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Biology of *Chromis insolatus* along a depth gradient (30-45 m) at Salt River, Canyon, St. Croix (OCTOBER 30 - NOVEMBER 5, 1980)

by

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Introduction

Fishes from many different families may forage together in the water column over coral reefs. Particularly dense aggregations of water column foragers have been observed over ledges or submarine terraces (Davis and Birdsong 1973 and Hobson 1974). Accordingly, these fishes may play a direct role in the transfer of oceanic productivity (i.e. plankton) to reef based food webs. Preliminary studies at Cane Bay St. Croix indicate that the guild of water column foragers is tightly structured with a high degree of vertical and horizontal stratification by species in the water column. (Johnson and Gladfelter, in prep.) Figure 1 depicts the relative spatial distribution of the most common species feeding above the drop off at Cane Bay. Analysis of stomach contents confirms that many of the fishes foraging in the upper depths do indeed feed on predominantly oceanic plankton along this steep seaward slope (Table 1).

Although the water column foragers extend well below 30 m, our knowledge of the composition and habits of these fishes in deeper water is extremely fragmentary due to the limitations of surface based diving. This is especially true for *Chromis insolatus* which is seldom observed above 30 meters. Emery's 1973 study of *C. insolatus* in the Florida Keys provides the only data available on its behavior and feeding.

This research was initiated to determine the composition and density of water column foraging fishes below 30 m with particular emphasis on the resource utilization patterns of *Chromis insolatus*.

Figure 1. Stratification pattern of the nine most abundant species foraging in the water column over the drop-off at Canebay, St. Croix.

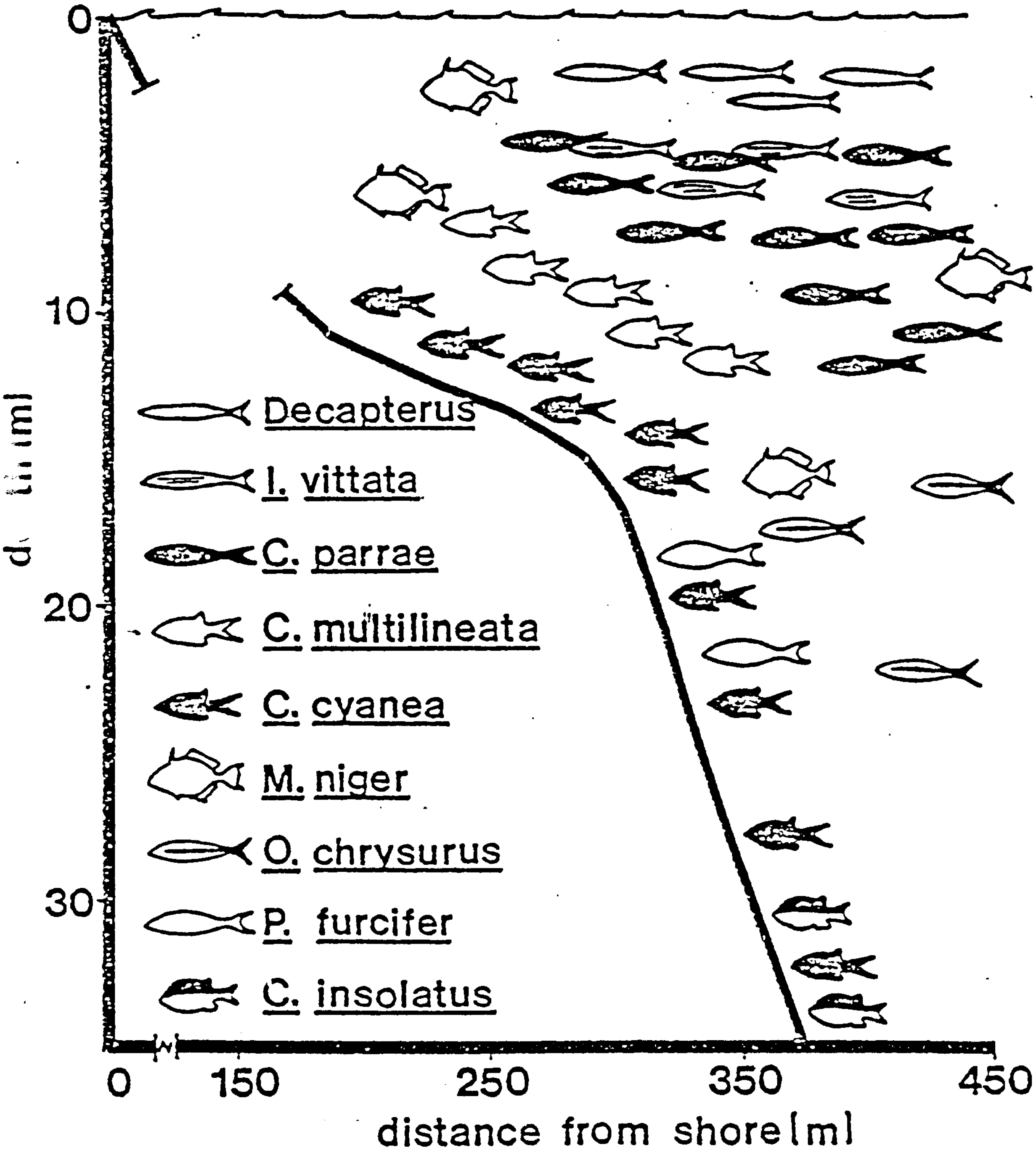


Table 1 - Gut Contents of Fishes Foraging in the Water Column Over the Cane Bay Drop Off

