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PALEOECOLOGY OF PLEISTOCENE MOLLUSCA FROM THE IRONSHORE FORMATION, GRAND CAYMAN, B.W.I.

by

SARAH ANNE CERRIDWEN ©

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled PALEOECOLOGY OF PLEISTOCENE MOLLUSCA FROM THE IRONSHORE FORMATION, GRAND CAYMAN, B.W.I. submitted by SARAH ANNE CERRIDWEN in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE in GEOLOGY.

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Supervisor

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Date ...August 18, 1989...

ABSTRACT

The mollusc fauna of the Ironshore Formation on Grand Cayman contains 83 bivalve and 90 gastropod species. Preservation is good, with little evidence of transport or breakage. Molluscs were collected from the reef tract, patch reef, interreef and lagoonal environments of the Ironshore Lagoon.

R-mode cluster analysis, based on 65 species, delineated seven species associations belonging to two groups. The first group, characterized by *Americardia guppyi*, *Anodontia alba*, *Cerithium spp.*, *Chione spp.*, *Codakia spp.*, *Crassinella martinicensis*, *Gouldia cerina*, *Laevicardium laevigatum*, *Linga pensylvanica*, *Pitar fulminatus*, and *Tellina spp.* inhabited the interreef and lagoonal environments. The second group, characterized by arcids, chamids, and numerous gastropods, inhabited patch reefs and the reef tract.

Q-mode analysis, based on 32 localities, delineated seven locality groupings. Locality grouping 1 occurred in the reef tract. Locality grouping 2 occurred in the patch reefs, with one locality in the reef tract. Locality grouping 3 occurred around small patch reefs, where reef and interreef deposits interfinger. Locality groupings 4 and 6 occurred in the interreef deposits around the patch reefs. Locality grouping 5 occurred in the main part of the lagoon. Locality grouping 7 occurred in the western part of the lagoon.

Distribution of species was controlled primarily by substrate type. Species group 1 occurred on soft sediment substrates in the interreef and lagoon environments, whereas species group 2 inhabited the hard substrates of reefs.

The reef tract (locality grouping 1) is dominated by free-living carnivorous, omnivorous and herbivorous gastropods, whereas the patch reefs (locality grouping 2) are dominated by epifaunal suspension feeding bivalves

with cementing, byssate and boring life habits. Infaunal suspension feeding burrowing bivalves dominate at interreef and lagoon localities, where epifaunal deposit feeding gastropods and suspension feeding bivalves are also abundant. Lagoonal localities (locality grouping 5) have a greater number of dominant species than interreef localities (locality grouping 4). Mixed reef/interreef localities (locality grouping 3) have lower dominance and higher species richness than either reef or interreef localities. Interreef (locality grouping 6) and lagoonal localities (locality grouping 7) in close proximity to the reef tract contain significant numbers of reef species (gastropods and epifaunal bivalves).

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

I. INTRODUCTION

The structure and composition of a community is determined by both the physical environment (e.g. salinity, substrate type, for marine communities) and biologic interactions (e.g. competition, predation). Fossil communities are therefore useful in interpreting ancient physical environments, in particular for reconstructing those aspects which are not preserved, e.g. salinity or turbidity (Johnson, 1964, Walker and Bambach, 1974a; Zeigler, 1974; Kauffman and Scott, 1976). The relationship between community composition and structure to the physical environment in benthic marine settings has been described in both ecology (Petersen, 1911 - 1918, 1924; Thorson, 1957; Newell *et al.*, 1959; Sanders, 1960; McNulty *et al.*, 1962; Robertson, 1963; Hoskins, 1964; Johnson, 1964; Warme, 1969; Turney and Perkins, 1972; Ekdale, 1974, 1977; Taylor and Reid, 1984) and paleoecology (Bretsky, 1969; Bowen *et al.*, 1974; Scott, 1974; Thayer, 1974; Keen, 1977; Ausich, 1980; Bottjer and Ausich, 1986; Yoshida, 1987). Major paleoecological studies of Pleistocene molluscs are notably absent, although limited surveys have been made on the Pleistocene molluscs of Grand Cayman (Brunt *et al.*, 1976; Woodroffe *et al.*, 1980).

Some studies begin with the assumption that the physical environment and faunal distribution patterns are directly correlated. Distinct physical environments are determined first, then the fauna in each environment is described (e.g. Jones, 1950; Robertson, 1963; Ekdale, 1974). There is commonly a high correlation between associations and their physical environments (Petersen, 1911 - 1918, 1924; Thorson, 1957; Newell *et al.*, 1959). However, by defining communities on the basis of physical environments and ignoring biological considerations, it is possible to miss the presence of more than one association or community in the same physical environment (Thorson, 1957; Newell *et al.*, 1959; Kauffman and Scott, 1976).

Other studies involve the determination of associations in the fauna. These associations are then correlated to the physical environment in order to determine the controlling factors. Many workers have described associations qualitatively or intuitively (e.g. Petersen, 1911 - 1918, 1924; Thorson, 1957; Newell *et al.*, 1959; Sanders, 1960; Bretsky, 1969; Turney and Perkins, 1972) while others (e.g. McNulty *et al.*, 1962; Hoskins, 1964; Warme, 1969; Keen, 1977) have defined them statistically, for example by cluster analysis. Quantitative analysis is advantageous because results are easily duplicated by different workers, whereas qualitative results may not be (Stephenson *et al.*, 1972). The disadvantage to examining the fauna solely in terms of composition is that structural features, which may reflect both physical and biological controls, are ignored.

A third approach is holistic. Both the composition and structure of communities (or associations) are examined, in order to understand the controlling factors completely (e.g. Bowen *et al.*, 1974; Scott, 1974; Thayer, 1974). Structural features of fossil associations may provide information about the composition of the non-preserved portion of the fauna (e.g. an abundance of predators indicates an abundance of prey, Scott, 1978), or non-preserved facets of the physical environment (e.g. turbulence, Stanton and Dodd, 1976). This is the optimum approach, because it is the most complete (Kauffman and Scott, 1976). A holistic approach is used in this study.

Definitions

The terms *community* and *association* are used in the sense of Kauffman and Scott (1976).

Community: A community is an ecological unit consisting of species occurring together and interacting with each other and their environment. The concept of an ecological or holistic community emphasizes the role of ecological interactions as well as the physical environment in shaping the community, and includes all organisms present, not just the common ones. A community can be highly variable internally, and can change through space and time (Newell *et al.*, 1959; Kauffman and Scott, 1976). The fossil fauna examined in this study does not represent a community or group of communities, because most of the species present in the original environments were not preserved. Also, the species examined here are from only one phylum.

Association: An association is "...a group of organisms derived from a single community." (Kauffman and Scott, 1976). Groups of species mixed from more than one community are assemblages (Kauffman and Scott, 1976). The molluscs in this study represent associations, because they represent portions of the original communities. By this definition, most "paleocommunities" in the literature are associations (Kauffman and Scott, 1976).

Locality grouping: The term "locality grouping" is used in this study to refer to a group of localities containing the same association of species.

Species group: The term "species group" is used to refer to a group of species associations.

Objectives

This study examines the composition, distribution and ecology of the molluscan (bivalve and gastropod) fauna from the Pleistocene Ironshore Formation of Grand Cayman, British West Indies. With respect to this fauna the objectives of this study are to: 1) identify the bivalves and gastropods, 2) give a detailed taxonomy of one group of molluscs (Superfamily Chamacea), and 3) analyse the paleoecology of the molluscan fauna.

The fauna is examined in several ways in order to determine the most effective way of describing the paleoecology of the fauna. These are: (a) determination of statistical associations by cluster analysis, (b) correlation of these associations with their physical environments, and (c) correlation of community structure (including diversity, feeding types, and bivalve life habits) with the associations.

Location of study

Grand Cayman, the largest of the Cayman Islands, is situated on the Cayman Ridge south of Cuba and northwest of Jamaica (Figure I-1). Grand Cayman is approximately 35 km long (east to west), 14 km from north to south at the widest part, and 197 km^2 in area. There is a large lagoon on the western part of the island (North Sound). Reefs fringe the south and east (windward) margins of the island and cross the entrance to North Sound. Much of the island, particularly the western part of the island around the shores of North Sound, consists of low wet ground covered by mangrove swamps.

Geological setting

Grand Cayman consists of a core of Oligocene-Miocene dolostone (the Bluff Formation) unconformably overlain by a fringe of late Pleistocene limestone deposits (the Ironshore Formation: Figure I-2; Matley, 1925, 1926; Brunt *et al.*, 1973; Jones and Hunter, 1989). The geology and geography of the island have been discussed by Matley (1925, 1926), Doran (1954), Richards (1955), Brunt *et al.*, 1973; Rigby and Roberts, 1976; Woodroffe *et al.* (1980), Woodroffe *et al.* (1983), Hunter and Jones (1989a, 1989b), and Jones and Hunter (1989).

The Bluff Formation is a dense finely crystalline dolostone, with poorly

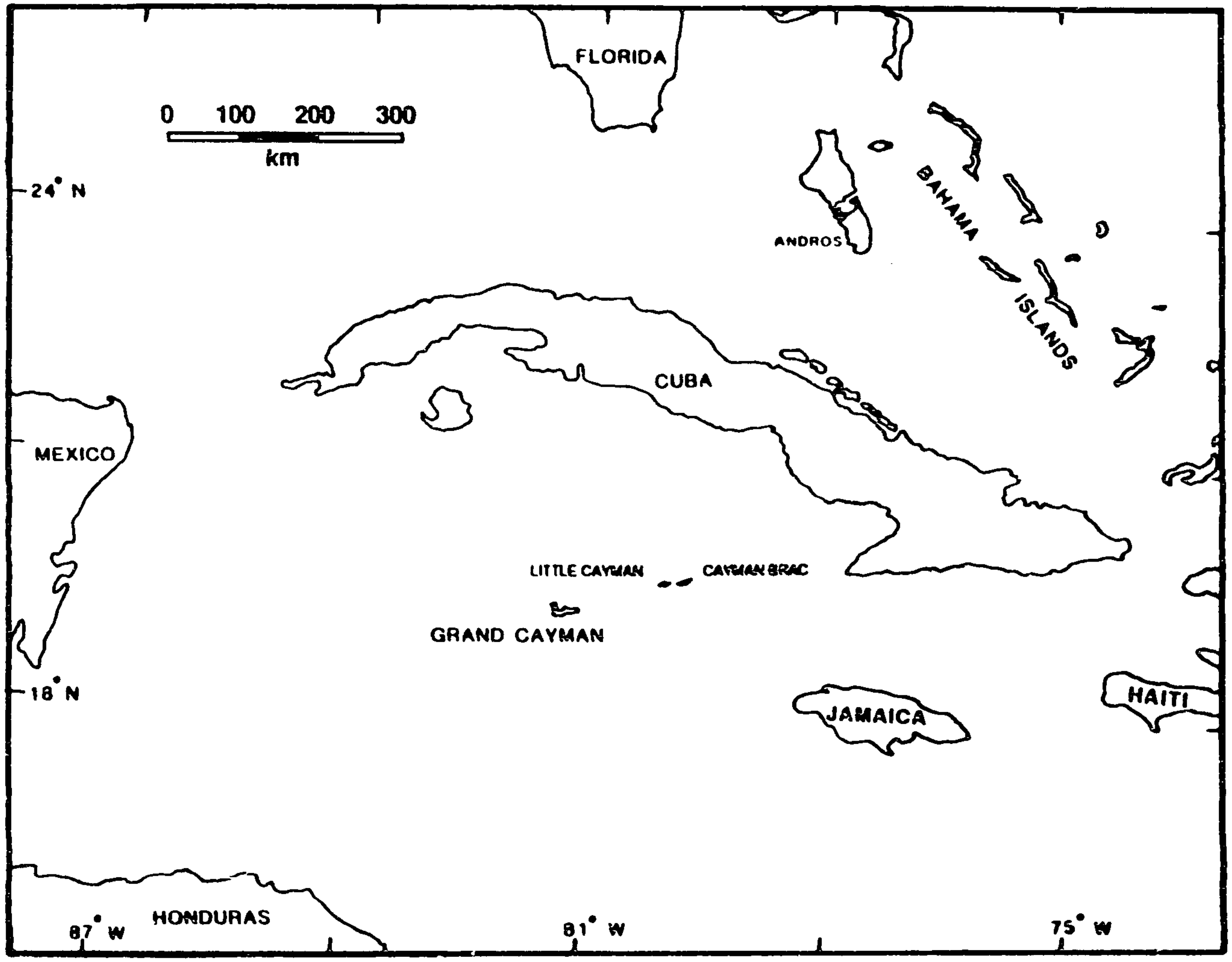


Figure I-1. Location map of Grand Cayman (modified after Squair, 1988).

