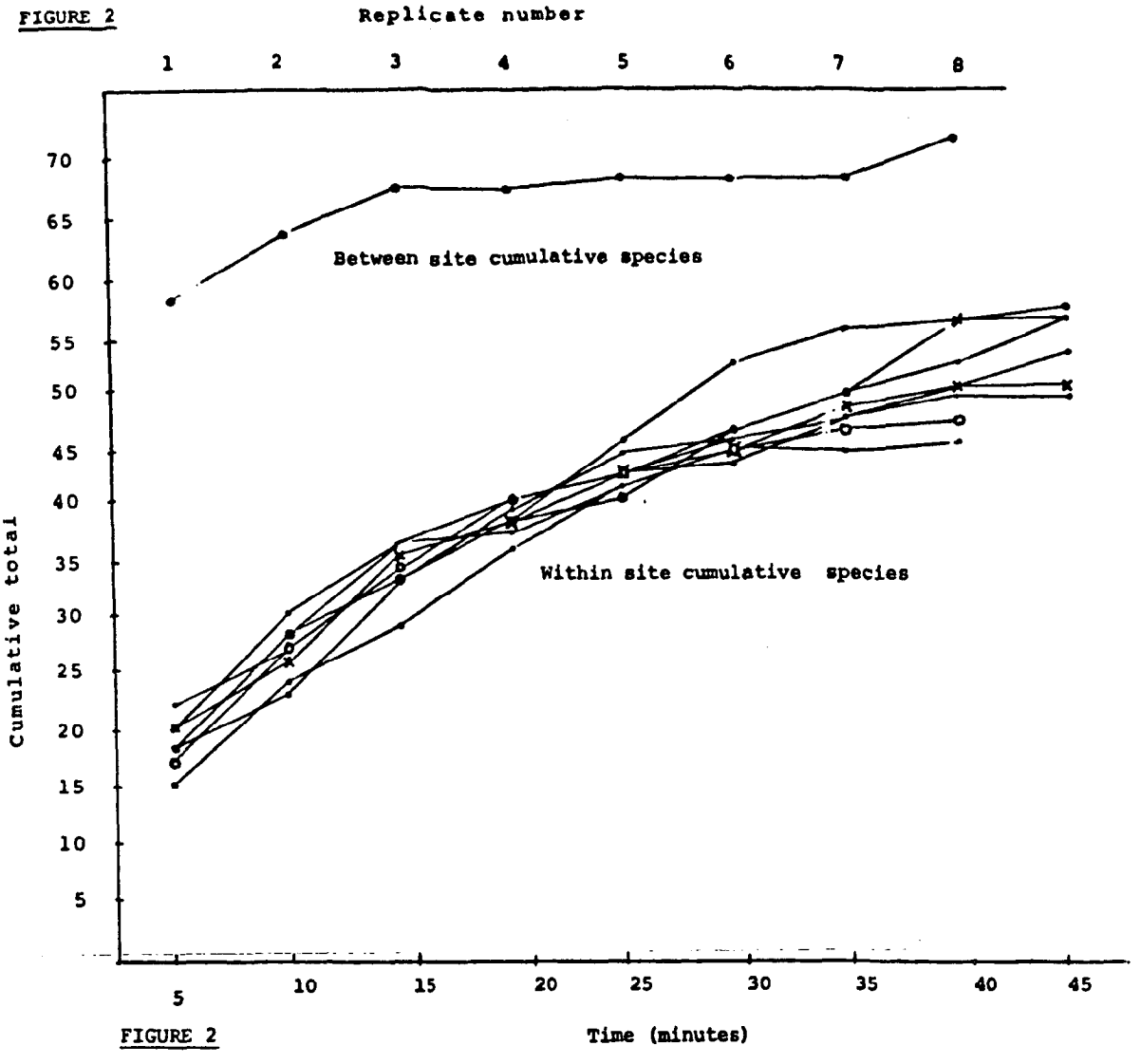


FIGURE 2

To test the feasibility of this method two sites were chosen for comparison, on the northern side of Heron Reef and the rather atypical situation on the southern side on the Heron-Wistari channel. Two sets of five replicates were obtained on the northern side, and one set of five replicates from the channel side (results shown in Tables 5, 6, 7) which allowed comparison with the northern face habitat and between the north and south face habitats. Wilcoxon matched pairs, signed ranks test, and Spearman rank correlation co-efficients were used in the comparison (Table 8). The Wilcoxon matched pairs, signed ranks test showed that the two samples from the north face of Heron Reef were not

significantly different ($p > .18$) and the Spearman rank correlation tests gave a highly significant correlation ($r_s = 0.88$ $p < .001$). Comparing the north face with the channel, the Spearman rank correlation gave a value of $r_s = 0.58$ which is also highly significant ($p < .001$) but less well correlated than the two north face samples.