Gut Contents (% by volume)

Species	N	Calanoids	Larvaceans	Ostracods	Siphonopores	Trichodesmium	Feces	Other
Clepticus parrae (Creole wrasse)	24	42		14	31			Pteropods (5), Chaetognaths (5), Harpacticoids (2)
Chromis multilineata (Brown chromis)	13	77	12	+				Pteropods (1), Harpacticoids (1)
Chromis cyanea (Blue chromis)	9	10	32			55		Fish eggs (1)
Paranthias furcifer (Creole fish)	10						39	Gastropods (1), Gel. zoopl. (45), Hyperiids (3)
Inermia vittata (Boga)	2	96						Pteropods (1)
Caranx ruber (Bar jack)	2					+		Pteropods (1), Crust. larvae
Melichthys niger (Black durgon)	5				8		69	Pteropods (1), Plant (18)
Abudefduf saxatilis (Sergeant major)	8		+			+	50	Plant (20)
Chromacentrus partitus (Bicolor damsel)	6	+				98		

Site Description:

The study was conducted from the Hydrolab Saturation Habitat located in Salt River submarine canyon, St. Croix. The study site was located on the east wall of the canyon approximately 50 m beyond the spar buoy "E" at the point at which the canyon meets the shelf edge. A steep drop-off extends from depths of 15 m to at least 45 m. One hundred meter transect lines were marked along the 30, 40 and 45 m contours. In this area the dense coral coverage at 15-20 m gradually gives way to more widely separated coral outcrops separated by sand, silt and cobbles. These outcrops are dominated by *Agaricia* and often support large sponges and black corals (*Antipathes*) up to 2 m long.

Techniques:

Descriptions of fish distribution are based on over 100 hours of underwater observation from October 30 to November 5, 1980. estimates of fish abundance along the depth gradient are based on visual census by divers swimming at 25, 28, 31, 34, 37, 40, 43 and 46 m depths. All pomacentrids sighted at depths within 1.5 m of the transect depth were recorded on underwater plastic scrolls (Ogden 1977). Additional observation time was used to record home range and height above substrate, and to describe feeding, schooling and territorial defense.

Twenty-one *Chromis insolatus* were collected at 130' by speargun or poisoning (quinaldine or rotenone). These fish were sent to the surface via a rope shuttle. Fish were then immediately injected with a 50% formalin solution and stored in 10% formalin. The stomachs were removed and stored in 5% formalin within 24 h of capture. The items in each gut were counted and identified to taxonomic group. The proportional contribution of each category of prey item was determined on the basis of total number, estimated volume and frequency of occurrence.

Plankton tows were made at 40 m utilizing a half meter conical net of 0.125 mm mesh towed by two divers to insure that the samples were taken within 1 m of the substrate where the *C. insolatus* were feeding. Each tow was a round trip of 200 m - out and back along the marked 40 m contour line at an average speed of 30 cm/sec. Assuming a 90% net efficiency (Tranter 1968), each tow strained 35 cubic meters. The bucket of the plankton net was tied off under water and the entire net sent to the surface via rope shuttle where the sample was preserved in a mixture of 5% formalin buffered with betaglycerophosphate, 5% propyleneglycol and 0.5% propylene phenoxytol in distilled water (Steedman 1976). Densities of zooplankton groups were obtained from volumetric subsampling with replacement as outlined in Youngbluth (1976). Settled volume was determined for each sample.

Results:

Distribution and Behavior.

Over 2000 fish were counted in the water column along a 100 meter section of the east wall of Salt River submarine canyon between 25 and 46 m (Table 2). At these depths only damselfish (Pomacentridae) were observed actively feeding in the water column. Figure 2 reveals that each species of *Chromis* has a distinctive pattern of distribution along the depth gradient. *Chromis insulatus* first appears along this depth gradient at 34 m and is the dominant diurnal plankton feeder at depths of 40 m to at least 46 m along this drop off. The two dominant shallow water species, *C. multilineata* and *C. cyanea*, were abundant along the 25 and 28 meter transects, but this seems to be the lower limit for brown chromis. Although the blue chromis is most abundant above 40 m, its range extends at least to 46 m, and individuals were sighted at depths considerably below divers swimming at 46 m.