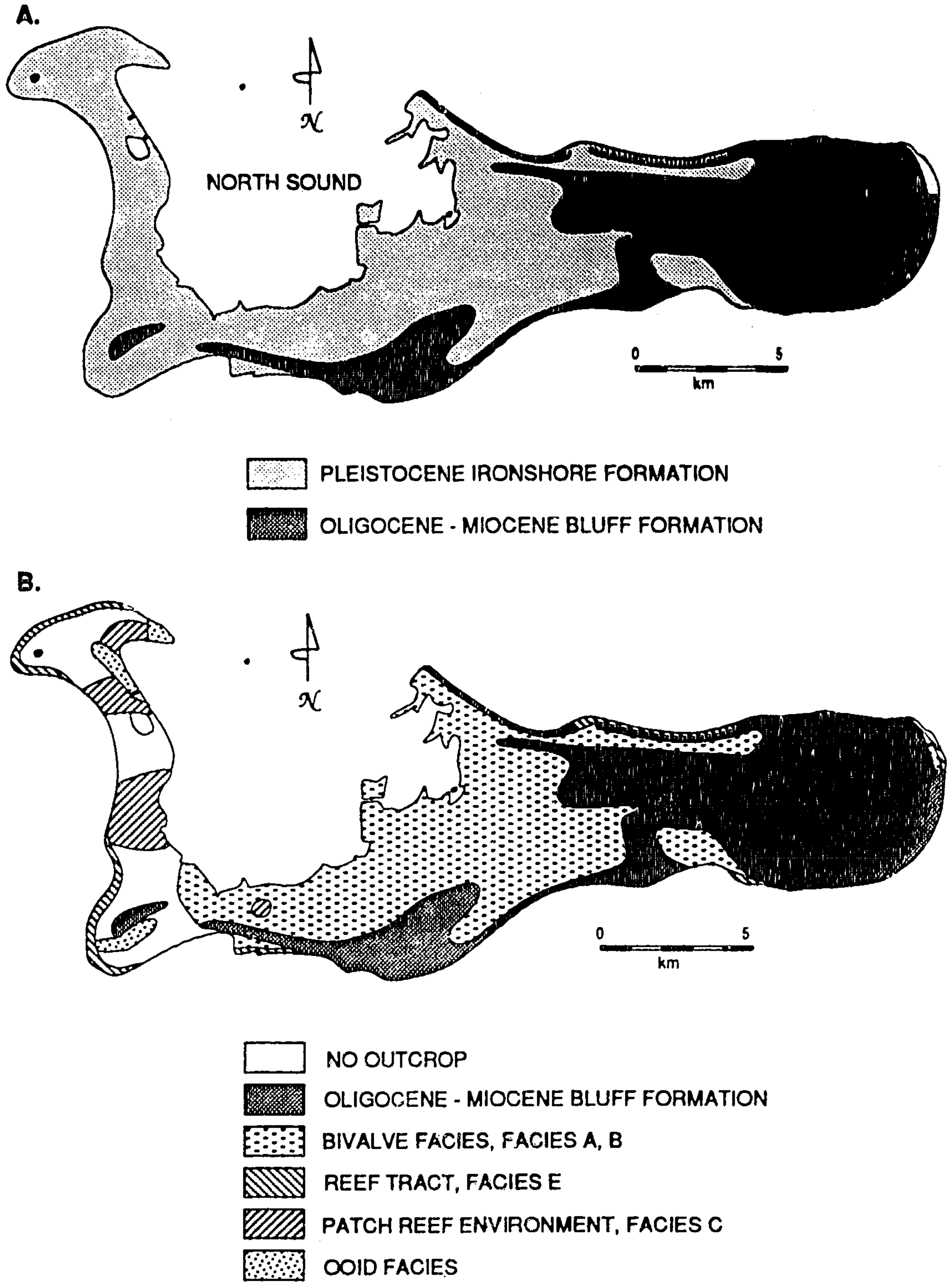


Figure I-2. Geology of Grand Cayman. A. Distribution of Ironshore and Bluff Formations. B. Distribution of facies in the Ironshore Formation. Facies from Hunter and Jones (1989b). After unpublished maps by I. G. Hunter.

preserved fossils represented mainly by casts and molds. Vaughan (in Matley,1926) considered it Oligocene and Miocene in age on the basis of fossil corals and Foraminifera. More recent work by Jones and Hunter (1989) indicated the presence of two different stratigraphic units: a lower unit of Oligocene age (the Cayman Member), unconformably overlain by an upper unit of Miocene age (the Pedro Castle Member), both dated on the basis of corals.

The Pleistocene Ironshore Formation forms a fringe around the island, particularly on the western part of the island. It is formed of consolidated lime sands and muds, with abundant corals and molluscs. Preservation of fossils is good, with coloration retained on some molluscs (this study; Hunter and Jones, 1989a). Woodroffe *et al.* (1983) determined the age of the top of this formation to be 124,000 ± 8000 years before present by U-Th dating of corals collected *in situ* from raised reefs in the Pleistocene deposits. This age corresponds with those of similar raised reefs in other parts of the Caribbean (Woodroffe *et al.*, 1983). Brunt *et al.* (1973) described five distinct "facies" in the Ironshore Formation: reef, back reef, lagoonal, shoal and beach ridge facies.

Hunter and Jones (1989a) mapped the occurrence of a Pleistocene lagoon, termed the Ironshore Lagoon, on the basis of the distribution of lithofacies and biofacies in the Ironshore Formation (Figure I-3). During the Pleistocene, a reef tract formed a barrier across the mouth of the lagoon, which opened to the western side of the island. The bivalve facies extended back into the Ironshore Lagoon. Patch reefs and interreef limestones occurred in a band parallel to the reef tract in the outermost part of the lagoonal deposits (Figure I-3). The ooid facies overlaps the bivalve facies in some exposures, indicating that it represents a later shallower stage in the development of the lagoon (Figure I-3). Molluscs (bivalves and gastropods) are abundant in all facies except the ooid facies. Hunter and Jones (1989b) subdivided these

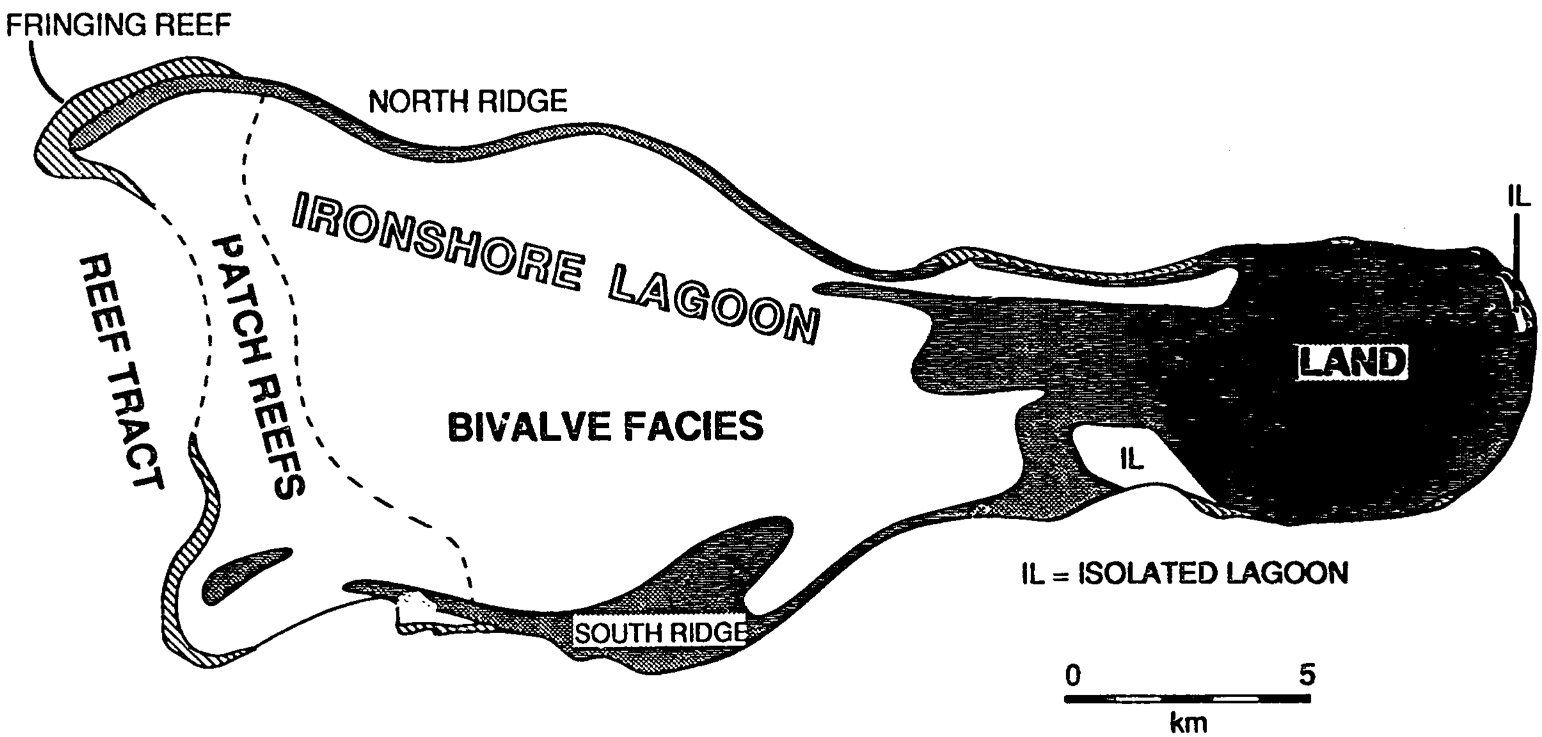


Figure I-3. Paleogeographical reconstruction of the Ironshore Lagoon, based on distribution of facies (Hunter and Jones, 1989a). Unpublished map by I. G. Hunter.

depositional regimes into seven facies on the basis of sediment type, sedimentary structures, fossils, and trace fossils (Table I-1). Facies A and B occur in the bivalve facies. Facies A, carbonate silt and very fine grained sand, is restricted to the easternmost part of the Ironshore Lagoon. Facies B, carbonate silt and fine grained sand, occurs through the rest of the bivalve facies. Facies C consists of the patch reefs, with sediment similar to that of facies D. Facies D, corresponding to the interreef sediments, consists of fine to coarse grained carbonate sands and silts. Facies E, containing diverse corals and very poorly sorted skeletal sands (Hunter, pers. comm.), corresponds to the reef tract. Facies F contains well sorted medium grained skeletal sands and ooids, and occurs as channels in the reef tract. Facies G consists of well sorted fine grained oolitic limestones, and corresponds to the ooid facies. In this study the distribution of the mollusc fauna is compared with the distribution of the four depositional environments and the seven lithofacies.

Pleistocene mollusc fauna

The earliest mention of Pleistocene molluscs on Grand Cayman was a list of 11 species which Matley (1926) included in his discussion of the geology of the Cayman Islands. Richards (1955) recorded 19 species of molluscs (including the 11 listed by Matley) primarily from the western exposures of the Ironshore Formation. Rehder (1962) summarized Richard's faunal list and supplemented it with 29 species of molluscs from exposures of the Ironshore Formation in the interior of the island. Brunt *et al.* (1973) described the distribution of molluscs and other organisms in five facies in the Ironshore Formation.

Woodroffe *et al.* (1980) used molluscan assemblages to distinguish between patch reef and interreef environments in the Pleistocene Ironshore

Table I-1. Facies in the Ironshore Formation, localities sampled, and their corresponding environments. After Hunter and Jones (1989), Hunter (pers. comm.).

