

NEW HEBRIDES MIDDEN ANALYSIS

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OUTLINE

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The purpose of this paper is the presentation of interesting shell midden sites in the Southern New Hebrides, and an attempt to stimulate pertinent aspects of the information that will lead to an understanding of what these physical remains of human activity mean with respect to environmental and cultural activities; the concepts used representing an attempt to utilize statistical methods within the framework of archaeological concepts.

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TABLES

TABLE 1

The above sites listed have been analyzed with respect to weights of all species represented; and in addition there are other sites listed only regarding to weight of univalves, bivalves, and miscellaneous material (includes coral, etc.). (See pages 8 to 23).

The analysis of species and families represented in some of the sites have provided information beyond that of presence or absence of a material, thus lending the sites available to analysis by such methods as the Chi-square and Analysis of Variance, in order that intrasite and intersite

The purpose of this paper is the presentation of information about shell middens in the Southern New Hebrides, and an attempt to manipulate pertinent aspects of the information that will lead to an understanding of what these physical remains of human activity mean with respect to environmental and cultural operatives; the concepts used representing an attempt to utilize statistical methods within the framework of archaeological concepts.

In the field of archaeological interpretation, there are two main methods of presentation of material - qualitative or quantitative. The latter is to be used in this paper; with the use of concepts that may be of some merit in the interpretation of shell middens in particular, and Archaeology in general, with statistical analysis a more rigorous approach to interpretation than taxonomic tabulations.

The material with which I am concerned comes from sites excavated by Dr. R. Shutler, Jr., in the Southern New Hebrides; the name, type, and location of some as follows:

NAME	TYPE OF SITE	LOCATION
TARS1 Pit No. 1	rock shelter	Tanna
TARS3 Loc. A Pit Nos. 3,6,14	rock shelter	Tanna
TARS3 Loc. C Pit No. 1	rock shelter	Tanna
EF3 Loc. D Pit Nos. 1,3	open village	Efate

Table a

The above sites listed have been analysed with respect to weights of all species represented; and in addition there are other sites listed only according to weight of univalves, bivalves, and miscellaneous (which includes coral, etc.). (See pages 8 to 23).

The analysis of species and families represented in some of the sites have provided information beyond that of presence or absence of a material, thus lending the sites available to analysis by such methods as the Chi-square and Analysis of Variance, in order that intrasite and intersite

comparisons can be made with respect to species represented (i.e., are differences due to chance, sampling procedures, or are they the result of cultural and/or environmental factors?) and change (if any) of types of shellfish through time.

The use of statistical tests in Archaeology is not unique to this study (see Spaulding 1960, Binford 1963, Greenwood 1960), nor even to midden analysis. But previous studies with respect to midden analysis have neglected the implications of intersite comparisons.

Of the process of quantitative analysis, Heizer and Cook (1956:240) wrote:

"The statistical problem connected with this type of archaeological research solves itself into a study of frequencies of occurrence. It should be clearly borne in mind that the statistical treatment is merely a means to an end. It is never an end in itself. Consequently then the simplest methods are always to be recommended and any attempt to complicate the procedure by stressing interest in the theory of mathematical statistics is to be deprecated."

Thus, I have structured my approach to the midden analysis with the above comments in mind, the tests representing ones that are easily applied and interpreted, while fulfilling the requirements of utility.

Shell middens are the material remains of a society, being the result of cultural patterns of resource utilization, and as such reveal cultural preferences (or necessity) with regard to diet. Meighan (1958:19) wrote of the exploitation of the environment as being a choice of alternatives, and shell middens, interpreted in this respect, do not necessarily represent a cross section of available food resources, but rather a culturally and environmentally influenced use of segments of the environment, or, as Ambrose(1963: 158) wrote: "...concentrated remains of selected materials gathered from various corners of the local environment". So a change, if any, in the shell content of a site would need to be interpreted as being the result of a complex set of interactions; changes in resources available due to natural

change or over-exploitation or changes in cultural preferences. Meighan (1958:1) summarizes this by writing:

"Interpretations of man's relationship to his environment are basic to the understanding of archaeological data."

The manipulation of data from a midden then can reveal if there have been changes in diet, fauna, climate, etc., and also enable one to make inferences as to the subsistence cycle of the indigenous peoples and the duration of habitation. Diet represents a selection by man within the range of shellfish available, taking into account seasonal variation (although a year is minute in the concept of temporality and archaeologically may be non-existent). Conversely, if the sequence of appearance and disappearance is known for a molluscan form, this information could be used to date sites. Davidson's (1964:208) concept of the most valuable type of deposit that can be utilized in assessing change in diet preference is stratified deposits, in which the successive layers are functionally similar, but show changes in shell content through time. This brings in another aspect of a midden - its structure, and the implications thereof. Taken as such, a midden is then to be treated as a formal entity, capable of structural analysis in its own right (which, according to Ambrose (1963:156) had yet to be done); having complexity in both a structural and a compositional sense.

The initial analysis of a midden is done by a method called micro-analysis - the analysis of small samples "based on the assumption that the mound components are evenly distributed, abundant, and finely fragmented". (Meighan 1958:4). This procedure has been described by others in detail (eg. Rappaport 1967), but an overview will provide a background to the method of sampling. Any area inhabited for a period of time will contain physical manifestations of the cultural activities of the resident group (considering decomposition, etc.). Microanalysis, then, is a technique by which, through analysis of cultural and non-cultural residue recovered from a site, one can

infer cultural patterns and temporal differences not possible with qualitative analysis, which is merely the presence or absence of something. The procedure, as defined by Heizer (1960) is threefold:

- 1. Systematic sampling of midden.
- 2. Screening samples (through wire mesh).
- 3. Sorting of constituents.

To the above procedures, a fourth can be added, and that is the manipulation (in the statistical sense) of data so as to provide information about degrees of relationship, patterns of occurrence, etc. So we now have:

- 4. Statistical analysis,

the first step of which would be to take the weight of each species as a percentage of the total shell weight (see also Davidson 1964, Davenport 1967).

Thus, the problem at this point is how does one make use of the available data from a midden excavation so as to make inferences about culture and context. Ambrose (1963:156) sees the informative aspects of middens as revolving "about the analysis of variations between samples for correlations of ecological and cultural significance", involving two basic requirements:

"Firstly, a means for showing this variation within samples, and secondly, a rigorously assembled control sample or series of samples."

Statistical tests can provide for the former in the above statement, but only assiduous field sampling techniques will provide the latter.

The data for this study, according to Dr. R. Shutler, Jr., (1968:note), is taken from 357 species of identified shells obtained from 738 bags of midden material, mostly shell, from twenty-four locations on four islands of the Southern New Hebrides (Aneityum, Tanna, Futuna, and Efate). This paper deals mainly with Tanna and Efate. The samples ranged in weight from fifty grams to over fifteen hundred grams screened from various levels of the archaeological sites. Temporally, the sites range in time from 420 B.C. to A.D. 1768, a duration of about 2200 years, and 2400 years using the present

as the end point.

The basis for any statistical tests to be carried out in this paper is that shellfish are one aspect of the physical residues of the cultural reality of a social group in conjunction with environmental factors and that analysis of the patterns of midden composition is the analysis (many times removed) of cultural and environmental patterns, or, as Spaulding (1960) wrote:

"Underlying the technique of statistical inference is the idea that the numerical behaviour of collections of phenomena is more alike than the phenomena themselves..."

Changes in patterns of occurrence of midden material are a reflection of changes that may have a cultural or environmental loci. With environment held constant, then changes in patterns represent cultural shifts with respect to preference or even abandonment of an area for periods of time.

Patterns of archaeological remains can be compared on an intersite basis for similarities of content and forms, as well as indicating climatic changes by the appearance, or disappearance, of type shells.

Another aspect that can be tested is whether or not geographically proximate sites can be said to represent manifestations of cultural preferences on a single resource population, i.e., are differences in the amount of certain species of shellfish between two apparently related sites the result of chance, or are we able to say that they represent the utilization of a common resource by the same culture within a single geographical area (in this case - islands). (See below).

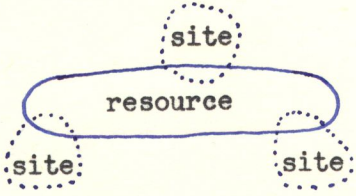


Figure 1



Table 1: Unmodified Shell Tabulation: By Weight in Grams and Percent Composition by Levels

Project: Southern New Hebrides  
 Site Name: FARSI  
 Type of Site: Rock Shelter  
 Date Excavated: I  
 Excavator: Shutler, Jr.  
 Pit No.: 1  
 Pit Size: 3' by 6'  
 Screen Size: 1/4"  
 Date Sorted:  
 Analyst: Curtis

Univalves	0-6"	6-12"	12-18"	18-24"	24-30"	30-36"	36-42"	42-48"	48-54"	54-60"	60-66"	66-72"	Total
	WT %	WT %	WT %	WT %	WT %	WT %	WT %	WT %	WT %	WT %	WT %	WT %	
Haliotis varia	1 (2)	-	-	2 (6.6)	-	-	-	1 (1.3)	-	1 (1)	8 (4.2)	1 (6.7)	6
Montfortula pulchra	3 (5)	3 (5)	2 (1.5)	3 (9)	4 (1.8)	-	1 (5)	1 (1.3)	-	2 (4)	1 (5)	1 (1)	20
Patella stellaeformis	1 (2)	-	-	-	-	-	-	-	-	1 (7)	-	-	3
Patella tahitiensis	2 (3)	5 (9)	7 (5.2)	6 (17)	1 (4)	-	-	1 (1.3)	-	1 (7)	-	2 (1.5)	28
Patella saccharina	-	2 (4)	-	-	-	-	2 (1.1)	-	-	-	-	-	4
Trochus fenestratus	43 (68)	31 (23.3)	17 (12.7)	61 (17.6)	24 (10.5)	-	15 (8.2)	10 (2.5)	20 (6.1)	38 (27.0)	34 (7.8)	30 (21.7)	423
Trochus maculatus	76 (12.0)	-	-	-	-	-	-	2 (2.5)	-	-	-	-	78
Trochus pyramis	-	-	1 (9)	-	68 (29.8)	-	-	-	88 (11.9)	-	-	-	1
Homalopoma sangarense	24 (3.8)	27 (4.8)	10 (7.5)	24 (6.9)	68 (29.8)	-	-	-	-	-	38 (19.9)	-	272
Turbo intercostalis	-	-	12 (3.5)	-	-	-	-	-	-	-	-	-	12
Turbo petholatus	10 (1.6)	6 (1.1)	7 (5.2)	2 (1.6)	-	-	-	-	-	-	-	-	25
Turbo porphyrites	76 (12.0)	73 (13.0)	23 (17.2)	62 (17.8)	20 (8.8)	-	11 (6.0)	24 (30.0)	-	31 (22.0)	16 (8.4)	40 (29.0)	385
Turbo setosus	14 (2.2)	24 (4.3)	11 (8.2)	11 (3.2)	9 (4.0)	-	69 (37.5)	5 (6.3)	-	13 (9.2)	5 (2.6)	6 (4.4)	74
Turbo sp.	134 (21.1)	112 (20.0)	21 (15.7)	63 (18.2)	50 (21.9)	-	15 (15)	3 (3)	-	2 (2)	15 (0.8)	6 (4.4)	501
Turbo opercula	(35)	(41)	(10)	(27)	(13)	-	(15)	(3)	-	4 (2.8)	(5)	(4)	(156)
Nerita opercula	8 (3)	8 (1.4)	1 (8)	3 (9)	2 (9)	-	-	-	-	-	-	-	26
Nerita plicata	6 (9)	2 (4)	1 (8)	2 (6)	4 (1.8)	-	-	-	-	-	-	-	16
Nerita polita	22 (55)	9 (1.6)	-	3 (9)	2 (1.9)	-	5 (2.1)	3 (3.8)	-	-	-	3 (2.2)	48
Nerita undata	1 (2)	1 (2)	2 (1.5)	-	2 (1.9)	-	-	-	1 (8)	-	-	-	4
Nerita sp.	-	-	-	2 (6)	2 (1.9)	-	-	-	-	-	-	-	4
Echininus cumingii	3 (5)	1 (2)	2 (1.5)	-	-	-	-	-	-	-	-	-	6
Littorina coccinea	5 (8)	3 (5)	-	-	-	-	-	-	-	-	-	1 (7)	6
Cerithium echinatum	2 (3)	-	-	3 (9)	-	-	8 (4.4)	-	-	-	-	-	3
Cerithium humilis	1 (2)	1 (2)	-	-	1 (4)	-	-	-	-	-	-	-	3
Cerithium tuberculatum	-	-	1 (8)	-	-	-	-	-	-	-	-	-	1
Hippionix conica	-	-	2 (1.5)	-	-	-	-	-	-	-	-	-	2
Hippionix foliacea	-	-	6 (1.8)	-	-	-	-	-	-	-	-	-	9
Strombus mutabilis	-	-	5 (1.5)	-	-	-	-	-	3 (6.4)	-	-	-	9
Cypraea arabica	-	5 (9)	5 (15)	16 (4.6)	10 (4.4)	-	11 (6.0)	-	3 (2.4)	15 (10.6)	1 (0.5)	4 (2.9)	70
Cypraea caputserpentis	-	-	-	-	-	-	-	-	-	-	-	-	1
Cypraea carneola	-	-	-	-	-	-	-	-	-	-	-	-	1
Cypraea cribraria	2 (3)	-	-	-	-	-	-	-	-	-	-	-	2
Cypraea icabolla	-	-	-	-	-	-	-	5 (6.3)	-	-	-	-	5

Table 1 (cont.)