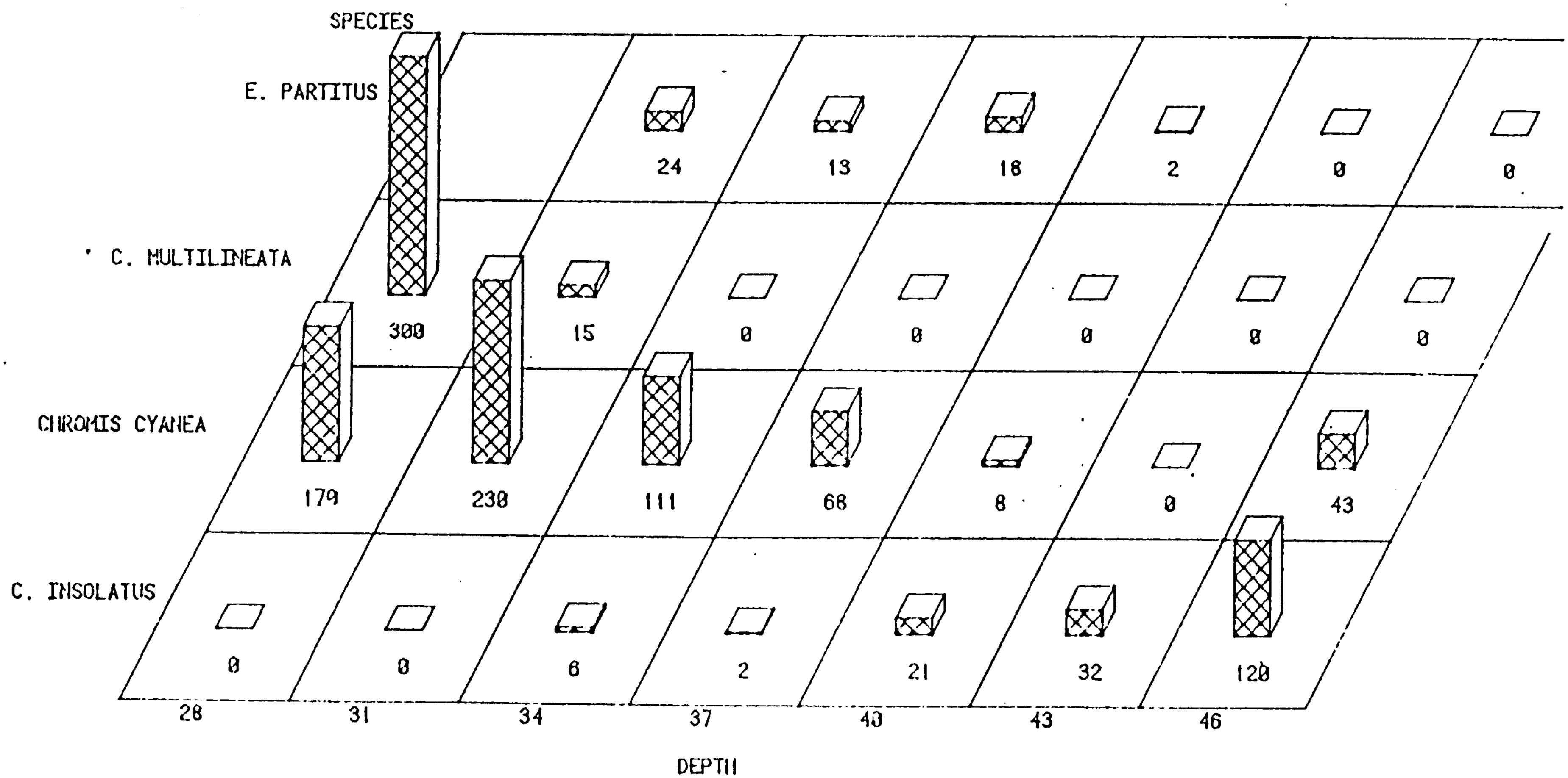
The olive chromis were restricted to the isolated coral outcrops and absent from intervening areas of sediment or rubble. Up to ten large adults occupied individual territories on the small outcrops (usually 1-2 m^2 in area) and were not observed more than 50 cm away from the substrate in any direction. Territories were defended against other adult olive chromis while most other species in the area i.e., *E. partitus* and *Gramma loreto* were ignored. While direct aggression toward *C. cyanea* was not observed, adults of these two species were seldom found together

Table 2 - Fish abundance along 100 m long transects vs. depth.

	25m	28m	31m	34m	37m	40m	43m	46m	total
Chromis insolatus	0	0	0	6	2	21	32	120	175
C. cyanea	500+	170	230	111	68	8	0	43	1130+
C. multilineata	500+	300+	15	0	0	0	0	0	815+
E. partitus	Abun-dant	16	24	13	18	2	0	0	73+
Total	1000+	486	269	130	88	31	32	163	2193

Figure 2. Abundance of pomacentrid fishes between 28 and 46 m along the dfrop off at Salt River Submarine Canyon, October 31 - November 4, 1980. The counts represent all fishes (both juveniles and adults) sighted by divers along 100 m transects at each depth.

FIGURE 3.


SPECIES
E. PARTITUS
C. MULTILINEATA
CHROMIS CYANEA
C. INSOLATUS
300
24
13
18
2
0
0
15
0
0
0
0
0
179
230
111
68
8
0
43
0
0
6
2
21
32
120
28
31
34
37
40
43
46
DEPTH

on the same outcrop. When they were on the same outcrop the more mobile blue chromis seemed to forage in a layer above the *C. insolatus*.