FACIES	LOCALITIES	DESCRIPTION	ENVIRONMENT
A	TSE	Carbonate silt and very fine grained sand.	lagoon
B	L, M, MA, NSE PWD, PWA OG, OGA SD, SDA SDB, SDC, TG U, VV, YY	Carbonate silt to fine grained sand.	lagoon
C	C, D, G	Corals with facies D sediment.	patch reef
C/D	B, CYB, E, F K, MH, MOS	Both facies C and D present in small area.	patch reef/interreef
D	CNP, CYA, GC H, MOA, MON	Fine to coarse grained carbonate sands and silts.	interreef
E	ACB, ACH BTD, BTH CDS, DPQ EOT, TFB	Corals with poorly sorted sediment.	reef tract
F	ABB, PMP	Well sorted medium grained skeletai sands or ooids.	channels through reef tract
G	N	Well sorted, fine grained oolitic limestones. Ooids with thin cortical layer.	probably quiet water

Formation exposed by MRCU excavations west of North Sound. They described three groups of molluscs that are (1) characteristic of patch reefs, (2) characteristic of lagoonal (interreef) environments, and (3) common to both environments.

Database

Collection of data

Samples of molluscs were collected from the Ironshore Formation at 44 localities that encompassed the reef tract, patch reef/interreef and lagoonal depositional environments (Figures I-4, I-5). Reef tract deposits were sampled from exposures along the western shoreline of the island. Patch reef/lagoonal deposits were sampled where friable Ironshore Formation deposits had been excavated in the western and central parts of the island. These excavations are residential projects, scattered throughout the area south and west of North Sound, and canals and roads built in the mangrove swamps west of North Sound by the Mosquito Research and Control Unit (MRCU) as part of the mosquito control program.

Samples were collected as thoroughly as possible. They were collected over the entire outcrop, commonly by three to five people, with 30 to 60 minutes being spent on each outcrop. Collection continued until as many shells as possible had been collected for sites with few molluscs or poor exposures, or a large collection made (six to ten one litre bags or more) at a site with numerous molluscs. Corals, samples of the large ubiquitous gastropod *Strombus gigas*, and matrix samples were also collected for other studies (corals: Hunter, Ph.D. thesis; *Strombus*: Rehman, M.Sc. thesis; matrix samples: Hunter and Jones, 1989b). Adult *Strombus gigas* were not considered in this study because they occur at almost all localities sampled, and so would not reflect species

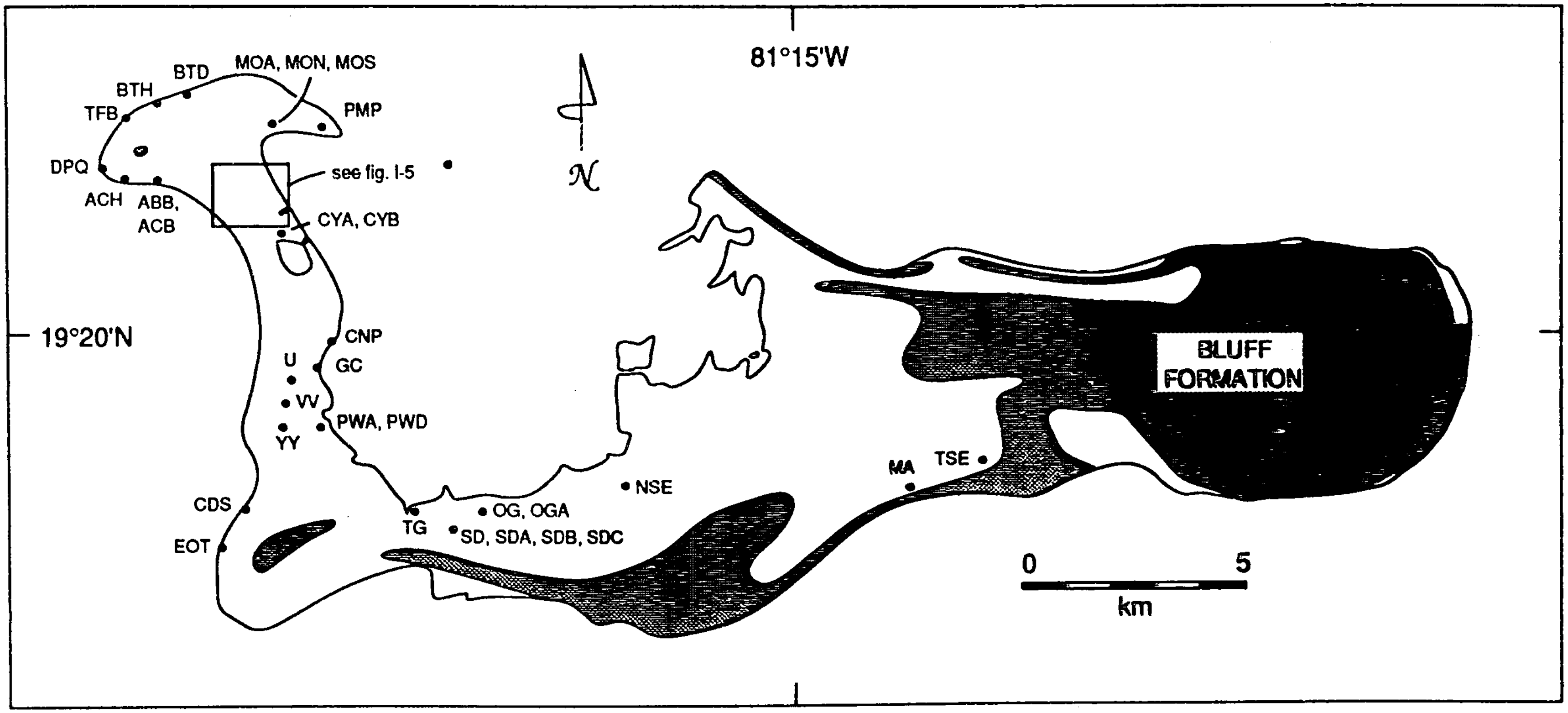


Figure I-4. Location map for mollusc samples, Ironshore Formation. Base map modified after unpublished map by I. G. Hunter. For localities in boxed area see figure I-5.

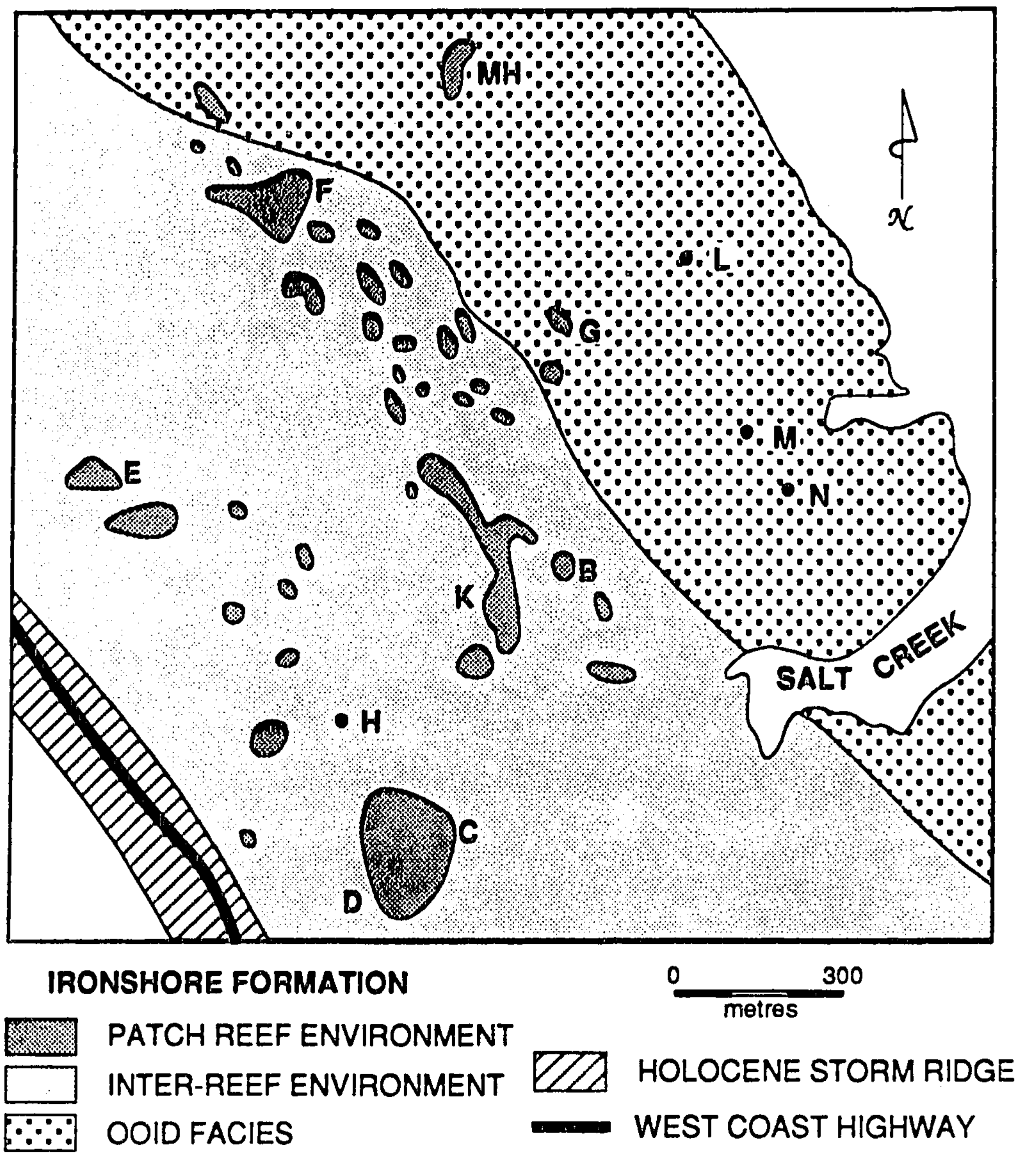


Figure I-5. Distribution of localities in the patch reef/interreef environments. Distribution of patch reefs modified after Woodroffe *et al.* (1980).

associations.

In addition to the collection of shells, sediment samples were taken at most localities to ensure that smaller species were also collected. This was not done at the localities where few molluscs were present or exposed. At one locality (TSE), a third sample (herein termed a "quadrat" sample) was taken in order to determine the collecting bias that occurred during sampling. For this locality, all shells occurring in four small circular (< 1 m diameter) areas were collected, for comparison with the samples taken over the whole area of the outcrop.

The samples, largely unconsolidated, were cleaned by rinsing in water to remove excess sediment. The sediment samples were washed through a sieve (2 mm mesh size) and shells picked out. These samples were counted separately, then their numbers were added into the main sample count (Appendix III). Sample sizes range from 1 to 1,304 individuals, with 32 samples containing 95 or more individuals. The total number of individuals collected was 20,989.

Identification of fauna

Eighty-three marine bivalve and 90 marine gastropod species were identified from the collected fauna (Table I-2). Species were identified primarily with the aid of Abbott (1958, 1974), Warmke and Abbott (1962), and Johnsonia (Volumes 1 to 5). Species names are those listed in Turgeon *et al.* (1988). For some genera, a lack of colour preservation, the availability of only one or a few individuals, and/or the high degree of similarity between species did not allow identification to the specific level. In the Chamacea much of the exterior ornament has been eroded by biological and/or mechanical activity. For this reason, a detailed taxonomy of the Chamacea is given to clarify their identification.

Table I-2. Sources used in identification of mollusc species in this study.