Univalves (cont.)	0-6" wt. %	6-12"	12-18"	18-24"	24-30"	30-36"	36-42"	42-48"	48-54"	54-60"	60-66"	66-72"	Total
<i>Septa hepatica</i>	1 (2)	-	-	-	-	-	-	-	-	-	-	-	1 (0.4)
<i>Bursa granulata</i>	5 (8)	-	2 (0.5)	3 (9)	-	-	2 (0.1)	-	-	2 (0.4)	4 (2.1)	-	5 (2)
<i>Drupa morum</i>	4 (6)	-	-	-	-	-	-	-	-	-	-	-	4 (1.1)
<i>Drupa ricina</i>	3 (5)	9 (6.6)	2 (1.5)	2 (6)	-	-	-	-	-	-	4 (2.1)	-	16 (6.6)
<i>Drupa rubsideaus</i>	4 (6)	2 (4)	-	-	-	-	-	-	-	-	-	11 (8.0)	21 (8.8)
<i>Purpura distinguenda</i>	10 (6.6)	2 (4)	3 (2.2)	2 (6)	6 (2.6)	8 (4.4)	-	-	-	10 (5.2)	-	-	41 (15.5)
<i>Thais intermedia</i>	13 (2.1)	4 (7)	-	-	-	2 (0.1)	-	-	-	2 (1.4)	3 (1.6)	2 (1.5)	26 (9.9)
<i>Cantharus undosus</i>	-	2 (4)	-	-	-	-	-	-	-	-	-	-	2 (0.1)
<i>Nassa serratim</i>	-	2 (4)	1 (0.8)	12 (3.5)	3 (1.3)	2 (0.1)	-	-	-	-	7 (3.7)	-	27 (10.0)
<i>Latirus polygonus</i>	-	2 (4)	2 (1.5)	-	-	-	-	-	-	-	4 (2.1)	1 (0.7)	2 (0.1)
<i>Mitra ambigua</i>	-	-	-	-	-	-	-	-	-	-	-	-	5 (2.2)
<i>Conus catus</i>	-	-	-	-	-	-	-	-	-	-	-	-	2 (0.1)
<i>Conus ebraeus</i>	2 (3)	-	-	-	-	-	-	-	-	-	-	-	2 (0.1)
<i>Conus fulgetrum</i>	-	-	-	2 (6)	-	-	-	2 (2.5)	-	-	-	-	2 (0.1)
<i>Conus nanus</i>	-	-	-	-	-	1 (0.5)	-	-	-	-	-	-	3 (1.1)
<i>Conus rattus</i>	-	-	-	-	-	-	-	1 (1.3)	-	-	-	-	4 (1.1)
<i>Conus textile</i>	-	3 (5)	-	-	-	-	-	-	-	-	-	-	12 (4.4)
<i>Conus sp.</i>	-	4 (6)	6 (1.1)	1 (3)	-	4 (2.2)	-	12 (5.0)	-	-	1 (0.5)	-	19 (7.1)
<i>Terebra maculata</i>	-	-	-	-	-	-	-	2 (2.6)	-	-	-	-	2 (0.1)
<i>Pythia scarabaeus</i>	-	-	-	1 (3)	-	-	-	-	-	-	9 (4.7)	-	9 (3.3)
<i>Siphonaria japonica</i>	-	1 (2)	2 (4)	1 (0.8)	3 (0.9)	1 (0.4)	3 (1.4)	-	4 (3.2)	-	4 (2.1)	-	15 (5.5)
<b>Bivalves</b>													
<i>Area scapha</i>	-	-	-	-	-	-	-	-	-	-	2 (1.1)	2 (1.5)	2 (0.1)
<i>Barbatia bicolorata</i>	12 (0.9)	7 (1.3)	10 (7.5)	8 (2.3)	-	-	-	3 (3.8)	-	6 (4.3)	2 (1.5)	2 (1.5)	48 (1.7)
<i>Isognomon isognomon</i>	20 (4.4)	2	-	1 (1.3)	-	-	-	-	-	4 (2.8)	6 (3.1)	-	33 (12.2)
<i>Modiolus philippinarum</i>	-	6 (1.1)	2 (1.5)	-	-	-	-	-	-	-	2 (1.1)	1 (0.7)	5 (2)
<i>Spondylus candidus</i>	5 (8)	-	-	-	-	-	-	-	-	1 (0.7)	1 (0.5)	-	6 (2.2)
<i>Codakia tigrina</i>	21 (4.3)	-	-	-	-	-	-	1 (1.3)	-	-	-	-	7 (2.3)
<i>Chama spinosa</i>	-	-	-	-	-	-	-	-	-	-	-	-	1 (0.1)
<i>Tridacna crocea</i>	-	-	-	-	-	-	-	-	-	-	-	-	27 (10.0)
<i>Cardium sp.</i>	-	-	-	-	-	-	-	-	-	-	-	2 (1.5)	2 (0.1)
<i>Antigone reticulata</i>	-	-	-	-	-	-	-	-	-	-	1 (0.5)	-	1 (0.1)
<i>Asaphis dichotoma</i>	24 (3.3)	32 (5.7)	2 (1.5)	1 (0.3)	6 (2.6)	2 (0.1)	-	-	-	-	-	-	67 (2.4)
<i>Telliniscobinata</i>	-	-	-	-	-	-	-	-	-	-	-	1 (0.7)	1 (0.1)

Table 4 (cont.)

Miscellaneous	0-6"	6-12"	12-18"	18-24"	24-30"	30-36"	36-42"	42-48"	48-54"	54-60"	60-66"	66-72"	Total
Heterocentrotus mammillatus	39 (6.1)	30 (5.3)	3 (2.2)	5 (1.4)	10 (4.4)	13 (7.1)	5 (6.3)	1 (0.8)	17 (12.4)	2 (1.1)	25 (18.1)	156 (5.4)	
Chiton sp.	9 (1.4)	6 (1.1)	1 (0.8)	20 (5.8)	5 (2.2)	1 (0.5)	2 (2.5)	1 (0.8)	1 (0.7)	1 (0.6)	2 (1.5)	49 (1.8)	
Melanoides punctata	2 (0.3)	-	-	-	-	4 (2.2)	-	-	-	-	-	2 (0.1)	
Barnacles spp.	8 (1.3)	17 (3.0)	2 (1.5)	6 (1.7)	-	-	-	-	-	-	-	37 (1.3)	
Decapod	2 (0.3)	-	2 (0.5)	1 (0.3)	-	-	2 (2.5)	-	-	-	-	7 (0.3)	
Pumice	-	-	-	-	-	-	-	-	-	-	-	1 (0.1)	
Basalt	-	5 (1.0)	2 (1.5)	-	-	-	-	-	-	-	8 (5.8)	15 (0.5)	
Coral	-	-	2 (1.5)	-	-	-	2 (1.6)	-	-	-	-	4 (0.1)	
<u>Totals</u>													
Univalves	489 (77.0)	462 (82.2)	114 (85.1)	307 (88.2)	207 (90.8)	164 (89.1)	69 (86.3)	122 (98.4)	112 (79.4)	176 (92.1)	103 (74.6)	2325 (84.3)	
Bivalves	88 (13.2)	47 (8.4)	14 (10.4)	10 (2.9)	6 (2.6)	2 (1.1)	4 (5.0)	-	11 (7.8)	12 (6.3)	8 (5.8)	202 (7.3)	
Miscellaneous	58 (9.1)	53 (9.4)	6 (4.5)	31 (8.9)	15 (6.6)	18 (9.8)	7 (8.7)	2 (1.6)	18 (12.8)	3 (1.6)	27 (19.6)	231 (8.4)	
Total Shell	635	562	134	348	228	184	80	124	141	191	138	2758	

TARS 3 Loc. A  
Pit Nos. 3 and 6

Shell tabulations by weight in grams  
and percent composition by  
levels: wt.-%

Univalves	Pit 3				Pit 6				
	0-6" WT %	6-12" WT %	12-18" WT %	18-24" WT %	Total WT %	0-6" WT %	6-12" WT %	12-18" WT %	Total WT %
<i>Haliotis varia</i>	2 (.4)	-	-	1 (3.0)	3 (.4)	10 (1.6)	1 (.6)	-	11 (1.3)
<i>Patella stellaiformis</i>	-	-	-	-	-	1 (.2)	-	4 (3.3)	5 (.6)
<i>Acmaea saccharina</i>	-	-	-	-	-	1 (.1)	-	1 (.8)	2 (.2)
<i>Trochus maculatus</i>	4 (.9)	3 (1.5)	7 (9.6)	7 (6.12)	21 (2.8)	24 (3.9)	2 (1.2)	28 (22.8)	34 (6.6)
<i>Trochus pyramis</i>	-	-	-	-	3 (.4)	-	4 (2.4)	6 (3.9)	10 (1.2)
<i>Astraea stellaris</i>	-	3 (1.5)	-	-	-	-	-	-	-
<i>Astraea intercostalis</i>	10 (2.2)	6 (2.9)	-	8 (2.2)	16 (2.0)	-	82 (46.3)	-	82 (10.7)
<i>Turbo marmoratus</i>	-	-	-	-	8 (1.0)	-	-	-	-
<i>Turbo porphyrites</i>	-	-	-	-	-	-	-	-	-
<i>Turbo setosus</i>	78 (17.3)	19 (9.2)	9 (12.3)	6 (8.2)	112 (14.7)	-	1 (.6)	-	1 (.1)
<i>Turbo sp.</i>	15 (3.3)	-	-	-	15 (2.0)	74 (12.1)	16 (9.0)	52 (42.3)	142 (17.6)
<i>Turbo opercula</i>	61 (13.5)	22 (10.7)	24 (32.9)	1 (3.0)	108 (14.0)	28 (4.6)	6 (3.4)	4 (3.5)	38 (4.6)
<i>Turbo opercula</i>	25 (5.5)	6 (6)	3 (3)	1 (1)	35 (4.5)	150 (24.5)	28 (15.0)	9 (7.3)	187 (22.8)
<i>Neritopsis radula</i>	3 (7)	-	-	-	3 (.4)	39 (1)	4 (1)	-	44 (4.4)
<i>Nerita plicata</i>	16 (3.5)	-	-	1 (3.0)	17 (2.2)	40 (6.5)	1 (.6)	-	41 (5.0)
<i>Nerita polita</i>	3 (7)	-	-	-	3 (.4)	6 (1.0)	7 (4.0)	-	13 (1.6)
<i>Nerita undata</i>	1 (2)	2 (1.0)	-	-	3 (.4)	7 (1.1)	-	6 (4.9)	13 (1.6)
<i>Cerithium monoliferum</i>	-	6 (2.9)	-	-	6 (.8)	-	-	-	-
<i>Hippomiz conica</i>	-	-	-	-	-	1 (.2)	-	-	1 (.1)
<i>Strombus luhuanus</i>	-	-	-	-	-	2 (.4)	-	-	2 (.2)
<i>Strombus mutabilis</i>	-	15 (7.3)	-	-	15 (2.4)	-	-	-	-
<i>Cypraea arabica</i>	-	-	-	-	-	4 (.7)	-	-	4 (.5)
<i>Cypraea caputserpentis</i>	18 (4.0)	17 (8.3)	-	-	35 (4.6)	7 (1.1)	1 (.6)	1 (.8)	9 (1.1)
<i>Cypraea isabella</i>	1 (1.2)	-	-	-	2 (.3)	-	-	-	-
<i>Cypraea poraria</i>	-	-	-	-	-	-	-	-	-
<i>Polinices marochiensis</i>	-	-	-	-	-	-	-	-	-
<i>Polinices melanostoma</i>	-	-	-	-	-	1 (.2)	-	2 (1.6)	2 (.2)
<i>Bursa granularis</i>	2 (4)	2 (1.0)	-	-	4 (.5)	2 (1.4)	-	-	1 (.1)
<i>Drupa morum</i>	2 (4)	3 (1.5)	2 (2.7)	2 (6.1)	7 (9)	4 (7)	-	3 (2.4)	5 (6)
<i>Drupa ricina</i>	2 (4)	-	-	-	4 (.5)	-	-	-	4 (5)
<i>Drupa rubsidaeus</i>	-	-	-	-	-	-	2 (1.2)	-	2 (2)
<i>Thais intermedia</i>	-	-	-	-	-	-	1 (.6)	-	1 (.6)
<i>Cantharus undosus</i>	3 (7)	-	-	3 (9.1)	6 (.8)	-	3 (1.8)	2 (1.6)	2 (2)
<i>Latirus polygonus</i>	2 (4)	5 (2.4)	-	-	7 (.9)	-	-	-	3 (3)
<i>Mitra ambigua</i>	-	-	-	-	-	-	2 (1.2)	-	2 (2)

Pit Nos. 3 and 6

(cont.)