The juveniles and sub-adult olive chromis are non-territorial and school together in groups of 5-30 individuals. There is a strict segregation between adults and the smaller size classes--each found on separate outcrops. Juveniles were always sighted within 10-20 cm of the substrate.

Feeding:

Both adult and juvenile C. insolatus were positioned in the water column just above the substrate where they seemed to pick individual items out of the plankton. These observations are confirmed by examination of stomach contents of the twenty-one fishes collected (Table 3). The diet consists entirely of planktonic organisms. Larvaceans (Oikopleura sp.) were consumed by all fish examined and were numerically the dominant prey item. However, a wide variety of organisms also contributed significantly to the diet. The planktonic blue-green alga (= cyanobacterium) Trichodesmium, pelagic eggs, and various copepods were quite commonly eaten although they seldom accounted for over 20% of the diet in any individual. The foraminiferan Globergerina was also a significant dietary item and was the dominant prey of fishes collected in the afternoon of November 2.

Plankton availability may be estimated from the plankton tows taken at the same times and locations as the fish samples within one meter of the substrate (Table 4). The overall density of zooplankton was quite variable on this exposed shelf edge within the four day sampling period. Although there were significant changes in the actual species composition from day to day, the relative abundance of the major zooplankton categories was relatively constant. If the relative proportions of prey items are compared to their relative abundance in the plankton samples (Figure 3) it is obvious that these fishes are selecting specific types of prey and avoiding others (Figure 3). The most numerous potential prey are copepods, and these were indeed consumed by all

Table 3 - Percent OCCURRENCE

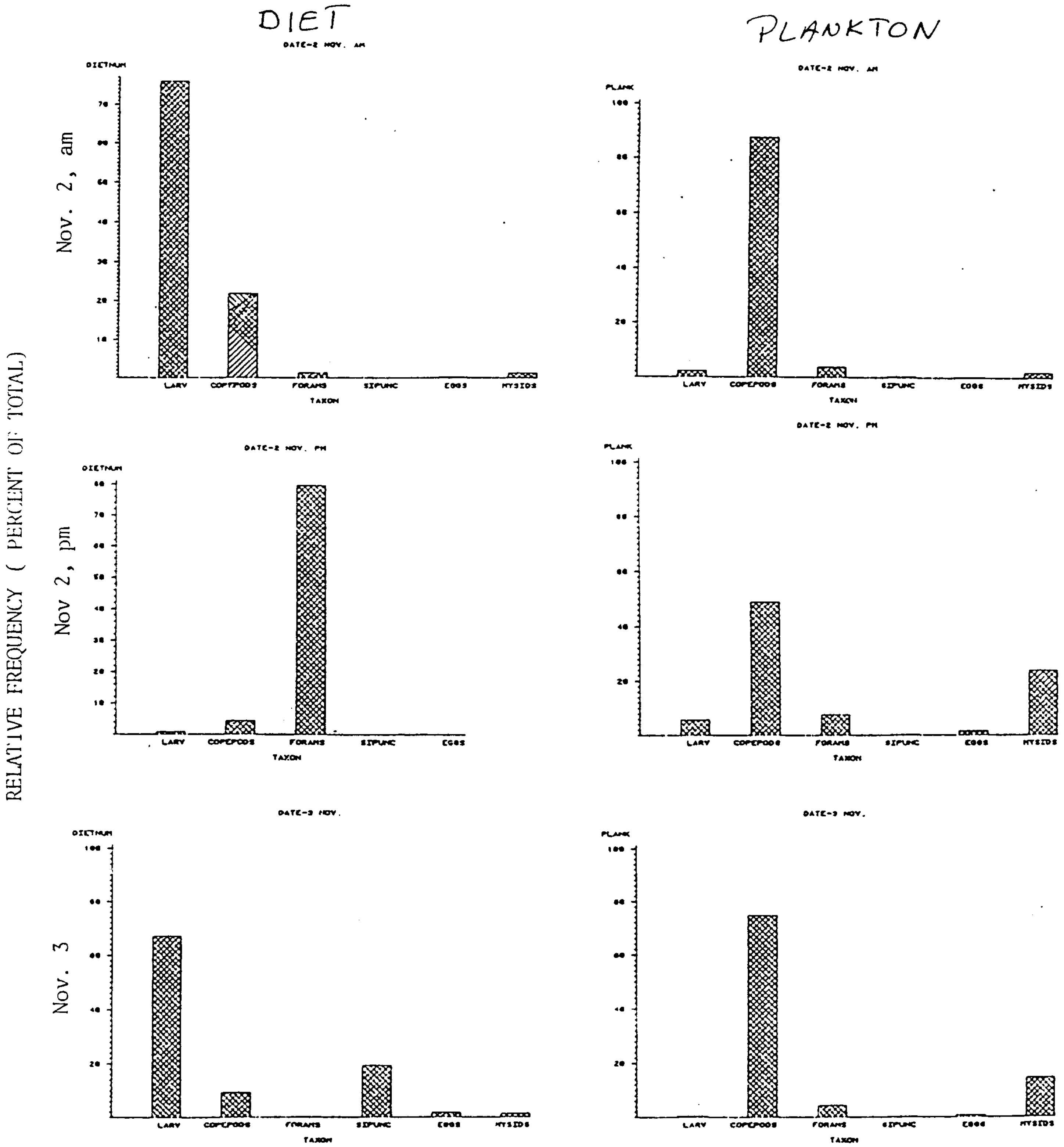
Percent by volume and percent of total number of taxa of prey items in diet of *Chromis insolatus*.