TABLE 5

HERON ISLAND - NORTH FACE - 24.11.78 - 27.11.78

Species	24/11 BR	24/11 GS	24/11 HS	27/11 GA	27/11 GA		Occ.	Rank
Chaetodon aureofasciatus	2	2	2	4	3	13	65	18.5
C. auriga			1		1	2	4	61.5
C. citrinellus		3	2	3	2	10	40	36.5
C. ulietensis	2					2	2	65
C. flavirostris	2	3	3	3	2	14	70	16
C. kleini	1		3	3		7	21	44
C. lineolatus		1		2	1	4	12	51
C. melanotus	2	2	3	2		9	36	38
C. ornatissimus			2			2	2	65
C. pelewensis/punctatofasciatus		2		2		4	8	57.5
C. plebeius	3	3	1	3	2	12	60	22.5
C. rainfordi	4	3	4	4	5	20	100	10
C. speculum	1	1			1	3	9	54
C. trifascialis	2	2	4	3	1	12	60	22.5
C. trifasciatus	2	2		3	3	10	40	36.5
C. unimaculatus	2	1	2	2		7	28	41
C. vagabundus	2		2	2		6	18	46.5
C. baronnessa	2	2	2		2	8	32	40
Chelmon rostratus	2	2	1	1	1	7	35	39
Forcipiger flavissimus			2	2	2	6	18	46.5
Coradion chrysozonus	1			1	1	3	9	54
Naso unicornis	2	2	3	3	2	12	60	22.5
N. brevirostris	2	2			1	5	15	48.5
N. annulatus					1	1	1	69
N. tuberosus	2	2				4	8	57.5
Zanclus canescens	2	2	3	2	3	12	60	22.5
Zebrazoma scopas	2	3	3	3	4	15	75	14
Z. veliferum				2	2	4	8	57.5

TABLE 5 (CONT)