Pit 3

Pit 6

Univalves (cont.)	0-6		6-12		12-18		18-24		Total	
	WT %	WT %	WT %	WT %	WT %	WT %	WT %	WT %	WT %	WT %
Conus catus	2 (1.4)	-	-	-	-	-	-	-	2 (1.3)	-
Conus ebraeus	2 (1.4)	-	2 (2.7)	-	-	-	-	-	2 (1.3)	-
Conus sp.	-	-	1 (1.4)	1 (3.0)	-	-	-	-	4 (5)	3 (4)
Pythia scarabaeus	Tr.	2 (1.0)	1 (1.4)	Tr.	-	-	-	-	3 (4)	4 (5)
<u>Bivalves</u>										
Area niyca	-	-	-	-	-	-	-	-	-	2 (1.6)
Barbatia bicolorata	1 (2)	3 (1.5)	-	-	-	-	-	-	4 (6.5)	2 (1.3)
Isognomon isognomum	2 (1.4)	12 (5.8)	-	-	-	-	-	-	14 (1.8)	6 (7)
Modiolus philippinarum	Tr.	19 (9.2)	1 (1.4)	-	-	-	-	-	20 (2.6)	1 (1.1)
Pecten radula	1 (2)	-	1 (6.8)	-	-	-	-	-	1 (1.1)	-
Lima sowerbyi	-	-	5 (7)	-	-	-	-	-	5 (7)	-
Chama iostoma	10 (2.2)	8 (3.9)	14 (9.2)	-	-	-	-	-	32 (4.2)	39 (4.8)
Chama spinosa	-	-	-	1 (3.0)	-	-	-	-	1 (1)	2 (3)
Gafrarium tumidum	-	6 (2.9)	-	-	-	-	-	-	6 (8)	-
Periglypta puerpera	-	-	-	-	-	-	-	-	-	4 (5)
Asaphis dichotoma	13 (2.9)	7 (3.4)	-	-	-	-	-	-	20 (2.6)	28 (3.4)
<u>Miscellaneous</u>										
Heterocentrotus mamillatus	150 (33.3)	27 (18.0)	2 (2.7)	1 (3.0)	190 (24.9)	-	-	-	55 7.2	53 (6.5)
Chiton spp.	44 (9.8)	9 (4.4)	2 (2.7)	-	55 7.2	-	-	-	3 (1.4)	40 (4.9)
Placostylus fuliginosus	3 (7)	-	-	-	3 (1.4)	-	-	-	-	-
Decapod	10 (2.2)	-	-	-	10 (1.3)	-	-	-	6 (1.0)	6 (1.7)
Coral	-	-	-	-	-	-	-	-	-	-
Totals	227 (50.3)	105 (51.4)	49 (12.3)	31 (94.0)	412 (54.0)	-	-	-	9 (3.9)	640 (78.5)
Univalves	27 (6.0)	55 (26.7)	27 (27.4)	1 (3.0)	103 (13.5)	-	-	-	83 (10.2)	83 (10.2)
Bivalves	197 (43.7)	46 (22.3)	4 (5.5)	1 (3.0)	248 (32.5)	-	-	-	53 (11.3)	53 (11.3)
Miscellaneous	451	206	73	33	763	-	-	-	612	1771
Total Shell	612	1771	123	123	820	-	-	-	612	820

x taken in the very early hrs

Table 3: Unmodified Shell Tabulation

Project: Southern New Hebrides  
 Site Name: TARS3 Loc A  
 Type of Site: Rock Shelter  
 Date Excavated:  
 Excavator: Shuttler, Jr.

Pit No.: 14  
 Pit Size: 3' by 6'  
 Screen Size: 1/4"  
 Date Sorted:  
 Analyst: Curtin

Univalves	0-6" WT %	6-12"	12-18"	18-24"	24-30"	30-36"	36-42"	Total
<i>Haliotis varia</i>	1 (.3)	-	-	6 (1.2)	1 (.1)	0	-	8 (.2)
<i>Diodora quadriradiata</i>	-	-	-	-	-	-	-	1 (-)
<i>Montfortula pulchra</i>	-	-	1 (.3)	-	-	2 (.1)	-	3 (.1)
<i>Patella stellaeformis</i>	1 (.3)	2 (1.7)	7 (2.1)	6 (1.2)	5 (.4)	3 (.2)	3 (.4)	27 (.6)
<i>Alona saccharina</i>	1 (.3)	-	1 (.3)	-	2 (.1)	2 (.1)	-	6 (.1)
<i>Trochus fenestratus</i>	19 (6.4)	10 (8.4)	71 (21.8)	127 (26.4)	420* (31.1)	345* (2.7)	160 (23.3)	1152 (24.2)
<i>Trochus pyramis</i>	12 (4.1)	-	-	22 (4.6)	14 (1.0)	38 (2.5)	51 (7.4)	137 (2.9)
<i>Astraea rhodostomus</i>	-	-	-	-	2 (.1)	12 (2.7)	-	14 (.3)
<i>Turbo argyrostomus</i>	-	-	-	-	90 (6.7)	-	-	90 (1.9)
<i>Turbo artensis</i>	19 (6.4)	31 (26.1)	15 (4.6)	-	-	41 (2.7)	-	106 (2.2)
<i>Turbo chrysostomus</i>	-	-	6 (1.8)	-	-	-	-	6 (.1)
<i>Turbo intercostalis</i>	80 (27.1)	15 (12.6)	12 (3.7)	11 (2.3)	90 (6.7)	60	80 (11.6)	348 (7.3)
<i>Turbo porphyrites</i>	2 (.7)	-	-	3 (.6)	4 (.3)	1 (.1)	4 (.6)	14 (.3)
<i>Turbo setosus</i>	51 (17.2)	8 (6.7)	8 (2.5)	88 (18.3)	44 (3.3)	83 (5.5)	74 (10.8)	356 (7.5)
<i>Turbo opercula</i>	46 (15.5)	3 (2.5)	45 (13.8)	118 (24.5)	102 (7.6)	150 (9.9)	78 (11.4)	542 (11.4)
<i>Turbo opercula</i>	(8)	(3)	(13)	(20)	(21)	(28)	(13)	(106)
<i>Neritopsis radula</i>	-	-	-	2 (.4)	-	9 (.6)	4 (.6)	15 (.3)
<i>Nerita albicilla</i>	-	-	-	-	3 (.2)	-	-	3 (.1)
<i>Nerita plicata</i>	3 (1.0)	-	2 (.6)	1 (.2)	6 (.4)	3 (.2)	-	15 (.3)
<i>Nerita polita</i>	-	-	2 (.6)	-	3 (.2)	2 (.1)	-	7 (.1)
<i>Nerita undata</i>	-	5 (4.2)	-	1 (.2)	1 (.1)	27 (1.8)	10 (1.5)	44 (.9)
<i>Nerita sp.</i>	-	-	1 (.3)	1 (.2)	-	-	-	2 (-)
<i>Echininus cumingii</i>	-	-	-	-	-	10 (.7)	-	10 (.2)
<i>Tectarius ballatus</i>	-	-	-	-	20 (1.5)	-	4 (.6)	25 (.5)
<i>Hipponix conica</i>	-	-	-	-	2 (.1)	1 (.1)	-	3 (.1)
<i>Hipponix foliacea</i>	-	-	-	-	1 (.1)	2 (.1)	1 (.2)	4 (.1)
<i>Strombus luhuanus</i>	1 (1.0)	8 (6.7)	-	-	-	-	-	9 (.2)
<i>Cypraea arabica</i>	-	-	2 (.6)	-	-	-	-	2 (-)
<i>Cypraea caputserpentis</i>	-	1 (.8)	6 (1.8)	30 (6.2)	74 (5.5)	37 (2.4)	44 (6.4)	192 (4.0)
<i>Cypraea cribraria</i>	-	-	2 (.6)	-	-	-	-	2 (-)
<i>Cypraea isabella</i>	5 (1.7)	-	-	-	2 (1.1)	8 (.5)	2 (.3)	17 (.4)
<i>Cypraea moneta</i>	-	-	-	-	2 (.1)	-	-	2 (-)
<i>Cypraea nucleus</i>	2 (.7)	2 (1.7)	-	-	1 (.1)	1 (.1)	-	6 (.1)
<i>Cypraea poraria</i>	3 (1.0)	-	-	-	6 (.4)	3 (.2)	-	12 (.3)
<i>Cypraea tigris</i>	-	-	-	-	6 (.4)	7 (.5)	-	13 (.3)

Table 3 (cont.)

Univalves (cont.)	0-6"	6-12"	12-18"	18-24"	24-30"	30-36"	36-42"	Total
Bursa buffonia	-	7 (5.9)	2 (1.6)	-	10 (1.7)	4 (.3)	-	14 (.3)
Bursa granulatis	-	-	-	-	2 (.1)	2 (.1)	2 (.3)	9 (.2)
Drupa granulata	6 (2.0)	1 (.8)	3 (.9)	10 (2.1)	22 (1.6)	1 (.1)	1 (.2)	44 (.9)
Drupa morum	-	-	-	-	4 (.3)	5 (.3)	-	9 (.2)
Drupa rubsideus	2 (.7)	-	-	-	3 (.2)	-	-	5 (.1)
Purpura distinguenda	1 (.3)	2 (1.7)	5 (1.5)	3 (.6)	7 (.5)	8 (.5)	4 (.6)	20 (1.4)
Thais intermedia	-	-	5 (1.5)	12 (3.2)	12 (.9)	1 (.1)	7 (1.0)	46 (1.0)
Cantharus undosus	-	-	-	-	6 (.4)	-	-	1 (-)
Nassarius gaudiosa	1 (.3)	-	1 (.3)	-	-	-	-	6 (.1)
Latirolagena smaragula	-	-	-	-	-	7 (.5)	-	2 (-)
Latirus polygonus	-	-	-	-	-	17 (1.1)	-	7 (.1)
Pleuroploca filamentosa	-	-	-	-	-	1 (.1)	1 (.2)	17 (.4)
Mitra monochialis	-	-	-	-	-	-	-	2 (0.0)
Mitra paupercula	-	-	4 (1.2)	-	-	-	-	4 (.1)
Conus catus	-	-	61 (16.7)	-	6 (.4)	5 (.3)	-	72 (1.5)
Conus distans	-	-	3 (.9)	-	3 (.2)	-	-	6 (.1)
Conus ebraeus	-	-	3 (.9)	-	-	7 (.5)	-	7 (.1)
Conus miles	-	-	3 (.9)	-	-	4 (.3)	-	7 (.1)
Conus rattus	-	-	-	-	-	-	-	4 (.1)
Conus retifer	-	-	-	4 (.8)	-	4 (.3)	-	4 (.1)
Conus tulipa	3 (1.0)	-	1 (.3)	5 (1.0)	-	8 (.5)	16 (2.3)	38 (.8)
Conus sp.	-	-	-	-	-	-	1 (.2)	1 (-)
Melampus luteus	-	-	5 (1.5)	2 (.4)	190 (14.1)	425 (28.0)	76 (11.1)	698 (14.6)
Pythia scarabaeus	13	1 (.8)	-	-	2 (.1)	-	-	3 (.1)
Siphonaria japonica	-	-	-	-	-	-	-	-
<u>Bivalves</u>								
Arca aceraca	-	-	1 (.3)	-	23 (1.7)	8 (.5)	8 (1.2)	23 (.5)
Arca nivea	3 (1.0)	5 (4.2)	10 (3.1)	5 (1.0)	8 (.6)	23 (1.5)	10 (1.5)	21 (.4)
Barbatia bicolorata	2 (.7)	-	2 (.6)	1 (.2)	2 (.1)	-	-	5 (.1)
Isognomon isognomon	-	-	4 (1.2)	-	-	-	-	4 (.1)
Pecten pallium	-	-	-	-	4 (.3)	-	-	4 (.1)
Spondylus candidus	-	2 (1.7)	-	-	-	-	1 (.2)	2 (-)
Spondylus ducalis	14 (4.7)	2 (1.7)	-	-	-	-	-	17 (.4)
Lima sowerbyi	-	-	-	-	-	-	-	5 (.1)
Chama iostoma	-	-	5 (1.5)	1 (1.2)	2 (.1)	4 (.3)	5 (.7)	13 (.3)
Chama spinosa	-	-	1 (.3)	-	-	-	-	2 (-)
Cardium sp.	-	-	2 (.6)	-	-	-	-	12 (.3)
Tridacna maxima	-	-	7 (2.1)	-	5 (.4)	-	2 (.3)	10 (.2)
Periglypta puerpera	-	-	8 (2.4)	5 (1.0)	3 (.2)	-	-	17 (.4)

Table B (cont.)