	% occurrence	% of volume	% of total
Pelagic algae (*Trichodesmium*)	85.7	7.6	- -
Foraminifera	52.4	9.0	3.6
Larvacea	100	51.2	70.6
Copepoda	100	13.7	12.2
Calanoida	90.5	6.6	4.9
Cyclopoida	100	6.9	6.4
Harpaetocoida	52.4	0.5	0.8
Other Crustacea	42.8	1	0.6
Mysidacea (fragments)	19.0	0.1	0.2
Ostracoda	19.0	0.1	0.3
Decopoda (larvae)	14.3	0.1	0.1
Cladocera	4.8		0.1
Isopoda	9.5		0.1
Sipunculida (larvae)	42.9	10.5	10.2
Polychaeta	57.1	1	1.7
Siphonophora	14.3	1	0.2
Eggs	71.4	3.4	1.4
Unidentified	- -	4.8	

Table 4 - Density and relative abundance (percent of total of major categories of zooplankton collected one meter above substrate at a depth of 40 m.

TAXON	2 Nov 1980 10:00		2 Nov 1980 16:05		3 Nov 1980 15:40		4 Nov 1980 10:45		Mean for 4 samples	
	#/m^3	% of total								
Larvacea	5.2	(2.4)	1.8	(5.8)	0.6	(0.4)	6.9	(2.6)	3.6	(2.8)
Copepoda	192.1	(83.1)	14.9	(49.0)	118.4	(74.9)	217	(83.6)	135.6	(73.9)
Foraminifera	8.6	(3.9)	2.4	(7.8)	7.1	(4.5)	19.4	(6.5)	9.4	(5.7)
Sipunculid larvae	1.1	(0.5)	0.1	(0.3)	0.3	(0.2)	1.1	(0.4)	0.6	(0.4)
Mysids	4.4	(2.0)	7.3	(24)	23.5	(14.8)	8.6	(3.3)	11.0	(6.6)
Planktonic eggs	0.5	(0.2)	0.5	(1.7)	1.3	(0.8)	0	(0)	0.6	(0.3)
Other	7.1	(2.9)	3.4	(11.4)	6.8	(4.4)	8.0	(3.6)	6.3	(3.8)
Total density (#/m)	219		30.4		158		261		167	
Settled Volume (ml)	11.0		3.5		8.0		9.5			

Figure 3. Comparison of zooplankton in *Chromis insolatus* guts with plankton tows taken at the same time and depth. Relative abundances of both plankton and gut contents is based on number of individuals counted.



of the fishes examined. However, they accounted for less than 15% of the total diet overall and never exceeded 20% for any individual fish. Although mysids were relatively common, only a few fragments were found in the guts. Conversely, the dominant prey, Oikopleura constituted only 3% of the plankton. Pelagic eggs and spunculid larvae were rather rare in the water but significant in the diet.

Additional information on prey selectivity may be obtained from the copepods since many of these could be identified from the stomachs (Table 5). Oithona sp. was consistently the most dominant copepod and the most abundant single species in the plankton, yet it was never encountered in the C. insolatus stomachs. However, the cyclopoid genera Corycaeus and Onceae were disproportionately more abundant in the guts than in the plankton.

Table 5 - Comparison of specific Copepod groups in the diet relative to their abundance in the plankton. The number eaten is the total from all 21 fishes. Plankton density is the average of the four plankton samples.

	Copepods in stomachs		Copepods in Plankton	
	# eaten	% of Copepods	(#/m)	% of Copepods
Cyclopoids	190	54.8	95.6	77.8
Oithona Sp.	0	0	87.0	70.8
Corycaeus concinus	89	25.6	2.5	2.0
Corycaeus crassiusculus	32	9.2	1.6	1.3
Onceae Spp.	63	18.2	3.4	2.8
Other Cyclopoids	6	1.7	1.1	0.9
Calanoids	145	41.8	26.8	21.9
Harpaeticoids	12	3.4	0.5	
Microsetella rosea	8	2.3	0.4	
Macrosetella gracilis	0		0.1	0.4
Miracia	4	1.2	<0.1	
Total =	347		$122.9/m^3$	

Discussion:

Chromis insolatus is the dominant species of water column forager present along the shelf edge between 38 and 46 m at Salt River submarine canyon. Bray (1981) and Johnson and Gladfelter (in prep.) have shown that this guild of plankton feeding fishes is a instrumental pathway of energy transfer from the largely pelagic planktonic community to the reef based food webs. Indeed, the unusually high density of fishes in the region of steep seaward drop offs along the shelf edge may be attributable to the availability of oceanic or off-shore productity. The data presented here on fish density and diet would indicate that *Chromis insolatus* constitutes an important link in this transfer. The species identified from olive chromis stomachs seem to be typical oceanic species. For example the copepods *Microsetella rosea* and *Miracia* are conspicuous components of offshore plankton collections (Michel and Foyo 1976 and Wickstead 1965, respectively), and Bjornberg (1963) considered *Onceae venusta* to be "a good indicator" of oceanic water.