Class Bivalvia	References
Family Nuculidae	
Nucula aegeensis Jeffreys?	1,3
Family Mytilidae	
Botula fusca (Gmelin)	1,3
Brachidontes modiolus (Linne)?	1
Gregariella coralliophaga (Gmelin)	1,3
Lithophaga antillarum (d'Orbigny)	1,3
Lithophaga nigra (d'Orbigny)	1,3
Lithophaga sp.	1
Musculus lateralis (Say)	1,3
Family Arcidae	
Anadara floridana (Conrad)	1,3
Anadara notabilis (Röding)	1,2,3
Anadara sp.	1
Arca imbricata (Bruguière)	1,2,3
Arca sp.	1
Arca zebra (Swainson)	1,2,3
Arcopsis adamsi (Dall)	1,2,3
Barbatia cancellaria (Lamarck)	1,2,3
Barbatia candida (Helbling)	1,2,3
Barbatia domingensis (Lamarck)	1,2,3
Family Glycymerididae	
Glycymeris pectinata (Gmelin)	1,3
Family Pteridae	
Pinctada imbricata Röding	1
Pteriid fragments	1
Family Limidae	
Lima lima (Linné)	1,3
Lima lima (Linné)?	1
Lima scabra (Born)	1
Family Pectinidae	
Argopecten nucleus (Born)	1,2,3,14
Bractechlamys antillarum (Récluz)	1,2,3
Pectinid fragments	1
Family Plicatulidae	
Plicatula gibbosa Lamarck	1,3
Family Spondylidae	
Spondylus americanus Hermann	1,3
Family Anomiidae	
Anomia simplex d'Orbigny	1
Family Ostreidae	
Dendostrea frons (Linné)	1,3,10
Family Lucinidae	
Anodontia alba Link	1,3
Codakia costata (d'Orbigny)	1,3
Codakia orbicularis (Linné)	1,3
Codakia orbiculata (Montagu)	1,3
Codakia pectinella C. B. Adams	1,2,3
Divaricella dentata (W. Wood)	1
Divaricella quadrisulcata (d'Orbigny)	1,3
Divaricella sp.	1
Linga pensylvanica (Linné)	1,3
Family Ungulinidae	
Diplodonta punctata (Say)	1,3
Diplodonta semiaspera Philippi	1,3
Diplodonta sp.	1
Family Chamidae	
Chama congregata Conrad	1,3
Chama macerophylla Gmelin	1,3
Chama sinuosa Broderip	1
Chama sp.	1
Pseudochama radians (Lamarck)	1,3
Pseudochama radians variegata (Reeve)	1,12
unidentified chamidae	1
Family Sportellidae	
Basterotia quadrata (Hinds)	1,2,3
Family Crassitellidae	
Crassinella martinicensis (d'Orbigny)	1,3
Family Cardiidae	
Americardia guppyi (Thiele)	1,2,3
Americardia media (Linne)	1,2,3
Laevicardium laevigatum (Linné)	1,2,3
Family Mesodesmatidae	
Ervilia concentrica (Holmes)	1,2,3,6
Family Tellinidae	
Leporimetis intastriata (Say)	1,3
Strigilla mirabilis (Philippi)	1,2,3
Tellina aequistriata Say	1,3,4
Tellina candeana d'Orbigny	1,2,3,5
Tellina fausta Pulteney	1,3,4
Tellina gouldii Hanley	1,4
Tellina listeri Röding	1,3,4
Tellina mera Say	1,3,5
Tellina radiata Linné	1,3,4
Tellina similis Sowerby	1,2,3,5
Tellina sp.	1
Tellina sybaritica Dall	1,3,5
Family Semelidae	
Cumingia coarctata Sowerby	1,2
Semele bellastriata (Conrad)	1,3
Semele proficua (Pulteney)	1,3
Family Solecurtidae	
Tagelus divisus (Spengler)	1,3
Family Trapeziidae	
Coralliophaga coralliophaga (Gmelin)	1,3,13
Family Veneridae	
?*Agriopoma texasianum* Dall	1
Chione cancellata (Linné)	1,3
Chione paphia (Linné)	1,3
Gouldia cerina (C. B. Adams)	1,2,3
Periglypta listeri (J. E. Gray)	1,3
Pitar fulminatus (Menke)	1,3
Transennella gerrardi Abbott	1,2
Family Petricolidae	
Petricola lapicida (Gmelin)	1,3
Family Gastrochaenidae	
Gastrochaena hians (Gmelin)	1,3
Family Poromyidae	
?*Poromya sp.*	1
Class Gastropoda:	
Family Fissurellidae	
Diodora dysoni (Reeve)	1,3,8
Diodora jaumei Aguayo and Rehder	1,8
Diodora listeri (d'Orbigny)	1,3,8
Diodora minuta (Lamarck)	1,3,8
Diodora sp.	1
Emarginula pumila (A. Adams)	1,2,3,9
Fissurella barbadensis (Gmelin)	1,3,7
Hemitoma emarginata (Blainville)	1,3
Lucapina suffusa (Reeve)	1,3,7
Puncturella pauper Dall?	1,9
Family Acmaeidae	
Acmaea sp.	1
Patelloida pustulata (Helbling)	1,2,3
Family Cyclostrematidae	
Arene cruentata (Mühlfeld)	1,2,3
Family Turbinidae	
Astralium phoebium (Röding)	1,2,3
Lithopoma tectum (Lightfoot)	1,2,3

Table I-2 (cont'd). Sources used in identification of mollusc species in this study.

Species	Sources
Lithopoma tuber (Linné)	1,3
Family Phasianellidae	
Tricolia thalassicola Robertson	1,2,3
Family Neritidae	
Smaragdia viridis (Linné)	1,2,3
Family Rissoidae	
Rissoina cancellata Philippi	1,2,3
Schwartziella bryerea (Montagu)	1,2,3
Zebina browniana (d'Orbigny)	1,3
Family Modulidae	
Modulus modulus (Linné)	1,3
Family Cerithiidae	
Bittium varium (Pfeiffer)	1,3
Cerithium eburneum Bruguière	1,2,3,11
Cerithium eburneum algicola (C. B. Adams)	1,2,3,11
Cerithium litteratum (Born)	1,2,3,11
Cerithium lutosum Menke	1,11
Cerithium sp.	1
Family Cerithiopsidae	
Cerithiopsis emersonii (C. B. Adams)	1
Seila adamsi (H. C. Lea)	1,2,3
Family Triphoridae	
Triphora melanura (C. B. Adams)?	1,2,3
Triphora turristhomae (Holten)	1,2,3
Family Epitoniidae	
Epitoneum sp. A	
Epitoneum sp. B	
Family Eulimidae	
Melanella sp.	1
Family Strombidae	
Strombus gigas Linné	1,2,3
Strombus gigas samba (Clench)?	1,2
Strombus sp.	1
Family Hipponicidae	
Hipponix antiquatus (Linné)	1,3
Family Calyptraeidae	
Cheilea equestris (Linné)	1,3
Crepidula aculeata (Gmelin)	1
Family Triviidae	
Trivia pediculus (Linné)?	1,3
Trivia quadripunctata (J. E. Gray)?	1,3
Family Cypraeidae	
Cypraea sp. A (*C. zebra* Linné?)	
Cypraea sp. B	
(*C. cinerea* Gmelin or *C. spurca acicularis* Gmelin)	
Family Ovulidae	
Cyphoma gibbosum (Linné)	1,3
Family Naticidae	
Natica canrena (Linné)	1,2,3
Natica livida Pfeiffer	1,2,3
Natica sp.	1
Polinices lacteus (Guilding)	1,3
Sinum perspectivum (Say)	1,3
Family Ranellidae	
Cymatium pileare (Linné)	1,2,3
Family Muricidae	
Chicoreus florifer (Reeve)	1
?Dermomurex pauperculus (C. B. Adams)	1,2,3
Phyllonotus pomum (Gmelin)	1,3
Thais deltoidea (Lamarck)	1,3
Family Coralliophilidae	
Coralliophila abbreviata (Lamarck)	1,2
Family Columbellidae	
Anachis hotessieriana (d'Orbigny)?	1,2
Columbella mercatoria (Linné)	1
Mitrella sp.	1
Family Buccinidae	
Bailya parva (C. B. Adams)	1,2,3
Pisania auritula (Link)	1,2,3
Family Nassariidae	
Nassarius albus (Say)	1,2,3
Family Fasciolariidae	
Fasciolaria tulipa (Linné)	1,3
Latirus carinifer Lamarck	1
Leucozonia nassa leucozonalis (Lamarck)	1,2,3
Family Olividae	
Oliva reticularis Lamarck	1,3
Olivella sp. A	
(*O. floralia* (Duclos)? or *O. dealbata* (Reeve)?)	
Family Mitridae	
Mitra barbadensis (Gmelin)	1,3
Family Marginellidae	
Marginella apicina Menke?	1
Marginella guttata (Dillwyn)?	1
Marginella pruniosum (Hinds)?	1,2
Marginella sp.	1
Volvarina avena (Kiener)	1,2,3
Family Conidae	
Conus jaspideus Gmelin	1,2,3
Conus jaspideus verrucosus (Hwass)	1,2,3
Conus mus Hwass	1,2,3
Conus sp.	1
Family Turridae	
Brachycythara biconica (C. B. Adams)	1,2,3
Crassispira fuscescens Reeve	1,2,3
Ithycythara sp.	1
Mangelia lastica Dall?	1
Pyrgocythara candidissima (C. B. Adams)	1,3
Family Pyramellidae	
Odostomia laevigata (d'Orbigny)	1,2,3
Pyramidella dolabrata (Linné)	1
Triptychus niveus Mörch	1,2
Turbonilla sp.	1
Family Scaphandridae	
Acteocina sp.	1
Family Bullidae	
Bulla striata Bruguière	1,2
Family Atyidae	
Atys sp.	1

REFERENCE:
(1) Abbott, 1974 (2) Abbott, 1958 (3) Warmke and Abbott, 1962 (4) Boss, 1966
(5) Boss, 1968 (6) J. D. Davis, 1973 (7) Farfante, 1943a (8) Farfante, 1943b
(9) Farfante, 1947 (10) Galstoff, 1964 (11) Houbrick, 1974 (12) Pilsbry and McGinty, 1938
(13) Solem, 1954 (14) Waller, 1969 ( ) This Study

Preservation of fauna

Overall, the preservation of the molluscs is good. Breakage and abrasion is insignificant for most of the abundant species, although some small thin species (e.g. *Tellina spp.*) are commonly broken. The long spines of the bivalve *Spondylus americanus* are preserved on some specimens. Coloration is preserved on a few shells (e.g. some valves of *Argopecten nucleus, Barbatia cancellaria, Chione paphia*, and *Leucozonia nassa leucozonalis*).

Biases present in the fauna collected

Although the preserved mollusc fauna probably reflects the composition of the fauna living in that environment during the Pleistocene, there are a number of factors that could potentially bias the sample.

Collecting bias

Both a hand collected sample and a sieved sample were obtained from most localities. A collected assemblage for a given locality is the combination of these two samples. A "quadrat" sample is a third sample carefully collected at TSE from four small (< 1 m diameter) areas.

Hand collected samples were generally biased in favour of large highly visible shells, with very small poorly visible shells underrepresented, while sieved samples were biased towards small shells. Comparison of the size distribution of a collected assemblage and a "quadrat" sample indicates a bias towards larger shells in the collected assemblage (Figure I-6). Very small shells (≤10 mm) may be underrepresented in the "quadrat" sample, because small shells are hard to see in the field. This is less of a problem for the collected assemblage, because it includes shells collected in sieved samples. Assuming that the "quadrat" sample is representative for the larger size classes (>10 mm), the collected assemblage contains disproportionate numbers of large shells, in

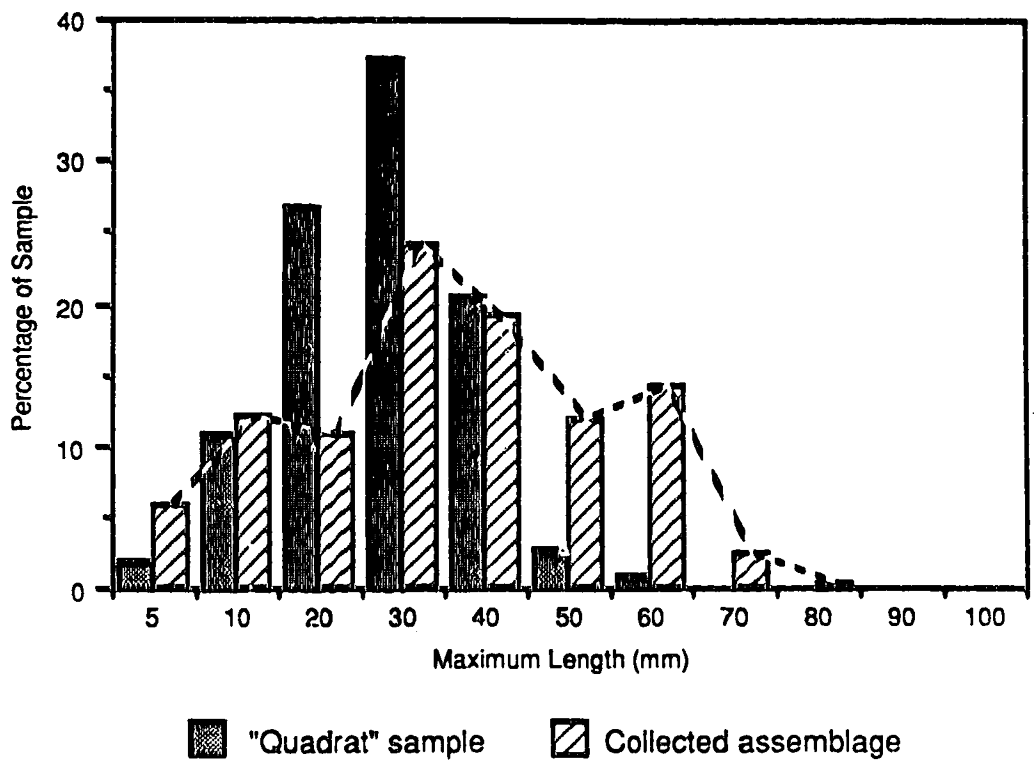


Figure I-6. Size distribution of mollusc shells at locality TSE. All individuals for each species have been assigned the length of the largest of that species, because most individuals are close to maximum length. The "quadrat" sample is a sample taken from four small (<1 m diameter) areas, where all visible shells were sampled. The collected assemblage is the combination of shells hand collected at the site and shells picked from sediment samples taken at the site.

particular those greater than 40 mm in length. For the Ironshore fauna, these species are *Chama macerophylla*, *Chama sinuosa*, *Codakia orbicularis*, and *Pseudochama radians*, and sometimes *Anadara spp.*, *Anodontia alba*, *Chione spp.*, and *Laevicardium laevigatum*. Several other large species (e.g. *Periglypta listeri*, *Leporimetis intastriata*, and *Tellina listeri*) are probably not significantly overrepresented because they are rare.