Miscellaneous	0-6"	6-12"	12-18"	18-24"	24-30"	30-36"	36-42"	Total
Heterocentrotus mammillatus	13 (4.4)	8 (6.7)	7 (2.1)	9 (1.9)	75 (5.6)	82 (5.4)	23 (3.3)	217 (4.5)
Chiton sp.	4 (1.4)	1 (.8)	2 (.6)	1 (.2)	15 (1.1)	8 (.5)	5 (.7)	36 (.8)
Melanoides punctata	3 (1.0)	3 (2.5)	-	2 (0.4)	3 (.2)	-	-	8 (1.1)
Barnacles	-	-	-	-	8 (.5)	-	-	10 (.2)
Coral	-	-	2 (.6)	-	-	-	-	2 (0.2)
<b>Totals</b>								
Univalves	259 (87.5)	96 (80.7)	277 (85.0)	455 (94.6)	1184 (87.8)	1387 (91.3)	635 (92.4)	4293 (90.0)
Bivalves	17 (6.7)	11 (9.2)	40 (12.3)	14 (2.9)	72 (5.3)	43 (2.8)	24 (3.5)	221 (4.6)
Miscellaneous	20 (6.8)	12 (10.1)	9 (2.7)	12 (2.5)	93 (6.9)	90 (5.9)	28 (4.1)	256 (5.4)
<b>Total Shell</b>	296	119	326 <sup>327</sup>	481	1349	1520	687	4770 <sup>4771</sup>

\*--Many whole shells  
 ° Most shells complete, unusual quantity

Shells in 30-36" and 36-42" levels worn looking

*Paul?*

Table 4: Unmodified Shell Tabulation

Project: Southern New Hebrides  
 Site Name: TARS3 Loc C  
 Type of Site: Rock Shelter  
 Date Excavated:  
 Excavator: Shuttler, Jr./

Pit No.: 1  
 Pit Size: 3' by 6'  
 Screen Size: 1/4"  
 Date Sorted:  
 Analyst: Curtis

	0-6"	6-12"	12-18"	18-24"	24-30"	30-36"	36-42"	42-48"	48-54"	54-60"	Total
Univalves											
<i>Patella stellaeformis</i>	2(.8)	5(3.2)	7(6.1)	4(2.7)	-	1(.4)	1(.5)	1(.9)	1(1.6)	1(1.0)	22(13)
<i>Patella bahitiensis</i>	-	2(1.3)	1(.9)	2(1.4)	-	-	-	-	-	-	1(.1)
<i>Acantha saccharina</i>	17(6.8)	4(2.6)	23(20.0)	32(21.6)	3(2.1)	8(3.1)	16(8.8)	48(41.4)	22(13.1)	10(10.2)	183(112)
<i>Trochus maculatus</i>	7(2.8)	-	-	-	-	-	5(2.5)	-	-	-	12(.7)
<i>Trochus pyramis</i>	-	-	-	-	-	-	5(2.5)	-	-	-	5(.3)
<i>Astraea stellaris</i>	-	-	-	-	-	-	4(2.2)	3(2.6)	-	-	3(.2)
<i>Turbo intercostalis</i>	3(1.2)	-	-	-	8(5.6)	1(.4)	-	-	-	-	16(1.0)
<i>Turbo porphyrites</i>	36(14.4)	35(22.7)	29(25.2)	51(34.5)	52(36.6)	44(17.1)	23(9.3)	20(17.2)	34(20.2)	30(30.6)	354(217)
<i>Turbo setosus</i>	-	7(4.5)	-	2(1.4)	4(2.8)	10(3.9)	4(5.9)	-	6(3.6)	13(13.3)	53(3.2)
<i>Turbo sp.</i>	64(25.6)	30(19.5)	27(23.5)	7(4.7)	2(1.4)	49(18.1)	30(16.0)	6(5.2)	9(5.4)	7(7.1)	231(141)
<i>Turbo opercula</i>	(2.9)	(1.9)	(9)	(3)	(1)	(1.5)	(12)	(1)	(3)	(2)	(82)
<i>Turbo opercula</i>	-	-	-	-	1(.7)	-	-	2(1.7)	-	-	3(.2)
<i>Nerita albicilla</i>	1(.4)	2(1.3)	-	2(1.4)	-	4(1.6)	3(1.6)	-	2(1.2)	-	14(.9)
<i>Nerita plicata</i>	2(.8)	2(1.3)	-	2(1.4)	4(2.8)	2(.8)	4(2.2)	-	-	-	20(1.2)
<i>Nerita undata</i>	1(.4)	-	-	-	-	1(.4)	-	-	-	-	2(.1)
<i>Nerita sp.</i>	-	-	-	-	-	-	1(.5)	-	-	-	1(.1)
<i>Echininus cumingii</i>	-	1(.6)	-	-	-	-	-	-	-	-	1(.1)
<i>Littorina coccinea</i>	1(.4)	-	-	-	-	1(.4)	-	-	1(1.6)	-	4(.2)
<i>Cdrithium echinatum</i>	-	-	-	-	-	-	-	-	-	-	1(.1)
<i>Cerithium tuberculatum</i>	1(.4)	1(.6)	-	1(1.7)	-	-	-	-	-	-	3(.2)
<i>Cerithium sp.</i>	1(.4)	-	1(.9)	1(1.7)	-	1(.4)	1(.5)	1(.9)	-	-	4(.2)
<i>Hippinx conica</i>	1(.4)	-	-	1(1.7)	-	-	-	-	-	-	1(.1)
<i>Strombus microureus</i>	-	-	-	-	-	-	-	-	-	-	3(.2)
<i>Strombus mutabilis</i>	6(2.4)	6(3.8)	2(1.7)	2(1.4)	2(1.4)	4(1.6)	7(3.8)	2(1.7)	7(4.2)	13(13.2)	51(31.1)
<i>Cypraea caputserpentis</i>	5(2.0)	-	-	-	-	-	-	-	-	-	5(.3)
<i>Cypraea lynx</i>	1(.4)	-	-	-	-	-	-	-	1(1.6)	-	2(.1)
<i>Cypraea poraria</i>	-	-	-	-	-	20(7.8)	4(2.2)	-	-	1(1.0)	24(1.5)
<i>Cypraea tigris</i>	-	-	-	-	-	-	-	-	-	-	1(.1)
<i>Cypraea vitellus</i>	-	-	-	-	-	-	-	-	-	-	2(.1)
<i>Cymatium tuberosum</i>	2(.8)	-	-	2(1.4)	-	-	-	-	-	-	2(.1)
<i>Septa hepatica</i>	-	-	-	-	-	-	-	-	4(2.4)	-	6(.4)
<i>Drupa mageriticola</i>	-	-	-	-	-	-	2(1.1)	-	-	-	7(.4)
<i>Drupa morum</i>	2(.8)	-	1(.9)	2(1.4)	-	-	2(1.1)	-	-	-	16(1.0)
<i>Drupa ricina</i>	1(.4)	6(3.8)	1(.9)	3(2.1)	3(2.1)	10(4.0)	2(1.1)	-	-	-	26(2.0)
<i>Drupa rubsidaeus</i>	2(.8)	-	-	2(1.4)	6(4.2)	6(3.2)	6(3.2)	-	-	-	26(2.0)

Table 4 (cont.)

Univalves (cont.)	0-6"	6-12"	12-18"	18-24"	24-30"	30-36"	36-42"	42-48"	48-54"	54-60"	Total
<i>Purpura distinguenda</i>	-	-	5 (4.3)	-	4 (2.8)	5 (1.9)	9 (4.8)	2 (1.7)	-	2 (2.0)	7 (.4)
<i>Thais intermedia</i>	27 (3.6)	5 (3.2)	-	3 (2.1)	-	6 (2.3)	4 (2.2)	-	10 (6.0)	-	40/7 (2.9)
<i>Cantharus undosus</i>	1 (.4)	2 (1.3)	-	-	-	-	-	-	7 (4.2)	-	20 (1.2)
<i>Latirus polygonus</i>	1 (.4)	3 (1.9)	-	-	-	2 (.8)	-	-	-	-	6 (.4)
<i>Pleuroploca trapezium</i>	-	-	-	-	-	50 (19.5)	-	-	-	-	50 (3.1)
<i>Conus ebraeus</i>	-	2 (1.3)	-	-	-	-	9 (4.8)	-	-	-	2 (.1)
<i>Conus fulgetrum</i>	-	-	-	-	-	8 (3.1)	-	-	-	-	9 (1.6)
<i>Conus milles</i>	-	-	-	-	-	3 (1.2)	3 (1.6)	1 (.9)	-	-	8 (.5)
<i>Conus sp.</i>	1 (.4)	1 (1.6)	1 (.9)	7 (4.7)	22 (15.5)	4 (1.6)	3 (1.6)	1 (.9)	5 (3.0)	6 (6.1)	9 (.6)
<i>Pythia scarabaeus</i>	1 (.4)	-	-	-	-	-	-	-	-	-	50 (3.1)
<i>Siphonaria atra</i>	1 (.4)	-	-	-	-	-	-	-	-	-	1 (.1)
<i>Siphonaria japonica</i>	1 (.4)	1 (.6)	1 (.9)	1 (1.7)	-	-	-	-	1 (1.6)	-	6 (.4)
<b>Bivalves</b>											
<i>Arca navicularis</i>	-	-	-	-	-	-	1 (.5)	-	-	-	1 (.1)
<i>Barbatia bicolorata</i>	-	11 (7.1)	-	1 (.7)	-	-	-	2 (1.7)	1 (.6)	-	15 (.9)
<i>Isognomon isognomon</i>	2 (.8)	1 (.6)	1 (.9)	1 (1.7)	-	1 (.4)	-	-	-	2 (2.0)	8 (.5)
<i>Modiolus philippinarum</i>	1 (.4)	1 (.6)	-	-	1 (1.7)	-	-	1 (1.9)	-	-	4 (.3)
<i>Pecten radula</i>	-	-	-	-	-	-	-	-	1 (1.6)	-	1 (.1)
<i>Spondylus butleri</i>	-	-	-	-	-	-	-	-	4 (2.4)	-	4 (.3)
<i>Ostrea sp.</i>	1 (.4)	7 (4.5)	-	3 (2.1)	12 (8.5)	-	4 (2.2)	12 (10.3)	23 (13.7)	-	62 (3.8)
<i>Chama iostoma</i>	-	-	-	-	3 (2.1)	-	3 (1.6)	-	-	-	6 (.4)
<i>Chama spinosa</i>	1 (.4)	-	-	-	-	-	3 (1.4)	-	-	-	1 (.1)
<i>Circe trigona</i>	-	-	-	-	-	-	-	-	3 (1.8)	-	6 (.4)
<i>Asaphis dichotoma</i>	9 (.8)	2 (1.3)	1 (.9)	2 (1.4)	2 (1.4)	2 (.8)	2 (1.1)	-	-	2 (2.0)	22 (1.3)
<b>Miscellaneous</b>											
<i>Heterocentrotus mammillatus</i>	35 (14.4)	5 (3.2)	7 (6.1)	9 (6.1)	10 (7.0)	13 (5.1)	18 (9.6)	8 (6.9)	21 (12.5)	5 (5.1)	131 (8.0)
<i>Chiton spp.</i>	21 (8.4)	4 (2.6)	1 (.9)	1 (1.7)	-	5 (1.9)	1 (1.1)	1 (.9)	1 (1.6)	1 (1.0)	36 (2.2)
<i>Dendrotrichus eva eva</i>	1 (.4)	-	-	-	-	-	-	-	-	-	1 (.1)
<i>Melanoides punctata</i>	1 (.4)	-	-	-	-	-	-	-	-	-	1 (.1)
<i>Barnacles</i>	6 (2.4)	-	4 (3.5)	-	-	-	-	-	-	-	10 (.6)
<i>Marine worm</i>	1 (.4)	-	-	-	1 (1.7)	-	-	-	-	-	2 (.1)
<i>Decapod</i>	-	-	2 (1.8)	-	1 (1.7)	1 (.4)	-	-	1 (1.6)	-	5 (.3)
<i>Coral</i>	-	-	2 (1.8)	-	-	-	-	-	3 (1.8)	-	5 (.3)
<b>Totals</b>											
<i>Univalves</i>	171 (68.4)	123 (79.9)	101 (87.8)	131 (86.5)	113 (79.6)	236 (91.8)	155 (82.9)	92 (79.3)	114 (67.9)	88 (89.8)	1324 (81.0)
<i>Bivalves</i>	14 (5.6)	22 (14.3)	2 (1.8)	7 (4.7)	18 (12.7)	3 (1.2)	13 (10)	15 (12.9)	32 (19.0)	4 (4.1)	130 (8.0)
<i>Miscellaneous</i>	65 (26.0)	9 (5.8)	12 (10.4)	10 (6.8)	11 (7.7)	18 (7.0)	19 (10.2)	5 (7.8)	22 (13.1)	6 (6.1)	181 (11.0)
<b>Total shell</b>	250	154	115	148	142	257	187	116	148	98	1635

Table 5: Unmodified Shell Tabulation

Project: Southern New Hebrides  
 Site Name: EF3 Loc D  
 Type of Site: Open Village  
 Date Excavated:  
 Excavator: ShuEler, Jr.