This exploitation of oceanic productivity must be significant to the reef escosystem both in terms of secondary productivity and as nutrient enrichment from fecal and urinary wastes. Since *C. insolatus* is the most numerous and conspicuous fish between 38 and 46 m, it could be quite important in supporting the piscivorous fishes seen here, most notably the groupers, snappers and jacks. Emery (1973) witnessed olive chromis being consumed by groupers per (*Epinephelus grattatus*). Indirect enrichment of reef- building corals has been demonstrated in shallow water (<5 m) where the schools of grunts (Haemulon spp.) significantly increased the growth rates of Acropora palmata and Porites furcata on St. Croix (Meyer et al. 1983). Fecal material represents rapid a trophic transfer between planktonic productivity and benthic reef invertebrates. Bray et al. (1981) determined that the plankton feeding blacksmith (Chromis punctipinnis) deposted 8 grams of carbon per square meter of reef per year off of southern California. The density of Chromis insolatus at Salt River varies from near zero over areas of sand and ruble to over forty fish on a reef of 2-4 m^2 area. The overall fecal contribution of C. insolatus in the 1600 m^2 area between 38 and 46 m is estimated as 381 g carbon/year when using the Bray et al (1981) algorhythm for daily fecal production as a function of body weight. Thus fecal production at these depths averages only 0.24 $g/m^2/yr$ for the total area, but this is concentrated on the isolated outcrops and may well constitute an important food source in this habitat.

Chromis insolatus consumes a wide variety of planktonic organisms. Emery (1973) reports a diet of Oikopleura, Trichodesmium, copepods and eggs for olive chromis collected in the Florida Keys. The studies here confirms these as the major dietary components and adds Globegerina and sipunculid larvae to this list. The inclusion of the foraminiferan Globegerina is rather surprising since it was not reported a a major constituent of the diet in any fish sampled in Randall's (1967) extensive survey of feeding habits of fishes in the Virgin Islands. Overall the diet consists of a remarkable variety of small (<2mm) organisims, at first glance, one might be tempted to call this species a "plankton generalist." But when the relative proportions of prey items is compared with the composition of the plankton available, it is clear that C. insolatus are anything but random feeders. The major prey, Oikopleura never exceed 6% of the total numbers in zooplankton samples from the same location. Similarly, Globegerina, eggs and sipunculids were highly favored food items even when present in extremely low densities. In the case of copepods, prey selectivity is notable down to the genus level where the relatively rare Corycaeus, Onceae and Microsetella were commonly eaten-to the total exclusion of the dominant copepod, Oithona.

The basis for this selectivity is not known. The guts contained only realtively small items < 2mm which probably excludes the larger taxa such as mysids, shrimps and siphonophores on the basis of size alone. Only rare fragments of these prey were found in the stomachs. The eggs, sipunculid larvae and foraminiferaus have little mobility and may therefore represent relatively easy prey even when sighted at a distance. Hamner et al. (1975) have reported that certain species of Oikopleura have quite effective escape responses while others do not. The species of Oikopleura eaten by C. insolatus could not be determined from their condition in stomachs, but whatever escape mechanisms they might have afforded little protection from olive chromis.

Selectivity of specific copepods is more difficult to analyse, but may be partially based upon pigmentation. Miracia, Microsetella, Corycaeus and Onceae are among the most brightly colored of tropical copepods and thus may be far more visible to fishes than are other more transparent or drab copepods (ie. Oithona). Zaret and Kerfoot (1975) showed that the freshwater atherinid planktivore Melaniris chagresi selected prey according to pigmentation. Ware (1971) and Eggers (1977) point out that although fish possess color vision, color itself may be less significant than overall luminance contrast between an object and its background. This is even more likely at the low levels of illumination at depths where C. insolatus feeds, especially considering the narrow band of wavelengths available. Here the heavy pigmentation of the preferred copepods may make them more visible when viewed against the surface illumination. Observation suggest that C. insolatus "picks" individual items out of the water column in short, quick motions. They do not pursue their prey more than a body length on most occasions. Their prey selectivity seems to be based upon visual discrimination of specific prey as they move past the fishes in the water column.