Size-frequency distributions representative of unmodified life assemblages should be strongly right-skewed, with the smallest size categories occurring most frequently (Boucot, 1953; Boucot *et al.*, 1958; Fagerstrom, 1964). Neither the collected assemblage nor the "quadrat" samples follow this pattern (Figure I-6). The size frequency distribution for the collected assemblage is irregular, with peaks for shells between 5 and 10 mm long, between 20 and 30 mm, and between 50 and 60 mm long (Figure I-6). This is because the collected assemblage is a combination of shells collected by hand (large shells) and those picked from sieved samples (small shells). The "quadrat" sample has an approximately normal size distribution. There are a number of possible reasons for the apparent lack of small species. One is the way the data are presented. For species where juveniles and adults occur in different size categories, the smaller size categories are underrepresented, because the maximum size of a species is chosen for all members of that species. This is not a big factor, because most individuals are close to their maximum size (there are few juveniles). Another factor is the relative sizes of the sieved and hand collected samples which made up the collected assemblage. Sieved samples, collected to ensure that smaller shells were included, generally represent a smaller area of outcrop than hand picked samples, and therefore cannot guarantee that their numbers are representative of their abundance in the field. Other factors resulting in underrepresentation of small shells in the samples may be winnowing out of small shells by water currents prior to burial (Boucot, 1953; Boucot *et al.*, 1958; Fagerstrom, 1964) and selective dissolution of smaller shells (Cummins *et al.*, 1986). The low numbers of juveniles in the collection suggest that some preferential loss of small shells has occurred.

In summary, there are two size biases which should be kept in mind when interpreting the data for the fauna from the Ironshore Formation. Very large shells are overrepresented, and very small shells may be underrepresented. Overall, size distributions in samples are fairly balanced. As most localities were collected in the same manner, those biases present are not a problem when comparing faunas between localities. The biases are only a problem when comparing this fauna to one collected in a different manner, such as a modern mollusc fauna collected by dredge (e.g. Grand Cayman fauna, Abbott, 1958).

Variable conditions of exposure

Localities along the modern coastline (Pleistocene reef tract and interreef channels) were typically poor sampling sites, because the outcrops have been cemented and karsted as a result of exposure to waves and sea spray. Consequently, molluscs were hard to see. Only two localities from this area, TFB and BTD (Figure I-4), yielded good mollusc faunas. At TFB the exposure had recently been bulldozed, exposing fresh outcrop surfaces. At BTD the outcrop surface had not been weathered into a jagged surface. Thus, samples from most "reef tract" localities had very low numbers of species because of poor exposure, not because the original fauna was poor (modern reefs typically have high mollusc richness; Barnes and Hughes, 1988). In contrast, all other localities were sites of recent excavations, allowing ready access to the mollusc fauna. Samples from these localities typically had a high number of species.

Variable access to outcrops has also affected the distribution of localities.

Many localities occur along the modern coastline (Pleistocene reef tract) and on the roads formed by the MRCU canal project (patch reef/interreef environment), where access to the Ironshore Formation is good. Further back into the Ironshore Lagoon deposits, however, there are fewer excavations, with no MRCU canals, and few residential excavations. The lack of sampling sites was particularly acute in the innermost area of the Ironshore Lagoon (Figure I-5). Sampling was impossible where the modern North Sound covers Ironshore Lagoon deposits, in the northeast section of the lagoon.

Selective preservation of species

The preservation potential of mollusc shells varies considerably. Thin shells (e.g. *Tellina spp.*) are more prone to abrasion and breakage, as are shells exposed at the sediment surface (e.g. epifaunal arcids). Rapid burial, or an infaunal life habit, increases the preservation potential of shells (Peterson, 1976; Cummins *et al.*, 1986). Thin-shelled species, such as *Tellina spp.*, may have been more common in the original fauna relative to robust species, such as *Chione spp.*. There is no evidence in the collection to indicate that the overall structure of the mollusc fauna is misrepresented. The effect of differential preservation has probably only affected the relative numbers of species.

Transport and mixing of death assemblages

Mixed death assemblages may result from the transport of shells from one locality or environment to another after death of the organisms. Presence-absence data for death assemblages generally show good agreement with the corresponding life assemblages (and therefore little transport) in stable protected low energy depositional environments (e.g. shallow water), but not in high energy or harsh environments (e.g. above wave base: Johnson, 1960; Warme, 1969; Peterson, 1976; MacDonald, 1976; Ekdale, 1977). Relative abundance data, however, may not accurately reflect the composition of the corresponding living community, because of time-averaging of communities, and because different species have different preservation potentials (Peterson, 1976; Fürsich, 1978; Cummins *et al.*, 1986). Most localities are from the Ironshore Lagoon, and would not have been exposed to high energy conditions, because they were sheltered by the reef tract. The lack of abrasion and breakage for most of the fauna suggests that transport was not significant.

The nature of the mollusc fauna collected from the reef tract suggests that these species were originally from that environment, and not transported, even though the reef tract would probably have been subjected to high energy conditions. However, transport of shells out of the reef environment after death (as with the modern reef fauna; Abbott, 1958), may have lowered the abundance preserved.

Three factors suggest that molluscs sampled from excavations (obviously no longer *in situ*) had not undergone significant transport prior to excavation. Firstly, most bivalve species are represented by similar numbers of left and right valves (Figure I-7). Transport of shells commonly sorts left and right valves into separate groups, because they have different hydrodynamic behaviour (Boucot, 1953; Boucot *et al.*, 1958; Fagerstrom, 1964; Scott, 1974). The Chamacea are the only exception to this pattern. For *Chama* (which cements itself to the substrate by its left valve) there are many more right valves than left valves. This is due to their cementing life habit. Right valves may be preferentially preserved because they are free to fall into crevices in the reef environment, instead of remaining exposed as the attached left valves are. Many of the left valves of *Chama* are cemented to corals and *Strombus gigas* shells collected at the same localities (Hunter, pers. comm.).

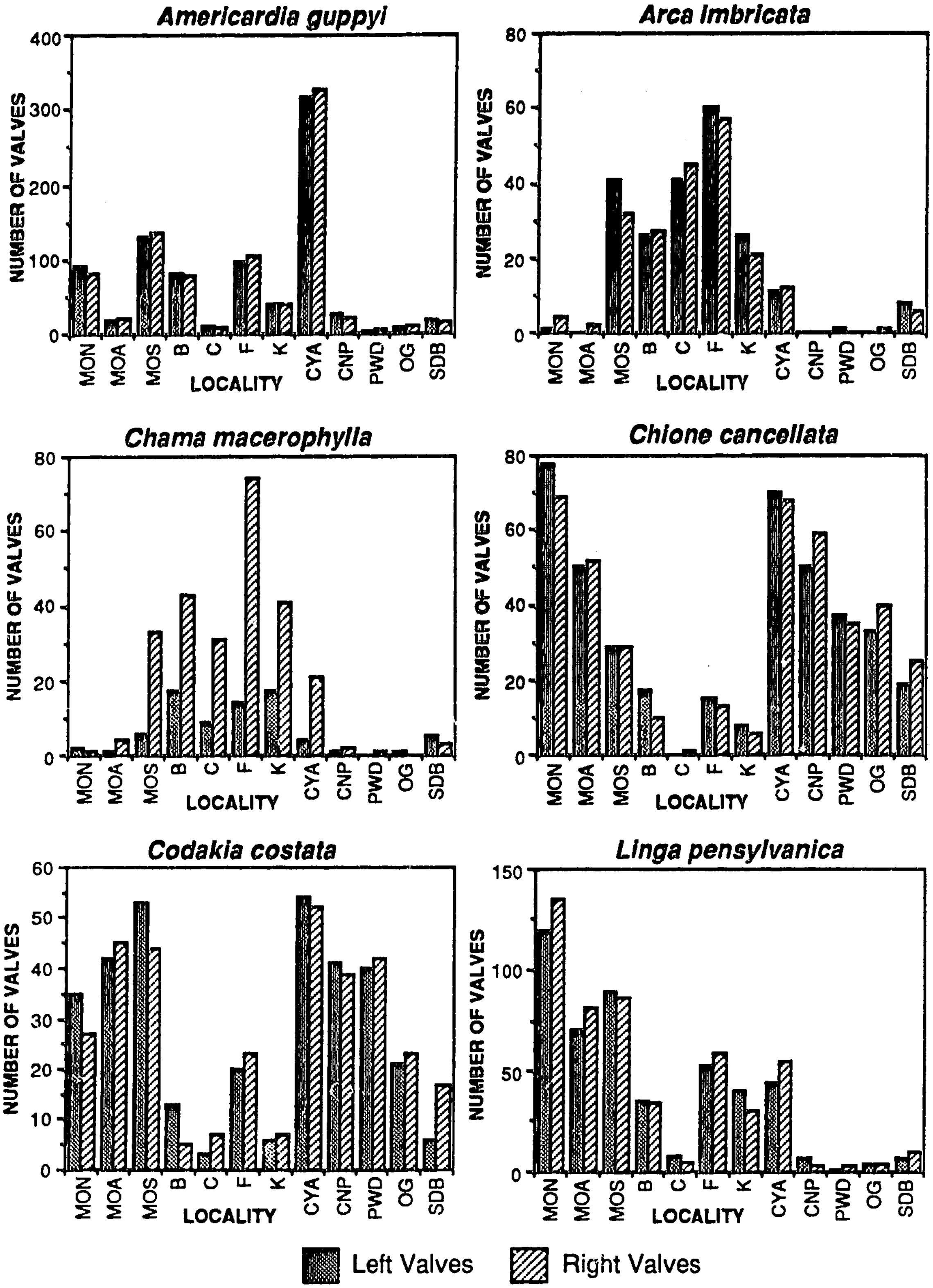


Figure I-7. Relative number of left and right valves for six bivalve species collected from the Ironshore Formation.

The common occurrence of articulated valves for many bivalve species (e.g. *Codakia orbicularis, Chione paphia,* Table I-3) also suggests lack of transport, as transport will disarticulate shells (Boucot, 1953; Boucot *et al.*, 1958). Some species (e.g. *Gregariella coralliophaga, Lithophaga spp.*, *Leporimetis intastriata*) almost always occur as articulated pairs. These are typically boring or deep burrowing species, which have a higher preservation potential.

The lack of abrasion and breakage for most of the shells also suggests that they were not transported. Although some smaller thin-shelled species are commonly broken (e.g. *Tellina spp.*), many species are rarely broken or abraded (e.g. *Chione paphia, Codakia orbiculata*).

There are a few localities where the nature of the sampling site suggests that some of the fauna present may have been transported some distance during modern excavations. At CYA and CYB, some of the sediment dredged in the area may have come from North Sound, instead of from the immediate area, and this may well have introduced contamination into the Pleistocene fauna. At PWA, Holocene corals have been introduced by storm deposition, suggesting that some of the mollusc fauna may also have been introduced this way. The mollusc fauna at these localities does not appear to be contaminated by modern shells, and so is included for analysis.