Pit Nos.: 1 and 3  
 Pit Soze: 3' by 6"  
 Screen Size: 1/4"  
 Date Sorted:  
 Analyst: Curtiss

Univalves	Pit 1			Pit 3			Total
	6-12" WT %	12-18" Total	18-24" Total	24-30" Total	30-36" Total	Total	
<i>Trochus fenestratus</i>		27(1.0)			8(7.5)	8	
<i>Trochus maculatus</i>	18(.9)					8	
<i>Trochus niloticus</i>	132(6.3)	204(7.9)	187(11.4)	29(9.7)		29	
<i>Trochus pyramis</i>		44(1.7)				44	
<i>Astraea stellaris</i>		8(.3)				8	
<i>Turbo chrysostronus</i>	13(.6)		6(.4)		5(5.0)	14	
<i>Turbo intercostalis</i>			26(1.6)		5(5.0)	13	
<i>Turbo marmoreus</i>						0	
<i>Turbo sp.</i>		9(.3)		10(3.4)		10	
<i>Turbo opercula</i>			3(.2)	3(1.0)		3	
<i>Turbo opercula</i>			(1)			3	
<i>Nerita albicilla</i>	2(-)	7(.3)	4(.3)			8	
<i>Nerita polita</i>	3(-)	3(-)				3	
<i>Cerithium aluco</i>	15(-.7)		10(.6)			15	
<i>Cerithium nodulosum</i>	1(-)	133(5.1)				133	
<i>Lambis lambis</i>	372(17.7)	95(3.7)	27(1.6)	24(8.1)		494(7.8)	
<i>Strombus canarium</i>	53(2.5)					53	
<i>Strombus gibberulus</i>						8	
<i>Strombus labiatus</i>		82(3.2)				82	
<i>Strombus lentiginosus</i>	25(1.2)	125(4.8)				150(2.4)	
<i>Strombus luhuanus</i>		82(3.2)				82	
<i>Strombus mutabilis</i>	10(.5)					10	
<i>Strombus thersites</i>	155(7.4)					155	
<i>Cypraea arabica</i>	12(.6)					12	
<i>Cypraea tigris</i>		70(2.7)				70	
<i>Charonia tritonis</i>		47(1.8)				47	
<i>Bursa granularis</i>		6(.2)				6	
<i>Murex torrefactus</i>	19(.9)	140(5.4)	24(1.5)			183(2.9)	
<i>Coralliophila bulbiformis</i>	5(.3)					5	
<i>Latirolagena smaragula</i>		20(.7)				20	
<i>Vasum turbinellum</i>		65(2.5)				65	
<i>Conus generalis</i>		8(.3)				8	
<i>Conus litteratus</i>	27(1.3)					27	
<i>Conus marmoreus</i>	9(.5)					9	

Table 5 (cont.)

Univalves (cont.)	Pit 1			Pit 3		
	6-12"	12-18"	18-24"	Total	24-30"	30-36"
<i>Conus miles</i>	-	8 (.3)	-	8 (.1)	21 (7.0)	-
<i>Conus rattus</i>	-	-	-	-	16 (5.4)	1 (0.0)
<i>Conus sp.</i>	-	29 (1.1)	-	29 (.5)	-	-
<i>Terebra crenulata</i>	25 (1.2)	100 (3.9)	90 (5.5)	215 (3.4)	-	-
<i>Terebra maculata</i>	-	-	-	-	-	-
<b>Bivalves</b>						
<i>Arca scapha</i>	104 (5.0)	457 (17.7)	242 (14.7)	803 (12.7)	90 (30.2)	-
<i>Isognomon isognomum</i>	-	84 (3.3)	-	84 (1.3)	4 (1.3)	-
<i>Spondylus bucleri</i>	-	48 (1.9)	-	48 (.7)	-	-
<i>Spondylus ducalis</i>	30 (1.4)	18 (.7)	-	48 (.7)	6 (2.0)	-
<i>Ostrea commercialis</i>	182 (8.7)	546 (21.1)	752 (45.7)	1480 (23.4)	45 (15.1)	4
<i>Chama imbricata</i>	227 (10.8)	20 (.8)	22 (1.3)	269 (4.3)	22 (7.4)	40 (37.4)
<i>Chama iostoma</i>	35 (1.7)	-	223 (13.6)	258 (4.1)	-	-
<i>Hippopus hippopus</i>	548 (26.1)	14 (.5)	-	562 (8.9)	-	-
<i>Tridacna maxima</i>	-	-	-	-	8 (2.7)	-
<i>Tridacna sp.</i>	-	-	1 (.1)	1 (-)	-	-
<i>Circe trigona</i>	34 (1.7)	-	-	34 (.5)	-	-
<i>Cyrene caledonica</i>	23 (1.1)	34 (1.3)	33 (2.0)	90 (1.4)	2 (.7)	2 (2.0)
<i>Gafrarium pectinatum</i>	-	2 (-)	-	2 (-)	-	-
<i>Mesoddsma glabrata</i>	21 (1.0)	43 (1.7)	-	64 (1.0)	2 (.7)	-
<i>Periglypta puerpera</i>	-	-	-	-	-	-
<b>Miscellaneous</b>						
<i>Heterocentrotus mammillatus</i>	Tr.	Tr.	-	Tr.	-	-
<b>Coral</b>	-	-	-	-	-	44 (41.5)
<b>Totals</b>						
Univalves	895 (42.6)	1318 (51.0)	371 (22.6)	2584 (40.8)	119 (39.9)	20 (18.7)
Bivalves	1204 (57.4)	1266 (49.0)	1273 (77.4)	3743 (59.2)	179 (60.1)	42 (32.0)
Miscellaneous	Tr.	Tr.	-	Tr.	-	44 (41.5)
Total Shell	2099	2584	1644	6327	298	106

Table 6a: Comparative Total Shell Distribution in TARS1, Pits 1,2,3

Depth	Pit 1	Pit 2	Pit 3
0-6"U	450/39	282/8	352/55
B	88/0	58/0	120/0
M	53/2#	73/0	31/1
6-12"U	354/108	333/83	303/82
B	45/2	47/1	14/0
M	44/9	74/0	23/0
12-18"U	112/2	190/134	175/21
B	14/0	11/5	28/0
M	6/2 2	32/2	8/0
18-24"U	268/39	131/31	130/14
B	8/2	14/3	18/0
M	32/0	10/1	12/0
24-30"U	187/20	112/2	225/20
B	6/0	13/0	13/0
M	15/0	9/1	13/0
30-36"U	15/0	370/22	161/14
B		22/0	4/0
M		18/3	11/0
36-42"U	139/25	65/13	133/5
B	2/0	7/1	20/2
M	16/2	3/0	13/0
42-48"U	63/6	93/20	59/0
B	4/0	2/0	2/0
M	6/3	4/1	1/0
48-54"U	122/0	66/0	50/0
B	—	—	12/0
M	2/0	2/0	4/0
54-60"U	78/34	77/0	35/4
B	11/0	4/0	3/0
M	18/0	2/0	5/0
60-66"U	16/15	35/0	147/11
B	11/1	4/0	32/0
M	3/0	2/0	6/0
66-72"U	86/15	100/3	135/20
B	8/0	10/0	27/0
M	23/4	10/2	135/1*
72-78"U			134/18
B			11/0
M			28/0
78-84"U			173/20
B			12/1
M			32/0
84-90"U			196/24
B			0/2
M			93/0°
90-96"U			102/19
B			2/0
M			33/0#
96-102"U			79/14
B			12/0
M			11/0#
Total U	2020/305	1855/316	2589/341
B	197/5	192/10	330/5
M	218/27	239/10	459/2
Total	2435/337	2286/336	3378/348

## Note:

U—Univalves  
 B—Bivalves  
 M—Miscellaneous, including urchins, chitons, barnacles, land snails, and decapod remains.

\*—mainly *Heterocentrotus* (spines) mamillatus, but all very fragmented.

°—mainly *Heterocentrotus* mamillatus spines, but not broken.

#—includes at least 8 grams of decapod remains

Univalves are predominant at all levels.

Table 6b: Comparative Total Shell Distribution in TARS3 Loc A, Pits 1-14

Pit No.	0-6"	6-12"	12-18"	18-24"	24-30"	30-36"	36-42"	Total	Totals
				24-30"	30-36"	36-42"			
1 U	87/0	29/2	103/0	38/0	X	X	X	257/2	335/3
B	8/1	12/0	6/0	11/0	X	X	X	37/1	
M	20/0	9/0	6/0	6/0	X	X	X	41/0	
2 U	127/9	113/10	66/4	X	X	X	X	306/23	485/23
B	25/0	32/0	12/0	X	X	X	X	69/0	
M	57/0	28/0	25/0	X	X	X	X	110/0	
3 U	216/11	100/5	49/0	31/0	X	X	X	396/16	749/17
B	27/0	55/0	20/0	1/0	X	X	X	103/0	
M	199/1	46/0	4/0	1/0	X	X	X	250/1	
4 U	217/20	75/3	41/2	X	X	X	X	333/25	541/29
B	52/0	27/2	30/1	X	X	X	X	109/3	
M	67/1	17/0	15/0	X	X	X	X	99/1	
5 U	530/3	61/0	27/2	X	X	X	X	618/5	753/23
B	50/0	18/0	11/0	X	X	X	X	79/0	
M	35/0	3/18	18/0	X	X	X	X	56/18	
6 U	360/90	75/0	119/0	X	X	X	X	554/90	731/90
B	71/0	9/0	3/0	X	X	X	X	83/0	
M	82/0	11/0	1/0	X	X	X	X	94/0	
7 U	89/10	32/0	183/10	X	X	X	X	304/10	418/15
B	52/4	15/0	18/0	X	X	X	X	85/4	
M	25/1	1/0	3/0	X	X	X	X	29/1	
8 U	201/0	59/0	80/0	54/0	X	X	X	394/0	524/0
B	39/0	7/0	32/0	13/0	X	X	X	91/0	
M	28/0	5/0	4/0	2/0	X	X	X	39/0	
9 U	182/0	24/0	161/5	253/2	X	X	X	620/7	759/7
B	17/0	8/0	9/0	45/0	X	X	X	79/0	
M	6/0	2/0	32/0	19/0	X	X	X	60/0	
10 U	210/1	127/0	85/6	69/1	384/5	184/4	X	1059/17	1283/18
B	56/0	22/0	15/0	1/0	20/0	13/0	X	127/0	
M	26/1	8/0	13/0	2/0	26/0	22/0	X	97/1	
11 U	118/0	96/9	131/0	195/15	301/0	176/9	X	1017/34	1258/34
B	11/0	49/0	11/0	28/0	13/0	19/0	X	131/0	
M	15/0	23/0	12/0	7/0	19/0	34/0	X	110/0	
12 U	110/2	206/40	130/1	134/4	294/21	186/0	X	1050/68	1407/69
B	94/0	27/0	91/0	13/0	22/1	2/0	X	249/1	
M	10/0	16/0	14/0	22/0	38/0	8/0	X	108/0	
13 U	94/2	154/7	178/2	457/0	1652/0	X	X	2535/21	3035/21
B	12/0	43/0	26/0	77/0	119/0	X	X	277/0	
M	13/0	12/0	7/0	39/0	152/0	X	X	223/0	
14 U	259/0	96/0	273/4	455/0	1184/0	1387/0	635/0	4289/4	4774/4
B	17/0	11/0	40/0	14/0	72/0	43/0	24/0	221/0	
M	20/0	12/0	9/0	12/0	93/0	90/0	28/0	264/0	

17052/353

X--Sterile

Univalves predominant at all levels

Table 6C: Comparative Total Shell Distribution in TARS3 Loc C, Pits 1-9

Depth	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6	Pit 7	Pit 8	Pit 9
0-6"U	151/20	282/23	145/0	345/0	94/0	99/0	113/16	66/2	221/0
B	14/0	29/0	118/0	79/0	34/0	24/0	85/2	16/0	17/0
M	65/0	61/0	22/0	27/0	32/1	8/0	33/0	29/0	57/0
6-12"U	122/1	137/0	98/3	174/0	52/0	30/0	63/7	212/4	146/0
B	22/0	30/0	21/0	24/0	16/0	16/0	52/0	30/0	31/0
M	9/0	34/0	31/0	30/0	94/0	8/0	37/0	39/0	51/0
12-18"U	101/0	171/11	86/7	165/0	76/1	14/0	X	170/4	141/0
B	2/0	34/0	14/0	21/0	10/0	6/0	X	30/0	22/0
M	14/0	7/1	26/0	14/0	48/0	X	X	44/0	44/0
18-24"U	131/0	126/0	105/0	141/0	X	X	X	240/0	82/0
B	7/0	9/0	25/0	10/0	X	X	X	28/0	21/0
M	10/0	4/0	14/0	4/1	X	X	X	16/0	19/0
24-30"U	113/0	148/0	38/0	X	X	X	X	194/2	109/1
B	18/0	6/0	---	X	X	X	X	48/0	43/0
M	12/0	6/0	1/0	X	X	X	X	38/0	17/0
30-36"U	224/14	139/0	97/0	X	X	X	X	16/2	95/1
B	3/0	16/0	1/0	X	X	X	X	9/0	15/1
M	19/0	32/0	1/0	X	X	X	X	1/0	6/0
36-42"U	134/21	173/0	X	X	X	X	X	X	97/0
B	13/0	22/0	X	X	X	X	X	X	28/0
M	19/0	11/4	X	X	X	X	X	X	27/0
42-48"U	87/5	147/9	X	X	X	X	X	X	121/0
B	15/0	19/1	X	X	X	X	X	X	---
M	9/0	25/0	X	X	X	X	X	X	26/0
48-54"U	111/3	66/0	XX	X	X	X	X	X	116/0
B	32/0	7/0	X	X	X	X	X	X	13/0
M	23/0	10/0	X	X	X	X	X	X	9/0
54-60"U	86/2	X	X	X	X	X	X	X	X
B	4/0	X	X	X	X	X	X	X	X
M	6/0	X	X	X	X	X	X	X	X
Total U	1260/66	1389/43	569/10	825/0	222/1	143/3	176/23	898/14	1128/2
B	130/0	172/1	179/0	134/0	60/0	46/0	137/2	161/0	190/1
M	186/0	190/5	95/0	75/1	174/1	16/0	70/0	143/0	256/0
Total	1576/66	1751/49	843/10	1034/1	456/2	205/3	383/25	1202/14	1574/3
X--Sterile	1642	1800	853	1035	458	208	408	1216	1577