Species	24/11 BR	24/11 GS	24/11 HS	27/11 GA	27/11 GA		Occ.	Rank
Acanthurus dussumieri		2				2	2	65
A. gahm (group)		1			3	4	8	57.5
A. lineatus		1				1	1	69
Siganus doliatus	2	2	3	2	2	11	55	28
S. puellus		1				1	1	69
S. lineatus					3	3	3	63
S. corallinus	1	2			2	5	15	48.5
Epibulus insidiator	1	2	1	2		6	24	43
Gomphosus varius	2	3	3	3	4	15	75	14
Lienardella fasciatus	3	1	3	3	3	13	65	18.5
Thalassoma amblycephalus	4	3	4		1	12	48	32.5
T. lunare	4	3	6	6	6	23	115	7.5
T. hardwicki	4	3	2	3		12	48	52.5
T. janseni	3	2	2	2	2	11	55	28
T. lutescens	4	3	4	3	3	17	85	12
Halichoeres centriquadrus	3	2	3	3	2	13	65	18.5
Hemigymnus fasciatus	3	3	4	3	2	15	75	14
H. melapterus	3	3	4	4		14	56	25.5
Coris variegata	3	2	4		4	13	52	30.5
C. gaimardi		1	1		1	3	9	54
C. aygula	1	1	2		1	5	20	45
Acanthochromis polyacanthus	4	4	4	4	3	19	95	11
Abedufduf coelestinus	2	1	2	4	2	11	55	28
A. whitleyi	5	5	5	6	3	24	120	5.5
A. saxatilus	3			4	2	9	27	42
Chromis atripectoralis	3	5	5	4	5	22	110	9
C. caeruleus		1	5			6	12	51
C. atripes	1	1	2			4	12	51
C. weberi			5			5	5	60
C. nitida	6	6	6	6	6	30	150	1
C. retrofasciatus	1	1				2	4	61.5
Dascyllus reticulatus		2	5	4	3	14	56	25.5
Glyphidodontops rex	1					1	1	69
G. talboti	4	2	1	3	3	13	65	18.5
G. flavipinnis	2	3	5		3	13	52	30.5
G. rollandi	4	1	4		2	11	44	34.5
Neopomacentrus azysron	6	5	6	6	4	27	135	3.5
Pomacentrus amboinensis	5	4	5	5	4	23	115	7.5
P. australis		2	2	3	4	11	44	39.5

TABLE 6 (CONT).

	BR	GS	HS	GA	BR		Occ.	Rank
Naso unicornis	2	3	3	3	3	14	70	22.5
N. lituratus		1	1	1	2	5	20	49.5
N. annulatus	2					2	2	63.5
N. brevirostris	3	2	3			8	24	48
N. tuberosus	3	2	2	3	2	12	60	32
Zanclus canescens	2	3	2	3	3	13	65	27.5
Zebrazoma scopas	3	3	4	3	4	17	85	15
Z. veliferum	2				2	4	8	56
Acanthurus dussumieri			1	2		3	6	59
A. pyroferus			1			1	1	66.5
A. gahm (group)	3	2	3	3	3	14	70	22.5
Siganus doliatus	2	2	2	2	2	10	50	38.5
S. puellus		2	1			3	6	59
S. corallinus	2		2	2	2	8	32	46.5
Epibulus insidiator				2	2	4	8	56
Gomphosus varius	2	3	3	3	3	14	70	22.5
Leinardella fasciatus	3	2	2	4	1	12	60	32
Thalassoma amblycephalus	2	3	4	3	5	17	85	15
T. lunare	5	4	5	4	5	23	115	7.5
T. hardwicki	3	3	2	2	3	13	65	27.5
T. janseni	2	2	1	2	3	10	50	38.5
T. lutescens	4	4	4	4	3	19	95	9.5
Halichoeres centriquadrus	2	3	2	2	2	11	55	35
Hemigymnus fasciatus	3	3	4	3	4	17	85	15
H. melapterus	3	3	4	3	4	17	85	15
Coris variegata	4	3	4	3	4	18	90	11.5
C. gaimardi			2	1	1	4	12	52.5
C. aygula		1		1	2	4	12	52.5
Acanthochromis polyacanthus	3	3	3	4	3	16	80	18
Abedufduf coelestinus	4	3	2	1	2	12	60	32
A. whitleyi	6	5	6	6	6	29	145	3
A. saxatilus	2	2	2	3		9	36	44
Chromis atripectoralis	6	5		3	4	18	72	20
C. weberi	1		4			5	10	54
C. nitida	6	6	6	6	6	30	150	1.5
C. ternatensis		1				1	1	66.5

In addition to the northern and southern sites at Heron Island reef, five samples were taken at a station 1,000 metres from the southern tip of the reef on the S.E. side on December 1 1978 (Table 9). These samples were compared with northern and southern sites using *Simple Matching Coefficients* (Sokal and Sneath 1963) which utilises only presence or absence information and, *Morisita's Index of Overlap* as modified by Horn (1966). This method of analysis compares the similarity between two habitats with respect of the distribution of individuals among the species present. With both these indices the minimum and maximum values are 0 and 1 respectively; the higher the value, the greater the similarity between the faunas of any two habitats. (See Table 10A and 10B). In terms of both species presence/absence (Table 10A) and the respective abundance of these species (Table 10B) it can be seen that the fish fauna of the *South-East Face* is substantially less similar to the *channel* fauna than to the *Northern Face* fauna.