While the probability of horizontal transport is not significant, vertical mixing of faunas is probable, particularly for excavated localities. The result of vertical mixing is a time-averaged fauna, representing a period of time, and not a specific time. This will broaden the scale at which the fauna may be interpreted, particularly if there is migration of environments over the time represented by the fauna (Fürsich, 1978).

Table I-3. Percentage of articulated shells (P/N) for bivalve species collected from the Ironshore Formation. Localities are those with fifty or more individual bivalves and more than two of the species listed here. Species are those which typically occur in large numbers in the samples. Values are not included for cases where there are fewer than ten individuals (N) of a species, so that percentages will be representative.

LOCALITY:	MON	MOA	MOS	MH	B	C	D	E	F	G	K	M	CYA	CYB	CNP	GC	PWD	PWA	TG	SD	SDA	SDB	SDC	OG	OGA	NSE	MA	TSE
Americardia guppyi	2	0	0	0	1	0			1		2		0	0	4	9				0	0	0	0	0	0			0
Anadara floridana														10			24		7				13	25		11		
Anodontia alba		31						72							0	45	67		57	78		75	64	88	69		42	86
Arca imbricata			0	17	31	17	10		22	24	10		14	10														
Arcopsis adamsi			0						0																	0	0	
Barbatia cancellaria			0		11	1	0		3	0	0		0	0														
Barbatia domingensis			0		13	0			5	8	0			2														
Chama congregata			0	0		0	0		0	2			0	3								0						
Chama macerophylla			0	0	4	0	0		3	11	2		0	0							0							
Chione cancellata	8	5	17	0	6				0			15	7	6	6	8	21	14	16	0	15	14	6	20	19	8	0	12
Chione paphia	12	8	15		10								15	29	20	19				40	23	37		23	27	27		23
Codakia costata	0	0	0		0			0	0				4	0	5	0	0	0	0	0	0	0	0	0	3	0	0	0
Codakia orbicularis		38			26				38				72		45	43	57	53	48	52	58		73	60	59	38		
Codakia orbiculata															19	20	9		15		0		5	0	0	4	0	
Codakia pectinella		5	17						10						9		7	0	6	0	0	0	0	0	0	0		
Crassinella martinicensis	11	3	15		4				19		10	6	25		21	14	6	8	3	6	7	6	0	4	2	15		
Diplodonta punctata	20								19				57	60	56													
Ervilia concentrica	13	7	11		15				6		8		33								8	0						
Gouldia cerina		0							0				11		3	11	2	3	0	0	0		3	0	0	0		
Laevicardium laevigatum	50		36												30				44	38	43	33	27	35	36	25		
Leporimetis intastriata								86														90		90				93
Linga pensylvanica	38	34	38	18	29	27		15	36		25	6	41	41	46	37					64	44					20	33
Pitar fulminatus	6	0	0	5	4				3		0	0	6	17	10		6	6	4	0	2	0	0	0	0	0	0	0
Tellina candeana		0	0																								1	0
Tellina similis			0					0												0								8
Tellina sybaritica	13		0	0					0										0	0	0	0	2	0	0			

II. SYSTEMATIC PALEONTOLOGY

Superfamily Chamacea Lamarck, 1819

Family Chamidae Lamarck, 1819

The superfamily Chamacea is a group of bivalve molluscs with thick, heavy, irregular, inequant valves, that cement themselves to hard substrates. Identification is based on which valve is cemented to the substrate, valve size and shape, the nature of the pallial line, and, for one species, ornamentation (Figure II-1).

The Chamacea of the Ironshore Formation of Grand Cayman are herein assigned to *Chama congregata*, *C. macerophylla*, *C. sinuosa*, *Pseudochama radians*, and *P. radians variegata*.

Genus *Chama* Linné, 1758

Chama Linné, 1758, p. 645, 691.
Chama Bruguière, 1792, pl. 385.
Chama Linné. Lamarck, 1835, p. 578.
Chama Linné. Odhner, 1919, p. 75.
Chama (Linné) Bruguière. Gardner, 1926, p. 92.

Diagnosis.—Shell inequant, left valve larger, coiling anteriorly. Left valve with distinct elongate socket; right valve with corresponding tooth; other dentition obscure. Two large muscle scars, anterior scar commonly elevated. Shell cements itself to hard substrate by left valve.

Type Species.—*Chama lazarus* Linné. (Recent, Indian Ocean), by subsequent designation, Gray, 1847.

Discussion.—The genus *Chama* (pronounced Ka´ ma) originally included the carditids, tridacnids and rudists as well as the chamids, because the original description by Linné (1758, p. 645, p. 691) was general.

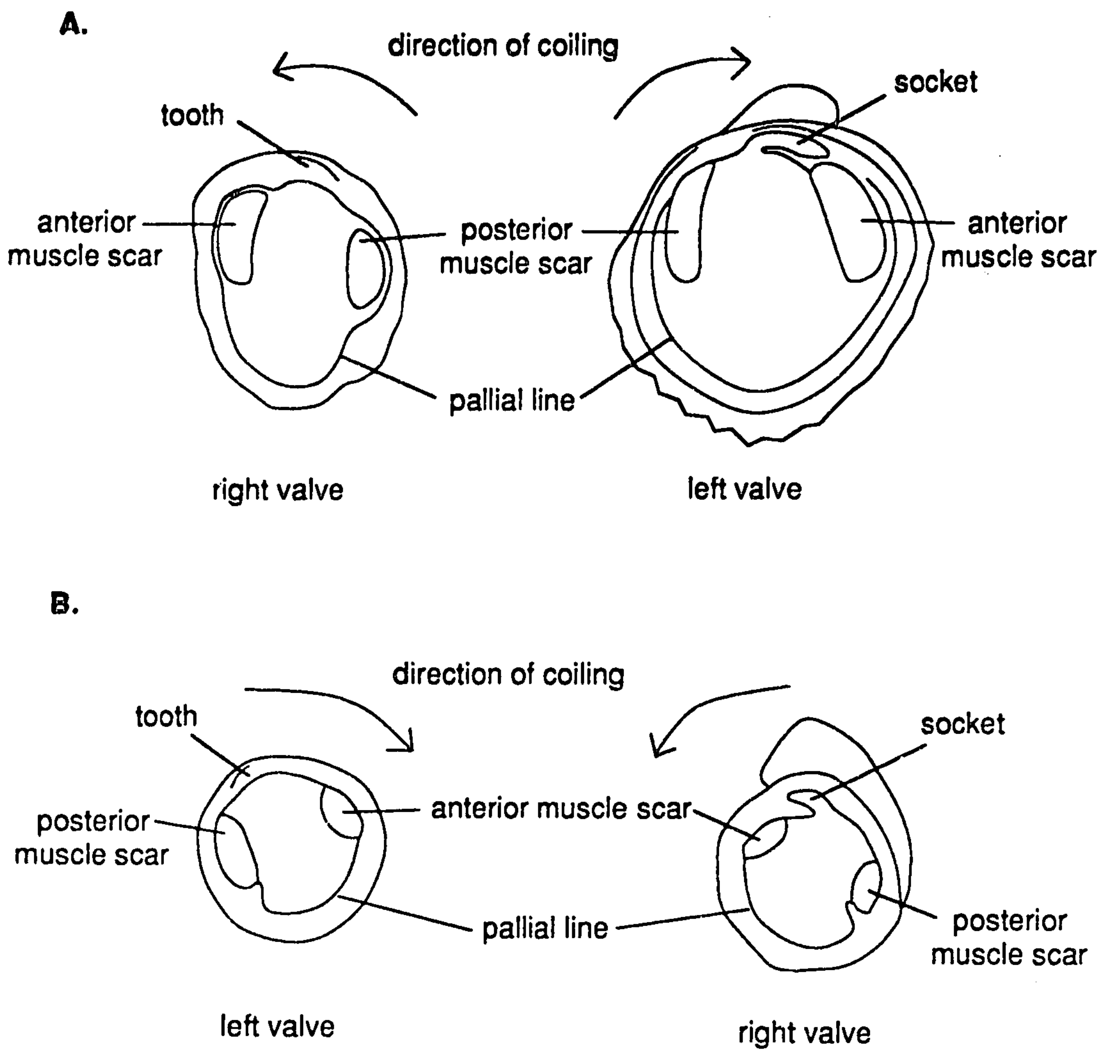


Figure II-1. Interior view of right and left valves of A. *Chama macerophylla*, and B. *Pseudochama radians variegata*, at life size.

Bruguière (*in* Lamarck, 1835) noted the wide variety of species that could be included based on the original description, and thus limited the genus *Chama* to those species with irregular inequant valves, one tooth, and a cementing habit.

Lamarck (*in* Odhner, 1919) and Munier-Chalmas (1882) noted the occurrence of two forms of *Chama*, which Munier-Chalmas (1882) referred to as "dextral" (coiling to the right) and "sinistral" (coiling to the left) but did not attempt to subdivide the genus. Munier-Chalmas (1882) suggested that the "sinistral" form was an inversion of the "dextral" form, much in the same way some gastropods coil in the direction opposite to most. The lower (attached) valves would thus correspond to each other, as would the upper (free) valves. The dextral form would coil anteriorly, and the sinistral form posteriorly.

Using dentition in juveniles and soft body morphology, Odhner (1917, 1919) determined that all the shells in the Chamacea coil anteriorly and that the dentition in the "sinistral" form is not an inversion or mirror image, but different. This difference becomes obscured in adults by continued secretion of shell material, hence the confusion. He restricted *Chama* to only "dextral" forms and reclassified all "sinistral" species in the new genus *Pseudochama*.

The left (lower) valve in *Chama* is distinguished from the right valve by having a distinct elongate socket in the hinge. An elongate tooth in the hinge of the right (upper) valve corresponds to this socket, but may not be as distinctive. The left valve is usually larger and thicker than the right valve, but can be the same size and thickness. The anterior direction can be determined from the direction of coiling, and from the placement of the muscle scars (the anterior muscle scar is commonly elevated with respect to the posterior muscle scar).

Chama congregata Conrad, 1833

Plate I, figures 18 - 22.

Chama congregata Conrad, 1833, p. 341.
Chama congregata Conrad. Pilsbry and McGinty, 1938, p. 75, pl. 7, figs. 6, 10.
Chama congregata Conrad. Perry, 1940, p. 54, pl. 10, fig. 59.
Chama congregata Conrad. Bayer, 1943, p. 120, pl. 12, fig. 3.
Chama congregata Conrad. Perry and Schwengel, 1955, p. 61, pl. 10, fig. 59.
Chama congregata Conrad. Abbott, 1974, p. 466.
Chama congregata Conrad. Emerson and Jacobson, 1976, p. 385, pl. 40, fig. 12.
Chama congregata Conrad. Vokes and Vokes, 1983, p. 39, pl. 40, fig. 1.
Chama congregata Conrad. Turgeon *et al.*, 1988, p. 36.

Diagnosis.—Sculpture of finely corrugated ribs; left valve cupped, right valve thin, flat; generally less than 25 mm in length.

Description.—Shell coils anteriorly; left valve larger, cupped; right valve commonly thin, flat. Pallial line extends around outside of both muscle scars; crenulations present on inside margins of valves. Sculpture of finely corrugated ridges. Valves up to 35 mm long, but generally less than 25 mm.

Distribution.—This species is present at 27 of the 44 localities, but is most common in the patch reef/interreef environments, forming up to 18 % of the fauna at individual localities (18.6% at locality G), and 1.2% of the total fauna. Abbott (1958) noted the occurrence of *Chama sp.*, probably *C. congregata*, in the modern fauna. The distribution of this species in the modern fauna is unknown, because the valves collected were found washed up on the beach.

Remarks.—This species is distinguished from other western Atlantic *Chama* by its corrugated external appearance, and by its smaller maximum size. *C. macerophylla* has a similar internal structure, but is generally larger, and has foliated or leafy sculpture. *C. sinuosa* is also larger, with foliated or leafy sculpture, and lacks crenulations on the inner margins of the valves. *C. sarda* is of a similar size, but its sculpture consists of irregular foliations, not corrugations.

Chama macerophylla (Gmelin, 1791)

Plate I, figures 23 and 24, plate II, figures 1 - 3.