9020/173

Table 7: Comparative Total Shell Distribution in Miscellaneous Sites

Site	0-6"	6-12"	12-18"	18-24"	24-30"	30-36"	72-78"
ATRS3 U	X	X	X	X	X	X	93/1
Pit 1 B	X	X	X	X	X	X	--
M	X	X	X	X	X	X	7/0
EF3 Loc B							
Tr H							
Pit 12 U	340/0						
B	339/0						
M	--						
EF3 Loc C							
Tr A							
Pit 1 U	382/24						
B	383/0						
M	1/0						
EF3 Loc D							
Pit 1 U	X	895/0	1318/0	371/0	X	X	
B		1204/0	1266/0	1273/0			
M		Tr	Tr	--			
EF3 Loc D							
Pit 3 U	X	X	X	X			
B							
M							
EF3 Loc E							
Pit 1 U	317/0	389/0/0	172/0				
B	212/0	367/4	367/0				
M	--	2/0	--				
Pit 2 U	X	X	81/0				
B			96/0				
M			1/0				
Pit 3 U	X	745/0					
B		800/0					
M		--					

Tr---Trace -- less than 1/2 gram  
 X---No excavation material for analysis

Results of statistical tests performed on some of the sites are shown as follows:

1. Amounts of Turbo spp. do not significantly differ in TARS3 Loc. A Pit Nos. 3 and 6 ( $\chi^2 = 3.49$ ,  $df=1$ , not significant). (See Calculation A).
2. Amounts of Turbo spp. do not differ significantly in TARS3 Loc. A Pits 3 and 14 ( $\chi^2 = 2.55$ ,  $df=1$ , not significant). (See Calculation B).
3. TARS3 Loc. A is a homogeneous area or site with respect to the presence of the dominant shellfish represented (Turbo).
4. Using Turbo opercula as representative of the Turbo spp., and the two way analysis of variance, it was shown that the horizontal and vertical distributions do not differ significantly between TARS1 Pit No. 1, TARS3 Loc. A Pit No. 14, and TARS3 Loc. C Pit No. 1. ( $F=2.02$ ,  $df=2,10$ , not significant;  $F=.41$ ,  $df=5,10$ , not significant). (See Calculation C).
5. Although when all the Tanna sites are considered, there is significant difference with respect to weight of Turbo spp. ( $\chi^2 = 184.21$ ,  $df=1$ ,  $p < .001$ ), (See Calculation D) the area can be said to have drawn from the same resources with common operatives of selection because of the previous results and the fact that Turbo spp. and Trochus spp. are the dominant shellfish in all the Tanna sites. (see Table 9).
6. A comparison of Tanna and Efate sites does not reveal homogeneity of composition; for where the rockshelter sites in Tanna are abundant in Turbo spp. and Trochus spp., the sites on Efate, which are open village sites, reveal an abundance of Bivalves, particularly Arca spp., Chama spp., and Tridacna spp. (See Table 8).

In TARS3 Loc. A, a decrease of Turbo spp. in one pit is offset by an increase in another (see Chart 2), suggesting alternate uses of sub-areas for refuse disposal. Pits 3 and 6 reveal evidence of recent use, for the greatest percentage of midden material was found in the upper layer; whereas

Pit 14 had the greatest percentage of midden material in the lower levels (60.5% in 24-36" levels).

In TARS1 Pit 1, the decline of the amount of one species of Turbo corresponds to a rise in the amount of another species of Turbo, indicating that while the species of Turbo were fluctuating, the overall amount of Turbo spp. remained constant. This pattern is to be found in all of the sites (see Chart 1), suggesting that one cannot assume uniform deposition of refuse in sites, and therefore, testing and excavation must be acted upon accordingly.

#### SUMMARY

From the information analysed, several patterns were noted. No dietary change of any great significance was indicated: Turbo spp. remained constant with respect to vertical distribution in the rockshelter sites on Tanna; Turbo spp. and Trochus spp. providing about 55% of the midden composition, i.e., utilization of the same aspects of the shellfish environment are represented in all Tanna sites, providing evidence of a common economic base, which remained constant and stable through time.

On Efate, because the sites analysed were open village sites of no great depth, I would only tentatively speculate that there exists a difference between rock shelters and open village sites with respect to the dominant families of shellfish represented. As for diet, Rippingdale and McMichael (1961:181) wrote that Chama, abundant in the Efate site, is unfit for eating, so its abundance may possibly be accounted for through natural causes, as Chama is a beach shellfish. But the insignificance of Turbo spp. and the dominance of Bivalves over Univalves would lend credence to such a speculation of an open village - Rockshelter difference. But more open village sites should be tested to verify this.

Great changes in water temperature cannot be postulated for this area: Turbo is a warm water shellfish, and its presence in quantity through time suggests no drastic changes.

PROBLEMS

As the statistical analysis of midden deposits is manifold removed from the actual deposition of the material in the ground there is opportunity for error to be introduced between deposition and interpretation; i.e., if one perceives archaeological material as having its origin in one culture, and its analysis in another, then there will be seen several stages of processing, any or all of which may reflect non-random selection of traits.

Culture A

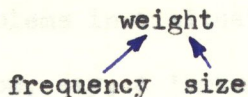
↓  
material remains.....acted upon by Culture B

- ↓
- {
- selection
- excavation
- collection
- recording
- classifying
- coding
- analysing
- }

Table b

Moving from the realm of observation to empirical realities of the shellfish themselves, there is a problem concerning the inferences that one draws due to certain information. For example, as Ambrose (1963:157) has pointed out, a shift in the ratios by weight of certain shellfish may lead one to infer that this shift was the result of changes in cultural preferences or the physical environment; although a count of shell frequencies, if possible, might show a constant preference or use. Thus, the analysis of shellfish can be seen to be a threefold situation, of which only one has been considered in this paper - weights of species groups. The other two aspects are frequency of occurrence and size of individual shells, which require careful sampling procedures and measurements.

Interaction of components of shellfish measurements ( Table c ):



Differences in midden composition that are due to chance can be tested statistically for significance, but random sampling, or at least non-selective collection of material, is something that must be performed in the excavation of a site - the bias of the collector ideally being absent in the sampling procedure. Statistical tests performed on selective samples reveal only selective patterns, and, in such cases a qualitative analysis would be an appropriate approach. Indeed, if selection is done qualitatively at all levels of a site, then samples are not random samples, but rather reflections of the interests of the collector.

For proper sampling techniques that would reduce the bias of the excavator, there should be a control sample pit or excavation and subsequent 'samples' should be compared with this (using Chi-square) to see if the samples are indeed representative of the material present and are random samples.

Also, if practical, a grid should be surveyed out and squares selected for excavation using random number tables, thus providing random excavations. Thus, given the nature of samples such as the one concerned with in this paper, there must be a realization of the limitations of analysis given the nature of the samples, and the fact that the samples are often a reflection of interests not manifested within the structure of the site. Thus the systematic sampling of a midden is of prime importance for the processes of interpretation.

The main purpose of this essay was the conceptualization of a methodical framework for midden analysis; to compare trends of percentage composition by weight of different shell species to find patterns of occurrence, trends

similar enough so as to be termed the result of 'like patterns of utilization'. One of the main problems in a situation such as this is that we are not measuring deviations from, say, a 'normal population distribution', as there exists no ideal pattern of occurrence of deposition. A random sample collection will hopefully provide an outline of the structure of the total distribution.

The basic assumption of this study has been that shell midden deposits can be used to determine changes (if any) through time with respect to cultural and environmental phenomena.

### CONCLUSIONS

There was found to be no significant change either vertically or horizontally with respect to midden composition, except when rock shelters and open village sites were compared with respect to weights of species represented.

The diet did not change significantly over the period tested; cultural and environmental factors remaining stable for a period of about 2500 years. Turbo spp. is the most abundant shellfish in the rockshelters; whereas Bivalves are predominant in the open village sites of Efate. Tanna represents a homogeneous area with respect to shell fish diet. The operatives determining midden composition are different for the sites analysed on Efate as compared to Tanna, and while there is evidence of a rock shelter--open village site difference, we cannot conclude that Efate had different cultural operatives. The reasons for the differences would have to be answered in terms of physical environment (presence or absence of a reef, etc.).

Operatives determining midden composition:

#### Rock Shelter

Cultural selection mainly.

#### Open village (beach)

Natural deposition juxtaposed with cultural selection.

With respect to collecting habits, the continued abundance of *Turbo* spp., a reef shell, would indicate small scale gathering of the fauna, rather than large-scale harvesting of other shellfish types, thus possibly suggesting a low population density.

<i>Turbo</i>	18.75	7.65	7.85	27.05	11.95	13.75	18.25
<i>Turbo</i>	15.5	10.7	15.2	30.6	10.5	11.5	15.5
<i>Natica</i>	2.5	24.9	5.5	4.5	8.5	6.5	—
<i>Natica</i>	0.5	10.4	0.7	14.6	7.1	—	—
<i>Strophomena</i>	—	15.0	0.5	0.2	8.2	4.5	3.0
<i>Arca</i>	—	—	0.5	0.7	—	12.7	27.0
<i>Chama</i>	—	1.2	3.0	0.4	0.0	17.0	25.3
<i>Tridacna</i>	—	—	—	0.2	—	2.7	3.0
<i>Callinectes</i>	1.2	7.0	4.9	0.5	2.2	—	—
<i>Bivalvia</i>	4.0	11.0	21.5	41.0	31.0	11.5	31.4
<i>Bivalvia</i>	7.5	15.5	20.5	4.5	8.0	39.7	51.7
<i>Misc.</i>	7.1	12.5	11.4	5.4	11.0	—	10.9

See 2-4-60

Represented only by 21-30"

Table 8

## Dominant Families: Percentage Composition by Weight

Family	TARS3 Loc.A				TARS3 Loc.C	EF3 Loc.D	
	Pit 1	Pit 3	Pit 6	Pit 14	Pit 1	*Pit 1	+Pit 3
Trochus	18.3%	2.8%	7.8%	27.0%	11.9%	9.7%	9.1%
Turbo	46.1	33.7	55.8	30.6	40.5	0.8	6.4
Hetero- centrotus	5.4	24.9	6.5	4.5	8.0	Tr.	--
Pythia	0.5	0.4	0.5	14.6	3.1	--	--
Strombus	--	2.0	0.3	0.2	0.2	8.4	3.0
Arca	--	--	0.3	0.9	--	12.7	22.3
Chama	--	5.2	5.0	0.4	0.5	27.7	26.5
Tridacna	--	--	--	0.3	--	8.9	2.0
Chiton	1.8	7.2	4.9	0.8	2.2	--	--
Univalves	84.3	54.0	78.5	90.0	81.0	40.8	34.4
Bivalves	7.3	13.5	10.1	4.6	8.0	59.2	54.7
Misc.	8.4	32.5	11.4	5.4	11.0	--	10.9

\*No 0-6" count

+ Represented only by 24-36"

Table 9

Comparison of Percent Composition of Sites With Respect to  
Dominant Family of Shellfish.

		<u>Turbo spp.</u>					
		TARS3 Loc.C Pit 1	TARS1 Pit 1	TARS3 Loc.A Pit 3	Loc.A Pit 6	TARS3 Loc.A Pit 14	
Depth ↓		41.2%	40.7%	36.3%	41.2%	66.9%	
		47.7	41.9	22.8	75.1	47.9	
		48.9	45.6	45.2	<u>52.9</u>	26.4	
		46.4	50.3	<u>45.4</u>		45.7	
		40.1	64.6			27.6	
		36.3	54.4			22.1	
		25.0	36.3			<u>32.3</u>	
		25.1	73.4				
		<u>51.0</u>	31.2				
			38.8				
			<u>33.4</u>				
Total		361.7	510.6	149.7	169.2	268.9	
Average		40.2	46.4	37.4	56.4	38.4	43.2%
Standard Deviation		9.1	12.6	10.7	14.1	14.7	
Coefficient of Variability		0.226	0.271	0.308	0.250	0.382	

Chama spp.