TABLE 9	Observer			Observer	
SOUTH EAST FACE	G. Stroud			S. Summerhays	
Sample No.	1	2	3	4	5
Chaetodon aureofasciatus	2				1
C. auriga	1	3	2		2
C. chrysurus					
C. citrinellus		2			
C. ephippium					
C. ulietensis					
C. flavirostris	3	3	3	3	3
C. kleini	2	2	2		2
C. lineolatus	2		2		3
C. lunula					
C. melanotus	2	3	3	3	3
C. ornatissimus					
C. pelewensis/punctatofasciatus	1	2		2	
C. plebeius	1	2	2	3	2
C. rainfordi	2	3	4		3
C. semeion					
C. speculum			1		
C. trifascialis		1		1	
C. trifasciatus	2		2		2
C. unimaculatus	1	2		2	2
C. vagabundus	1		2		2
C. bennetti					
C. mertensi	2				

TABLE 9 (CONT.)

	Observer G. Stroud			Observer S. Summerhays	
Sample No.	1	2	3	4	5
LABRIDAE					
Epibulus insidiator	3				
Gomphosus varius	2	2	1	1	3
Lienardiella fasciata	2				1
Thalassoma amblycephalus	2		4		2
T. lunare		3	4	3	4
T. hardwicki		2	3	3	2
T. janseni	3	2	3		
Thalassoma lutescens	3	3	3	4	3
Halichoeres centriquadrus	2	2	2	3	2
H. trimaculatus					
Hemigymnus fasciatus	2	3	3	3	4
H. melapterus	2	3	3	4	4
Coris variegata		2	3		
C. gaimard					
C. aygula		1			
POMACENTRIDAE					
Acanthochromis polyacanthus		2	2	4	4
Abudefduf coelestinus		1	2		2
A. whitleyi		3	4	2	5
A. saxatilus				1	
A. sordidus					
A. bengalensis					
Chromis atripectoralis	5				
C. caeruleus				1	
C. atripes					
C. lepidolepis					
C. weberi (=opercularis)			2		2
C. nitida		6	5	6	6
C. retrofasciata				1	
C. ternatensis					
Dascyllus reticulatus	2	2	2	3	3
D. aruanus					
D. trimaculatus				1	
D. melanurus	2				
Glyphidodontops cyaneus			1		

TABLE 9 (CONT.)

	Observer G. Stroud			Observer S. Summerhays	
Sample No.	1	2	3	4	5
POMACENTRIDAE (CONT.)					
Glyphidodontops rex	5	2	2		2
G. talboti					
G. flavipinnis					
G. rollandi	4	3	3	4	3
G. biocellatus					
ADDITIONAL SPECIES					
MULLIDAE					
Mulloidichthys samoensis					
M. auriflamma					
Parupeneus barbarinus					
P. barbarinoides					
P. bifasciatus					
P. trifasciatus					
P. indicus					
P. porphyreus					
SERRANIDAE					
Anthias squamipinnis					
Mirolabrichthys tuka					
GOBIIDAE					
Valenciennes longipinnis	2				
V. strigatus					
Ptereleotris evides		3		3	4
P. microlepis				2	
POMACENTRIDAE					
Amblyglyphidodon aureus					
A. curacao		2	2	1	
A. leucogaster					
Chromis iomelas	3				
C. margaritifer					
C. lineata	1				
C. vanderbilti					
C. xanthura					