Macerophylla, Flos Macis Chemnitz, 1784, p. 101, 149, pl. 52, fig. 514 - 515.
Chama macerophylla Gmelin,1791, p. 3304.
Chama citrea Gmelin, 1791, p. 3305.
Chama gryphoides Linné (pars) Bruguière, 1792, p. 388.
Chama imbricata Lamarck (non Chemnitz, nec Broderip), 1801, p. 131.
Chama lazarus Lamarck (non Linné),1819, p. 93.
Chama lazarus Lamarck. Blainville, 1825, p. 631, pl. 70, fig. 2(1).
Chama lazarus Lamarck. Sowerby, 1825, pl. 92, fig. 3.
Chama lazarus Lamarck. Deshayes, in Lamarck, 1835, p. 579.
Chama macerophylla Chemnitz. Deshayes, in Lamarck, 1835, p. 580.
Chama macrophylla Chemnitz. Deshayes, 1836, pl. 95, fig. 2.
Chama lazarus Lamarck. Reeve, 1841, p. 129, pl. 96, fig. 3.
Chama macrophylla Chemnitz. Hanley, 1843, p. 226.
Chama lazarus Lamarck. Chenu, 1846, pl. 1, fig. 1-1 a-d, 2-2 a and 3-3 a.
Chama macrophylla Chemnitz. Reeve, 1847, pl. 2, fig. 6.
Chama macrophylla var ß, Reeve, 1847, pl. 8, fig. 6b.
Chama maceropyhlla Gmelin. D'Orbigny, 1853, p. 363.
Chama macerophylla Chemnitz. Adams and Adams, 1857, p. 463, pl. 13, fig. 1 a, b.
Chama macrophylla Chemnitz. Tryon, Jr., 1872, p. 118.
Chama imbricata Arango (non Broderip), 1878, p. 272.
Chama macrophylla Chemnitz. Clessin, 1889, p. 17, pl. 2, fig. 1-2, pl. 20, fig. 1-2.
Chama macerophylla Chemnitz. Dautzenberg, 1900, p. 246.
Chama macrophylla Gmelin. Dall and Simpson, 1902, p. 1403.
Chama macerophylla Gmelin. Dall, 1903, p. 1403.
Chama macerophylla Chemnitz. Odhner, 1919, pl. 1, fig. 4.
Chama macerophylla (Chemnitz) Gmelin. Lamy, 1927, p. 308.
Chama macerophylla Gmelin. Pilsbry and McGinty, 1938, p. 75, pl. 7, figs. 2, 8.
Chama macerophylla Gmelin. Perry, 1940, p. 55, pl. 10, fig. 60.
Chama macerophylla Gmelin. Bayer, 1943, p. 119, pl. 13, fig. 12.
Chama macerophylla Gmelin. Perry and Schwengel, 1955, p. 62, pl. 10, fig. 60.
Chama macerophylla Gmelin. Abbott, 1974, p. 466.
Chama macerophylla Gmelin. Emerson and Jacobson, 1976, p. 385, pl. 41, fig. 4.
Chama macerophylla Gmelin. Vokes and Vokes, 1983, p. 39, pl. 40, fig. 3.
Chama macerophylla Gmelin. Turgeon *et al.*, 1988, p. 36.

Diagnosis.—Both valves large, thick, heavy; sculpture foliated; inner margins crenulated.

Description.—Shell coils anteriorly; left valve larger; both valves large, thick, heavy. Pallial line extends around outside of both muscle scars. Inner margin of valves crenulated. Sculpture variable, from leafy fronds to absent. Valves up to 70 mm long.

Distribution.—This species occurs at 24 of the 44 localities, but is most common in the patch reef/interreef environments. It is the most common chamid in the

Ironshore Formation, forming 1.9% of the total fauna, and up to 10% of the fauna at individual localities (10.6% at locality G). It has not been described from the modern fauna (Abbott, 1958).

Remarks.—There are three juveniles in the collection that are faintly flushed with pink (3506 - F; 3515 - JSB), but all other specimens are white. Modern shells of this species are white, yellow, red, orange, or purple (Abbott, 1974). Shells from the Ironshore Formation are commonly cemented, and pitted with sponge borings, so that ornamentation and internal structure are commonly obliterated and thus difficult to determine.

This species is distinguished from *C. sinuosa* by the presence of crenulations on the inner margin (commonly visible even in heavily cemented valves). Also, the pallial line extends around both muscle scars in *C. macerophylla*, but does not extend past the anterior muscle scar in *C. sinuosa*. *C. congregata* is smaller, with corrugated, not foliated, sculpture.

Chama sinuosa Broderip, 1835

Plate II, figures 4 - 6.

Chama sinuosa Broderip, 1835, p. 303, pl. 38, fig. 6.
Chama sinuosa Broderip. Chenu, 1846, pl. 6, fig. 3.
Chama sinuosa Broderip. Reeve, 1847, pl. 3, fig. 11.
Chama sinuosa Broderip. Tryon Jr., 1872, p. 120.
Chama sinuosa Broderip. Clessin, 1889, p. 14, pl. 6, fig. 6.
Chama lamarckiana Clessin, 1889, p. 42, pl. 5, fig. 1, 2.
Chama bermudensis Heilprin, 1889, p.141, pl. 8, fig. 1.
Chama sinuosa Broderip. Lamy, 1927, p. 311.
Chama sinuosa Broderip. Pilsbry and McGinty, 1938, p. 76, pl. 7, fig. 9.
Chama sinuosa Broderip. Bayer, 1943, p. 121, pl. 13, figs. 9, 10.
Chama sinuosa Broderip. Abbott, 1974, p. 466.
Chama sinuosa Broderip. Vokes and Vokes, 1983, p. 39, pl. 40, fig. 5.
Chama sinuosa Broderip. Turgeon *et al.*, 1988, p. 36.

Diagnosis.—Inner margin smooth; pallial line not extending past anterior muscle scar.

Description.—Shell coils anteriorly; left valve larger; both valves commonly large, thick, heavy. Pallial line extends around outside of posterior muscle scar but meets anterior muscle scar at its base. Inner margins of valves smooth, lacking crenulations. Sculpture variable, as in *C. macerophylla*. Length up to 75 mm.

Distribution.—This species never makes up more than 2 % of the fauna from any locality with more than 100 individuals. It occurs at 11 localities, 10 of these being in the reef tract and patch reef/interreef environments. *C. sinuosa* has not been described form the modern Grand Cayman fauna (Abbott, 1958).

Remarks.—*C. sinuosa* is unique among western Atlantic *Chama* in that the pallial line does not extend past both muscle scars, but extends only to the base of the anterior muscle scar; and that it lacks crenulations on its inner margins. According to Odhner (1919, p. 78) *Chama bermudensis* Heilprin (and possibly also *C. lamarckiana* Clessin) has the same internal structure as *C. sinuosa*, but has slightly different sculpture and form, and is probably an environmental variation of *C. sinuosa*.

Genus *Pseudochama* Odhner, 1917

Pseudochama Odhner, 1917, p. 28.
Pseudochama Odhner, 1919, p. 80 - 84, plates 1 to 6.
Pseudochama Odhner. Gardner, 1926, p. 92.

Diagnosis.—Valves inequant, with right valve larger, attached to substrate. Shell coils anteriorly. Right valve with distinct elongate socket; left valve with corresponding tooth; other dentition obscure. Two large muscle scars, anterior scar often elevated with respect to posterior scar.

Type Species.—*Pseudochama cristella* (Lamarck), by subsequent designation, Gardner, 1926, p. 92. (Recent, from Indonesia to Australia).

Discussion.—Munier-Chalmas (1882) noted that species of *Chama* can attach by either their "left" or "right" valve, and thus occur in two forms. "Dextral" (or normal) forms attach by the left valve and appear to coil to the right when viewed from above, while "sinistral" (or inverse) forms attach by the right valve and appear to coil to the left. He noted that left or right valves in "sinistral" and "dextral" forms are not homologous with each other, but rather with the opposite valve: that is, the left valve in "sinistral" forms corresponds to the right, not left, valve in "dextral" forms. Lower (attached) valves resemble each other in form and in dentition, as do upper (free) valves. Munier-Chalmas (1882) designated the valve that is free in *Chama* and in most rudists as valve α and the other valve, attached in *Chama* and most rudists, as β, for lack of better terms.

Odhner (1917, 1919) determined several features in which the normal ("dextral") and inverse ("sinistral") forms differ significantly. The dentition is different, not (although similar to) a mirror image, in the inverse form. The nepionic (juvenile) shells differ. There are also soft-body differences. On the basis of the evidence determined from a number of species of *Chama*, Odhner (1917) referred all inverse (sinistral) species to *Pseudochama*. He referred the *Arcinella* (=*Echinochama*) group of chamids to *Pseudochama* as well, although Abbott (1974) considered *Arcinella* a separate genus. Continued shell secretion in adults blurs dentition, resulting in misinterpretation of dentition in *Chama* and *Pseudochama*. Although the two types of dentition look different in juveniles, in adults they do resemble each other. This pattern is a pseudoconvergence, not a mirror image, as had been previously thought (Odhner, 1919, p. 22).

Yonge (1967) supported Munier-Chalmas's interpretation of coiled growth in normal and inverse directions, citing examples of inversion in *Pseudochama inezae* (Bayer, 1943), *Chama pellucida* (Palmer, 1928), and

Pseudochama exogyra (Yonge, 1967). The few inverse forms described may be cases where the form of one species has varied for environmental reasons and resembles a species of the other genus. Yonge's (1967) interpretation is questionable, as he did not examine dentition in juveniles, and relied on external morphology in at least one comparison.

Distinct differences (other than a "mirror image") in the dentition of *Chama* and *Pseudochama* are not evident in the specimens from the Ironshore Formation of Grand Cayman. While this is mainly due to the nature of dentition in adult Chamacea, it is also the result of poor preservation in the specimens collected, whose valves are well cemented and eroded. Sometimes it is not even possible to determine if a valve has a distinct tooth or socket, although this is necessary to determine the species, as a left coiling valve could be either *Chama* (left attached valve, with socket distinct), or *Pseudochama* (left free valve, with prominent tooth).

Pseudochama radians (Lamarck, 1819)

Plate II, figures 7, 8.

Chama gryphoides Chemnitz (non Linné), 1786, p. 145, pl. 116, fig. 992.
Chama radians Lamarck, 1819, p. 96.
Chama sinistrorsa Wood (non Bruguière), 1828, pl. 9, fig. 24.
Chama radians Lamarck, 1835, p. 585.
Chama radians Lamarck. Hanley, 1843, p. 227.
Chama radians Lamarck. Chenu, 1846, pl. 4, fig. 7-7, a, b.
Chama radians Lamarck. Reeve, 1847, pl. 4, fig. 19.
Chama ferruginea Reeve, 1847, pl. 4, fig. 21.
Chama variegata Reeve, 1847, pl. 9, fig. 50.
Chama radians Lamarck. Adams and Adams, 1857, p. 464.
Chama variegata Reeve. Adams and Adams, 1857, p. 464.
Chama radians Lamarck. Tryon Jr., 1872, p. 119.
Chama variegata Reeve. Tryon Jr., 1872, p. 120.
Chama radians Lamarck. Clessin, 1889, p. 36, pl. 16, fig. 1.
Chama ferruginea Reeve. Clessin, 1889, p. 22, pl. 9, fig. 5.
Chama variegata Reeve. Clessin, 1889, p. 46, pl. 18, fig. 5.
Chama ferruginea Reeve. Dall, 1903, p. 1404.
Chama variegata Reeve. Dall, 1903, p. 1404.
Chama radians Lamarck. Lamy, 1917, p. 266.
Pseudochama radians (Lamarck). Odhner, 1919, p. 81

Pseudochama ferruginea Reeve. Odhner, 1919, pl. 1, figs. 7,8; pl. 4, figs. 38, 39; pl. 5, figs. 40 - 45.
Chama radians Lamarck. Lamy, 1921, p. 310.
Chama radians Lamarck. Lamy, 1927, p. 375.
Chama ferruginea Reeve. Lamy, 1927, p. 312.
Chama variegata Reeve. Lamy, 1927, p. 337.
Pseudochama radians (Lamarck). Pilsbry and McGinty, 1938, p. 77.
Pseudochama radians (Lamarck). Abbott, 1974, p. 467.
Pseudochama radians Lamarck. Emerson and Jacobson, 1976, p. 385 - 386, pl. 40, fig. 13.
Pseudochama radians (Lamarck). Vokes and Vokes, 1983, p. 39, pl. 40, fig. 6.
Pseudochama radians (Lamarck). Turgeon *et al.*, 1988, p. 36.