		EF3 Loc.D Pit 1
Depth ↓		19.5%
		21.9
		<u>46.0</u>
Total		87.4
Average		29.1
Standard Deviation		12.0
Coefficient of Variability		0.411

Table 10  
Shellfish Types and Site Types:

Island	Site	Predominate Shellfish Type		Type of Site	
		Univalves	Bivalves	Rockshelter	Open Village
Tanna	TARS1	x		x	
Tanna	TARS3 Loc.A	x		x	
Tanna	TARS3 Loc.C	x <sub>1</sub>		x	
Efate	EF3 Loc.B	x	x		x
Efate	EF3 Loc.C	x			x
Efate	EF3 Loc.D		x		x
Efate	EF3 Loc.E		x		x
Aneityum	ATRS3	x		x	

1 equal distribution

Table 11  
Distribution of Shellfish:

Name	Location	Use
Arca	coral reefs estuarine mud flats	
Nerita	shorelines	
Trochus	littoral zone	buttons, shell necklaces
Chama	coral boulders	unfit for eating
Tridacna	lagoon, reefs coral boulders	food
Turbo	coral reefs littoral zone	food
Conus		artifacts

Chart 1

TARS 1  
PIT. 1

PERCENTAGE COMPOSITION BY  
WEIGHT OF MOST ABUNDANT SPECIES  
PER TOTAL SHELL WEIGHT PER LEVEL

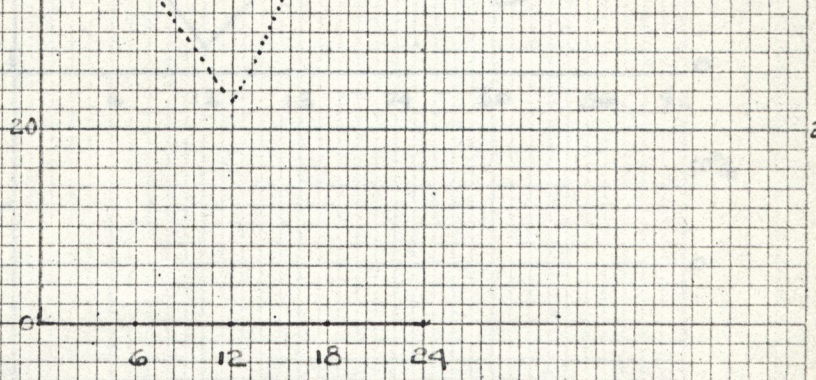
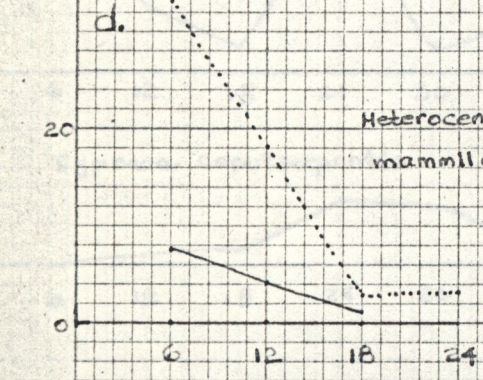
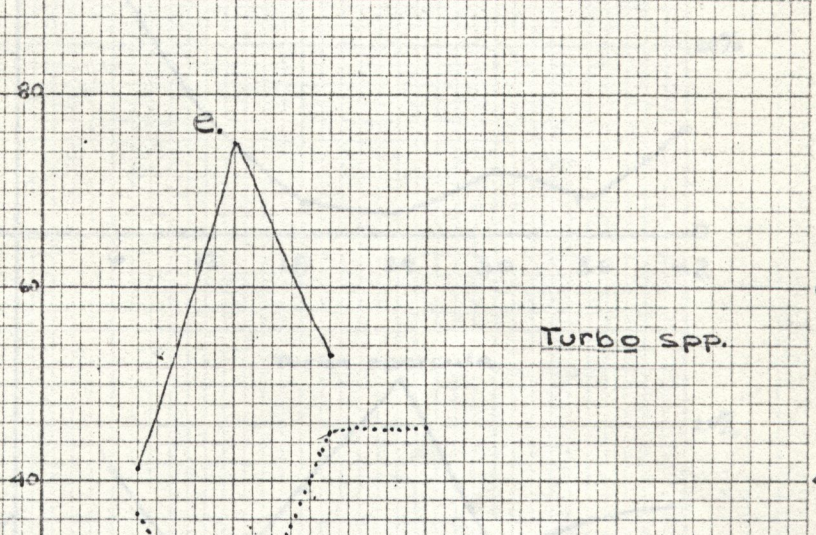
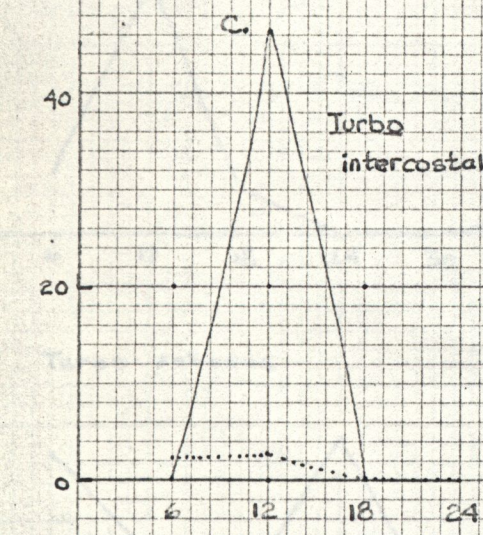
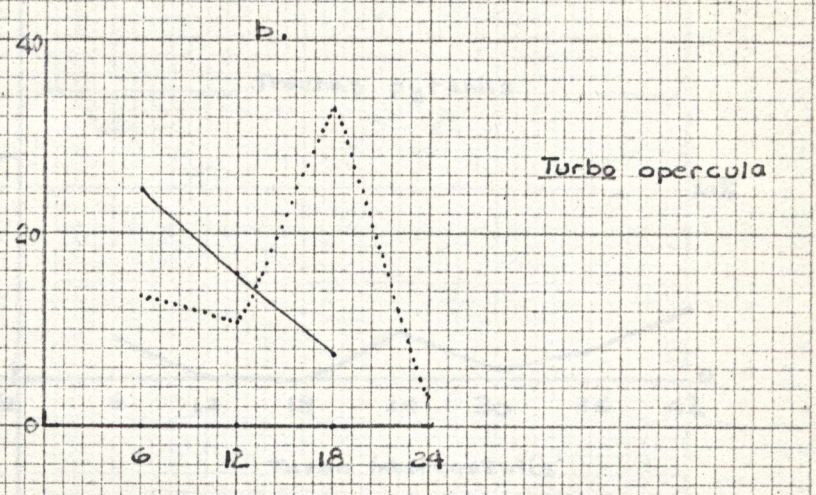
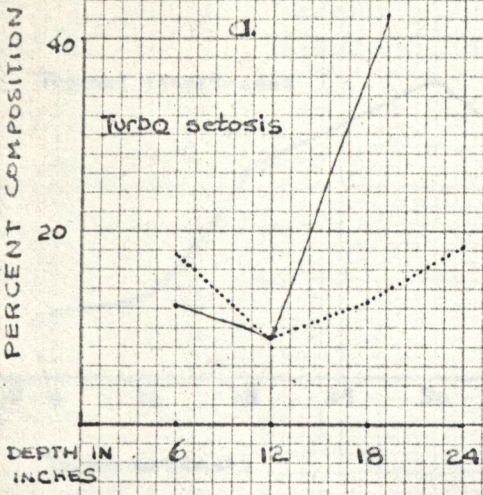


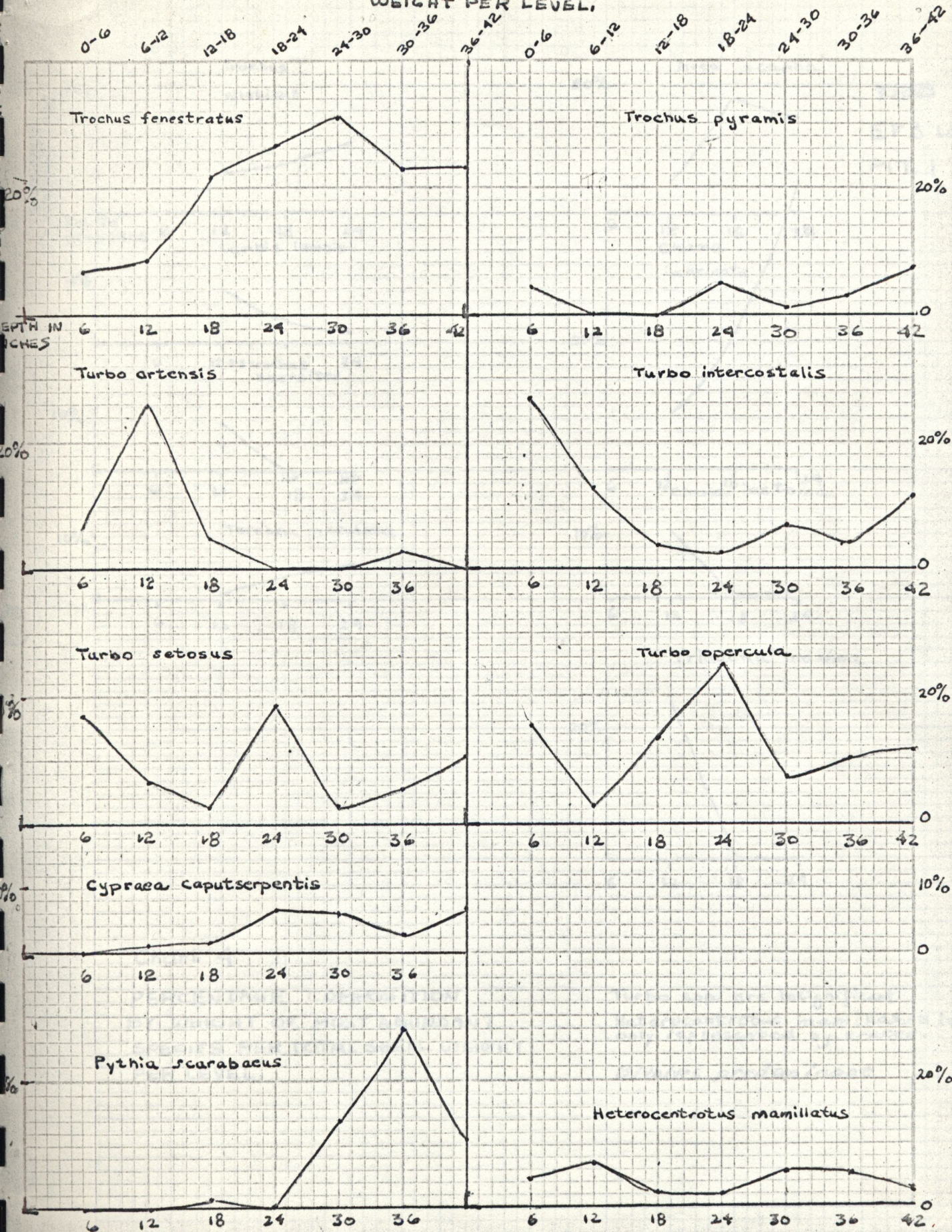
PERCENTAGE COMPOSITION BY WEIGHT OF MOST ABUNDANT SPECIES PER TOTAL SHELL WEIGHT PER LEVEL

TARS 3 Loc. A

Pit 3 .....