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APPENDIX A. EQUIPMENT AND DOCUMENTATION

1. Personnel.

Participants	Duties on Mission
William S. Johnson Goucher College Towson, MD. 21204	Principal Investigator Acquanaut Team Leader
Jeffrey M. Davidson National Heart and Lung Institute National Institutes of Health Bethesda, MD 20205	Acquanaut: Fish census and behavioral observations
Stephen S. Hamilton 1509 S. Street NW Washington, D.C. Fred Johnson Whidbey Island Biological Services 5280 South Wilkenson Road Langley, Washington 98260	Acquanaut: Underwater Plankton Tows Fish Collection
Valerie C. Chase National Aquarium at Baltimore Baltimore, MD David Bracher Hopkins Marine Station Pacific Grove, CA	Surface Scientific Support: Preservation of Zooplankton samples Prservation & dissection of fishes for stomach analysis. Photography of living zooplankton Overall logistic support for divers (camera repair, marker-bouys, etc.)

Operational Statistics

Name of Divers Aquanauts	# of Excursions	Total Man-Hours on Excursions	Longest Excursions	Avg Depth	Max Depth
W.J. Johnson	15	36.0	4 hrs	130'	150
J.M. Davidson	16	37.5	4 hrs	130'	150
F. Johnson	13	30.0	3 hrs	130'	150
S.S. Hamilton	15	31.5	3 hrs	130'	150

APPENDIX A. CHRONOLOGY

Oct 27-29	Training for aquanauts Preparation of bouys for transect lines Set up of laboratory for sample preservation and analysis.
Oct 30-Nov 6	Saturation
Oct 30	p.m. Fish census and Plankton collection
Oct 31	a.m. Fish Census and Plankton collection p.m. Fish Behavior analysis/plankton collections
Nov 1	a.m. Fish Census & Plankton collection p.m. Fish Behavior analysis/plankton Collections
Nov 2,3,4	Plankton Collection Fish Census Fish Collection
Nov 5	a.m. Analysis of Fish Behavior
Nov 6	decompression
Nov 7 & 8	analysis of census and behavior data Pack samples of plankton & fishes Prepare & submit quick look report.
Nov 8-present	Identify & enumerate species in plankton & gut contents Analyze data.

APPENDIX A. FACILITIES

The NULS-I habitat was completely adequate for the mission as were the shore based facilities.

The following are relatively minor comments: When performing strenuous tasks at depths of 130' or more, the dives seemed to use air faster than anticipated. This sorely taxed the relatively small supply of tanks available and required the support divers to race to and fro for refils.

Safety problems or concerns during operations:

Absolutely need better tables to calculate allowable bottom time at 120-150' depths that include allowance for step dives.

Deep dives required much more air than anticipated.

Management or personnel problems:

Could be better communications between: 1) MUST office, 2) Hydrolab Base, and 3) West Indies Laboratory, although this problem caused no difficulty during the mission.

On-site personnel were exceptional.

Logistics or support problems:

Definite need for tank drop as close as possible to study site when work exceeds 120'. This will help maximize study vs. travel time/change time and help with the air supply problem.

A shuttle system to get samples to surface and gear down helps.

APPENDIX A: SCIENTIFIC/DIVER EQUIPMENT

Scientific and Diver Equipment

LIST SCIENTIFIC AND/OR DIVER EQUIPMENT	GENERAL SUITABILITY (P,F,G,VG)	LIMITATIONS, FAILURES, OR OPERATIONAL PROBLEMS NOTED DURING MISSION	RECOMMENDATIONS FOR CORRECTIVE ACTION OR IMPROVEMENT
Double tanks	G	Tend to float bottom-up when empty. Would be easier to change if tail-heavy.	
Regulators	G	Hose comes off tank at an awkward angle which leads to excessive jaw fatigue.	Longer low pressure hose or softer low pressure hose.
Buoyancy compensators	P	Unfortable. Tend to push head down at uncomfortable angle. Pouch too small for required gear in addition to anything else.	Tape collar shut? Different model?
Thru-bolts for weights on doubles		Thru-bolts gouge foreleg of support personnel coming in and out of Safety Boat.	Should have sharp edge remove[illegible] Use acorn nuts or cover with sleeve of neoprene/rubatex.
Decompression vent	F	Excessively and unnecessarily noisy.	A muffler would help.
Tank rack	F	Lack of mobility. Required more travel time between study site and air supply.	Mobile tank rack and bubble.

PLANKTON DATA

EAST WALL SALT RIVER SUBMARINE CANYON

2 NOVEMBER 1980, 10:00

DEPTH= 40 m

TOTAL COUNTED

TOTAL TAXA = 29

TAXON	COUNT	NO./CUBIC M.	PERCENT
OITHONA	1237	176.8	80.73
CORYCAEUS CONCINUS	3	.5	.22
C. CRASSCICULUS	4	0.5	0.23
ONCAEA sp.	23	3.3	1.51
SAPPHRINA	2	0.3	0.14
OTHER CYCLOPOIDS	3	0.4	0.18
MICROSETELLA ROSEA	3	0.2	0.09
MACROSETELLA	3	0.4	0.18
CALANOIDS >2mm	21	2.99	1.32
CALANOIDS <2mm	37	5.3	2.42
CAL #30	1	0.3	0.14
CAL #31	8	1.2	0.56
OSTRACODS	5	0.7	0.32
MYSIDS	31	4.4	2.01
POLYCHAETES	5	0.8	0.36
CHAETOGNATHS	2	0.3	0.14
SIPHONOPHORES	3	0.4	0.18
GLOBEGERINA	38	5.4	2.46
OTHER FORAMS	22	3.2	1.46
OIKOPLEURA	37	5.2	2.37
FRITILLARIA	4	.06	0.27
ISOPODA	5	0.9	0.41
PENEID	1	0.2	0.09
CARIDEANS	5	0.7	0.32
GASTRPPODA	9	1.3	0.59
SIPUNCULIDA	8	1.1	0.5
BIVALVES	4	0.5	0.23
EGGS	4	0.5	0.23
	1528	219	100