Pit 6 ———





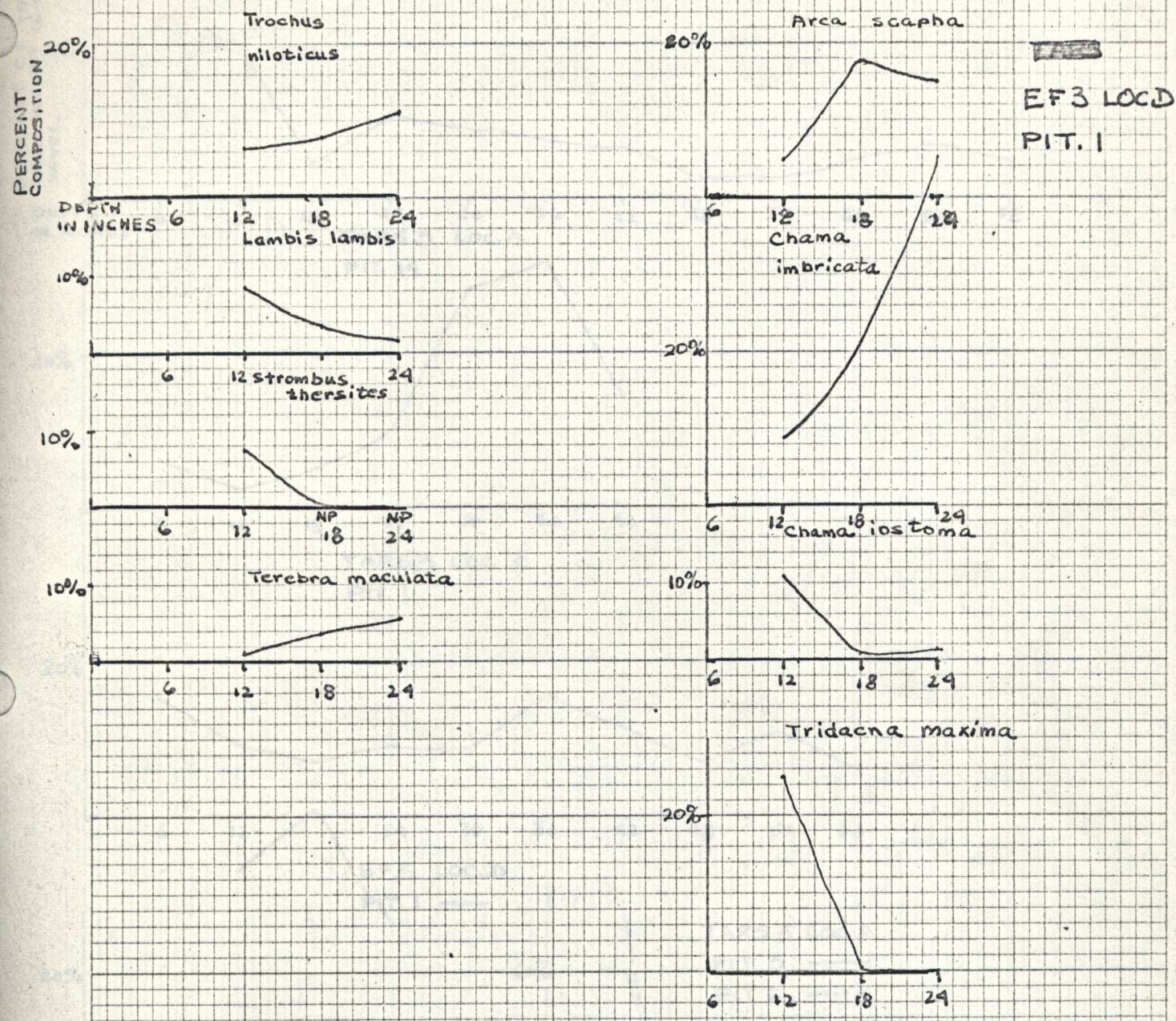


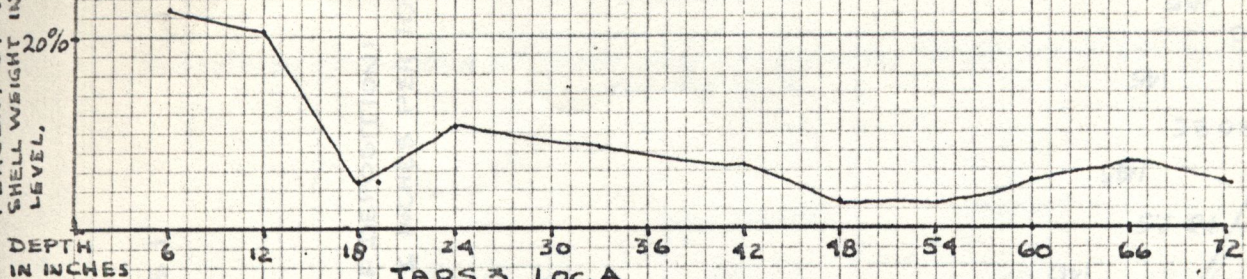
Chart 4

PERCENTAGE COMPOSITION  
BY WEIGHT OF MOST ABUNDANT  
SPECIES PER TOTAL SHELL WEIGHT  
PER LEVEL.

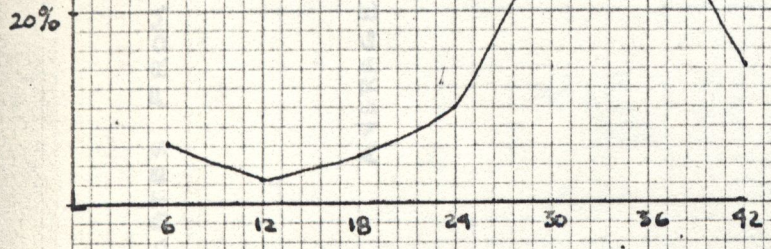
Turbo spp. are insignificant  
Heterocontrotus mamillatus is  
only represented by traces.  
Bivalves predominant

PERCENT OF TOTAL SHELL WEIGHT IN EACH LEVEL,

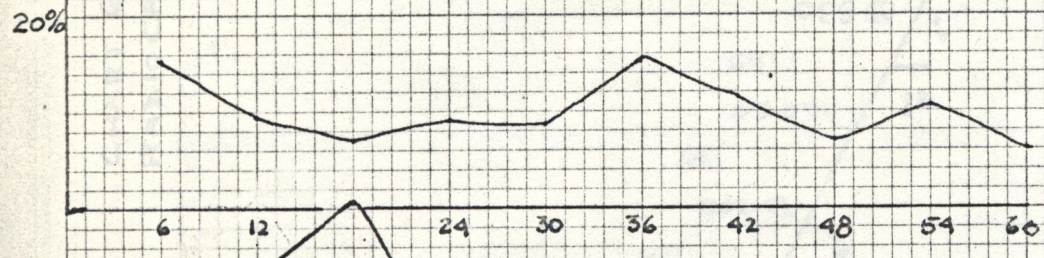
TARS 1 PIT 1



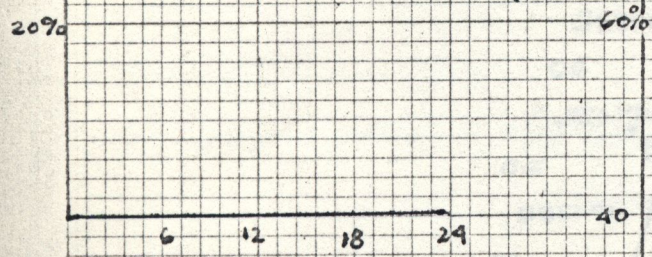
TARS 3 LOC. A  
PIT. 14



TARS 3 LOC. C  
PIT. 1



EF3 LOC. D  
PIT. 1



TARS 3 LOC. A  
PIT 3 ———  
PIT 6 ······

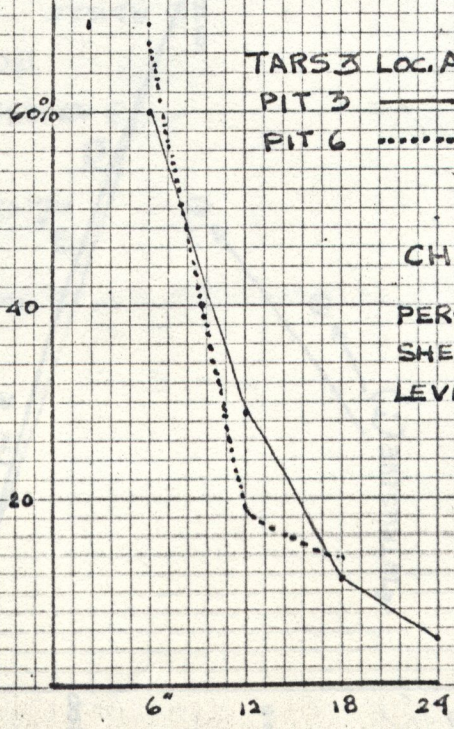
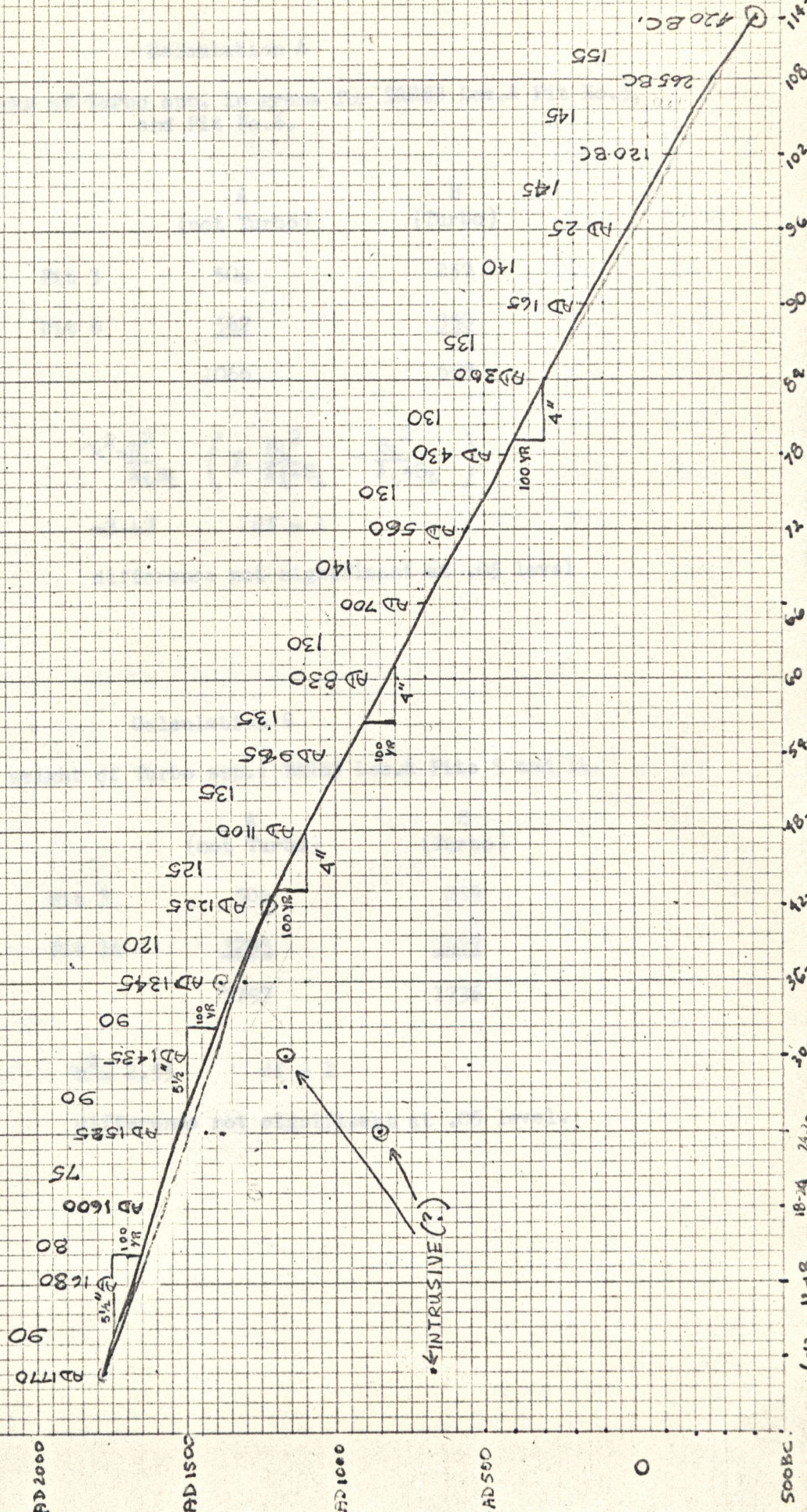


CHART 5  
PERCENTAGE OF TOTAL SHELL WEIGHT IN EACH LEVEL.

CHART 6  
RADIOCARBON DATES FROM TARS I

AVERAGE RATE OF DEPOSITION:  
4.6 INCHES PER 100 YRS.



## Calculation A

Comparison of weights of Turbo spp. in grams for TARS3 Loc.A Pit No.3,  
and Pit No.6.

	A (not Turbo)	B (Turbo)
Pit 3	504	259
Pit 6	<u>562</u>	<u>350</u>
	1066	609

$$\chi^2 = \frac{N^2}{A_t B_t} \left( \sum \frac{B_i^2}{A_i + B_i} - \frac{B_t^2}{A_t + B_t} \right)$$

$$= 3.49 \quad df = 1$$

difference not significant at .05 level

## Calculation B

Comparison of weight of Turbo spp.: TARS3 Loc.A Pits 3 and 14.

	A (not Turbo)	B (Turbo)
Pit 3	504	259
Pit 14	<u>3293</u>	<u>1477</u>
	3797	1736

$$\chi^2 = 2.55 \quad df = 1$$

difference not significant at .05 level.

## Calculation C

## Turbo opercula: Percentage Composition by Levels

Level	TARS1 Pit 1	TARS3 Loc.A Pit 14	TARS3 Loc.C Pit 1	$\Sigma x_r$	$\bar{x}_r$
6"	21.1%	15.5%	25.6%	62.2%	20.7%
12"	23.5	2.5	19.5	45.5	15.2
18"	15.7	13.8	23.5	53.0	17.7
24"	18.2	24.5	14.7	47.4	15.8
36"	21.9	17.5	20.1	59.5	19.8
42"	<u>37.5</u>	<u>11.4</u>	<u>16.0</u>	<u>64.9</u>	<u>21.6</u>
$\Sigma x_c$	137.9	85.2	109.4	Total Sum 332.5	
$\bar{x}_c$	22.98	14.2	18.3	Average	18.47

	Sum of Squares	Degrees of freedom	Estimate of variance	F/
Total	1062.4	17	132.65	
Between columns	265.3	2	132.65	2.02 n.s. at .05 level
Between rows	140.2	5	28.04	0.42 n.s.
Error	656.9	10	65.69	

no significant difference between the sites.

$\Sigma x_r$  = sum of row scores

$\Sigma x_c$  = sum of column scores.

## Calculation D.

## Comparison of weight of Turbo spp.

	A (not Turbo)	B (Turbo)
TARS1 Pit 1	1484	1274
TARS3 Loc.A Pit 3	504	259
Pit 6	562	350
Pit 14	3293	1477
TARS3 Loc.C Pit 1	<u>978</u>	<u>657</u>
Total	6821	4017

$$\chi^2 = 184.21 \quad df = 4$$

difference significant at .001 level

	A (not Turbo)	B (Turbo)
TARS3 Loc. A Pit 6	562	350
TARS3 Loc. C Pit 1	978	657
Total	11540	11007

$$\chi^2 = 0.47 \quad df = 1$$

difference not significant at .05 level

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