APPENDIX C

PLANKTON DATA

EAST WALL SALT RIVER SUBMARINE CANYON

4 NOVEMBER 1980, 10:45

DEPTH= 40 m

TOTAL COUNTED= 456

TOTAL TAXA = 23

TAXON	COUNT	NO./CUBIC M.	PERCENT
OITHONA	255	145.7	55.92
CORYCAEUS CONCINUS	15	8.6	3.29
C. CRASSCICULUS	5	2.9	1.10
ONCAEA sp.	12	6.9	2.63
SAPPHRINA	0	0	0
OTHER CYCLOPOIDS	4	2.3	0.88
MICROSETELLA ROSEA	2	1.1	0.44
MACROSETELLA	0	0	0
CALANOIDS >2mm	8	4.6	1.73
CALANOIDS <2mm	71	40.6	15.57
CAL #30	7	4.0	1.54
CAL #31	2	1.1	0.44
OSTRACODS	0	0	0
MYSIDS	31	15	8.63.29
CHAETOGNATHS	1	0.6	0.22
SIPHONOPHORES	1	0.6	0.22
GLOBEGERINA	25	14.3	5.48
OTHER FORAMS	9	5.1	1.97
OIKOPLEURA	12	6.9	2.63
ISOPODA	3	1.7	0.66
PENEID	3	1.7	0.66
GASTROPODA	2	1.1	0.44
BIVALVES	1	0.6	0.22
	456	260.6	100

APPENDIX C

PLANKTON DATA

EAST WALL SALT RIVER SUBMARINE CANYON

3 NOVEMBER 1980, 10:44 DEPTH= 40 m TOTAL COUNTED=1044

TOTAL TAXA = 27

TAXON	COUNT	NO./CUBIC M.	PERCENT
OITHONA	149	23.4	14.8
CORYCAEUS CONCINUS	4	.6	.35
C. CRASSCICULUS	18	2.7	1.68
ONCAEA sp.	16	2.5	1.61
SAPPHRINA	0	0	0
OTHER CYCLOPOIDS	0	0	0.
MICROSETELLA ROSEA	2	0.3	0.2
MACROSETELLA	0	0	0
CALANOIDS >2mm	0	0	0
CALANOIDS <2mm	96	16.1	10.19
CAL #30	0	0	0
CAL #31	11	1.9	1.18
OSTRACODS	6	1.0	0.62
MYSIDS	157	23.5	14.8
POLYCHAETES	8	1.3	.82
GLOBEGERINA	31	5.4	3.41
OTHER FORAMS	11	1.7	1.06
OIKOPLEURA	4	0.6	0.39
ISOPODA	5	.6	0.39
PENEID	6	0.9	0.59
GASTROPODA	14	2.1	1.33
SIPUNCULIDA	2	0.3	0.20
BIVALVES	8	1.1	0.65
EGGS	9	1.3	0.82
	1044	158	100

APPENDIX C

PLANKTON DATA

EAST WALL SALT RIVER SUBMARINE CANYON

2 NOVEMBER 1980, 16:05

DEPTH= 40 m

TOTAL COUNTED=474

TOTAL TAXA = 30

TAXON	COUNT	NO./CUBIC M.	PERCENT
OITHONA	33	2.2	7.3
CORYCAEUS CONCINUS	8	0.5	1.56
C. CRASSCICULUS	8	0.5	1.56
ONCAEA sp.	15	1.0	3.44
SAPPHRINA	2	0.2	0.63
OTHER CYCLOPOIDS	6	0.4	0.94
MICROSETELLA ROSEA	3	0.2	0.36
MACROSETELLA	2	0.1	0.47
CALANOIDS >2mm	27	1.8	5.79
CALANOIDS <2mm	105	7.2	23.6
CAL #30	1	3	0.20.63
CAL #31	7	0.6	2.03
OSTRACODS	6	0.4	1.23
MYSIDS	122	7.3	24.1
POLYCHAETES	3	0.1	0.47
CHAETOGNATHS	0	0	0
SIPHONOPHORES	6	0.3	1.10
GLOBEGERINA	39	2.4	7.82
OTHER FORAMS	0	0	0
OIKOPLEURA	27	1.8	5.79
FRITILLARIA	2	0.2	0.6
ISOPODA	3	0.2	0.63
PENEID	0	0	0
CARIDEANS	19	1.2	3.91
GASTROPODA	3	0.1	0.47
SIPUNCULIDA	2	0.1	0.63
BIVALVES	2	0.1	0.31
EGGS	8	0.5	1.71
	474	30.4	100