Diagnosis.—Both valves large, heavy; pallial line extends to base of both muscle scars.

Description.—Shell coils anteriorly; right valve larger; both valves large, heavy. Pallial line extends to base of anterior muscle scar, meets posterior muscle scar on inside base edge of scar. Inner margins of valves crenulated. Sculpture may be leafy, but commonly eroded or bored, possibly absent to begin with. Length up to 60 mm.

Distribution.—This species is rare, occurring at only 7 localities (6 patch reef/interreef localities) and never forming more than 2 % of any sample. This species has not been recorded in the modern fauna (Abbott, 1958).

Remarks.—This form of *Pseudochama radians* resembles a mirror image of *Chama macerophylla* externally, and is also typically highly bored and cemented, leaving determination of features difficult. It is distinguished from the *Chama* by its sinistral coiling, and from *P.radians. variagata* by its large, heavy, thick valves.

Reeve (1847) described three species of *Pseudochama* from the Caribbean: *P. radians* (Lamarck), *P. variegata*, and *P. ferruginea*. Subsequent work (Odhner, 1919) has shown these species to be ecological forms of *P. radians*.

Pseudochama radians variegata (Reeve, 1847)

Plate III, figures 1 - 5.

Chama radians Lamarck, 1819, p. 96.
Chama sinistrorsa Wood (non Bruguière), 1828, pl. 9, fig. 24.
Chama radians Lamarck, 1835, p. 585.
Chama radians Lamarck. Hanley, 1843, p. 227.
Chama radians Lamarck. Chenu, 1846, pl. 4, fig. 7-7, a, b.
Chama radians Lamarck. Reeve, 1847, Plate 4, fig. 19.
Chama variegata Reeve, 1847, Pl. 9, fig. 50.
Chama radians Lamarck. Adams and Adams, 1857, p. 464.
Chama variegata Reeve. Adams and Adams, 1857, p. 464.
Chama radians Lamarck. Tryon Jr., 1872, p. 119.
Chama variegata Reeve. Tryon Jr., 1872, p. 120.
Chama radians Lamarck. Clessin, 1889, p. 36, pl. 16, fig. 1.
Chama variegata Reeve. Clessin, 1889, p. 46, pl. 18, fig. 5.
Chama variegata Reeve. Dall, 1903, p. 1404.
Chama radians Lamarck. Lamy, 1917, p. 266.
Pseudochama radians (Lamarck). Odhner, 1919, p. 81.
Chama radians Lamarck. Lamy, 1921, p. 310.
Chama radians Lamarck. Lamy, 1927, p. 375.
Chama variegata Reeve. Lamy, 1927, p. 337.
Pseudochama radians variegata (Reeve). Pilsbry and McGinty,1938, p. 77, pl. 7, figs. 3, 4, 5.
Pseudochama radians variegata Reeve. Perry, 1940, p. 55, pl. 10, fig. 61.
Pseudochama radians variegata Reeve. Bayer, 1943, p. 122, pl. 12, fig. 4.
Pseudochama radians variegata (Reeve). Perry and Schwengel, 1955, p. 62, pl. 10, fig. 61.

Diagnosis.—Valves thin, light; right valve cupped; left valve flattened. Pallial line extends to base of both muscle scars.

Description.—Shell coils anteriorly. Right valve typically triangular in cross-section, with large flat base of attachment. Left valve typically flattened lid. Shell up to 40 mm long. Pallial line extends to base of anterior muscle scar, and to inside base of posterior muscle scar. Inner margins crenulate. Sculpture variable, from leafy to corrugated to absent.

Distribution.—This species is widespread, occurring at 20 localities, but is concentrated in 14 patch reef/interreef localities, forming up to 4 % of samples there. It has not been noted in the modern fauna of Grand Cayman (Abbott, 1958).

Remarks.—This variety of *Pseudochama radians* can resemble a mirror image of *Chama congregata* in external appearance, with a similar shape and corrugated sculpture. It is distinguished from the other forms of *P. radians* by its deeply cupped right valve and flattened left valve, and its slightly smaller size.

Pilsbry and McGinty (1938) described *P.radians variegata* as being small (30 mm) and corrugated, resembling a mirror image of *Chama congregata.*

Discussion

The size and shape of the valves of the chamids is highly variable. This has led to a large number of probably redundant species being named. An example of the variability possible was described by Pilsbry and McGinty (1938) for Florida chamids. Chamacea found on open shores exposed to the surf were typically attached by a broad flat base, with the shell erect only along the upper margin, resulting in a triangular cross-section. Sculpture was reduced and blunted. In low energy areas the area of shell attachment was reduced or absent, with the attached valve convex and commonly well sculptured. The sculpture is commonly obscured by encrustations of calcareous algae. Both *Chama sinuosa firma* and *Pseudochama radians variegata* occur in the higher energy environments. Pilsbry and McGinty (1938) described *P.radians variegata* as being small (30 mm) and corrugated, resembling a mirror image of *Chama congregata. Pseudochama radians* also occurred in a larger form (50 - 60 mm) with a heavy shell and little sculpture, in the high energy areas. The authors were uncertain whether the variations they found were entirely environmental, or were in part genetic, and so maintained separate names for the different forms.

Five species or forms of Chamacea form a significant part of the Ironshore Formation fauna, but are rare or absent in the modern fauna. Abbott (1958) notes that a sixth species, *Chama sarda*, has been identified from the modern fauna of Grand Cayman, but has not been found in the Ironshore

Formation fauna. Abbott (1974, p. 466) described it as: "1 inch, with the attached valve sometimes deeply cupped. Color mostly red, inside and out. Sculpture of irregular foliations. Internal margin crenulated. Rare in Florida; common in the West Indies; attached to dead coral and shells and gorgonians." If it is present it may be confused with and included among juvenile *Chama macerophylla*. The Chamacea appear to have mostly disappeared since the Pleistocene, but may still be present but inaccessible or poorly distributed today.

The Chamacea of the Ironshore Formation are particularly important in some of the patch reef localities, where they are common (up to 38 %, locality G). Their cementing habit, and the large size of most of the species, allows these molluscs to modify the environment by increasing the amount of hard substrate available to themselves and other organisms, and possibly also to form reefs independently of corals.

III. METHODS OF ANALYSIS

Numerous methods are available for the measurement of diversity and cluster analysis of databases. The most effective method must be determined before analysis can take place. Effective diversity indices are those which are not strongly biased by sample size, and do not duplicate each other. Seven diversity indices were considered for this study. Trends in values were compared in order to determine the most effective indices for the fauna of the Ironshore Formation. The method of cluster analysis selected should be appropriate for the nature of the study and the nature of the database. Seven correlation coefficients and three methods of clustering were compared using two sets of data. The first set of data, for modern shoreline molluscs from Grand Cayman (collected and analysed by Brian Jones and S. George Pemberton; Jones, 1988) was used because it is known to contain distinct associations. Methods effective for the modern shoreline fauna were then applied to the Ironshore Formation mollusc data.

Measurement of diversity

Diversity is a measure of the abundance of taxa in a community. In any community there are generally a few dominant taxa (with large numbers or biomass) and many other taxa present in small numbers (Figure III-1; Odum, 1971). Tropical communities typically have higher numbers of dominant taxa than temperate communities or communities in harsh physical environments (Odum, 1971).

Diversity consists of two components, richness and evenness (Lloyd and Ghelardi, 1964; Whittaker, 1965; Hurlbert, 1971; Odum, 1971; Peet, 1974; Dodd and Stanton, 1981). Richness is a measure of the total number of taxa present

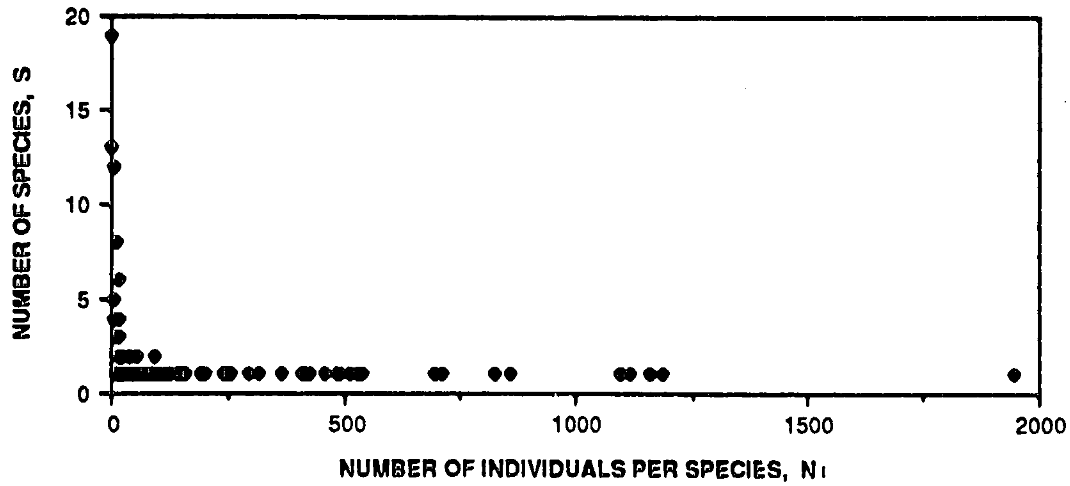


Figure III-1. Cross-plot of the number of species versus the total number of individuals present in the fauna for each species. Many species occur in small numbers, whereas few occur in large numbers.

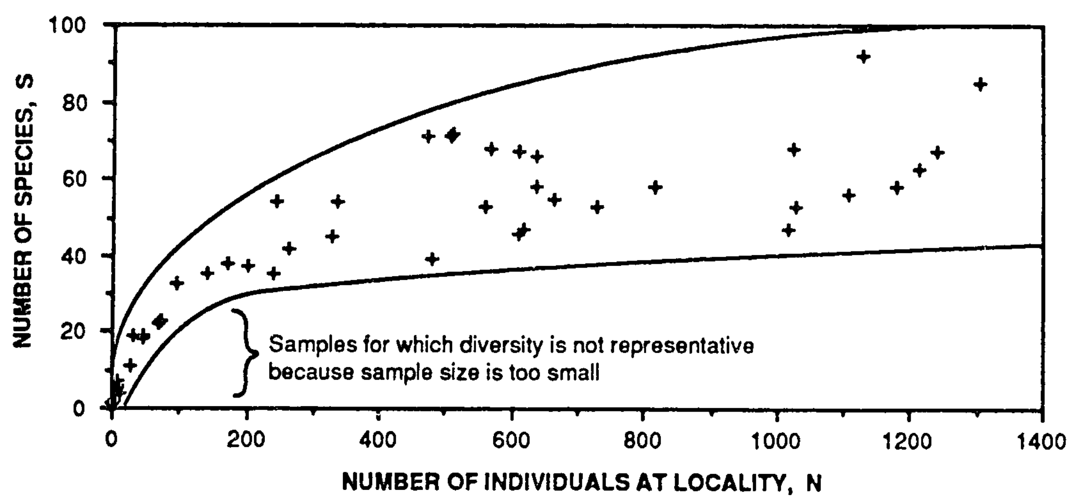


Figure III-2. Cross-plot of richness (S, the number of species) versus abundance (N, the number of individuals) for localities in the Ironshore Formation.

in a community. The number of rare taxa present is thus important in determining richness (Odum, 1971). Evenness, or equitability, is a measure of the relative abundances of taxa in a community. A community with large numbers of a few taxa and low numbers of other taxa has lower evenness than a community with similar abundances of many taxa, but higher evenness than a community with only one dominant taxon, and low numbers of all other taxa present (Pielou, 1966a; Hurlbert, 1971; Odum, 1971; Dodd and Stanton, 1981). Some diversity indices measure the abundance of taxa by incorporating both the richness and the evenness in a community, whereas others examine only one component or the other (Hurlbert, 1971; Odum, 1971; Peet, 1974; Dodd and Stanton, 1981). The definition of diversity depends on which type of index is used to measure it.

For most communities, diversity must be estimated from representative samples, because it is impossible to count the entire community (Pielou, 1966a). Estimation of diversity by sampling introduces a serious problem in that the number of species present in a sample is commonly a function of the sample size (Figure III-2). Care must be taken to ensure that samples are large enough that this effect is reduced. The size required depends on the nature of the fauna involved, and is inversely proportional to the evenness and richness of the fauna (Stanton and Evans, 1972). Cross-plots of sample size versus indices are used in this study to indicate the bias introduced by sample size. Those indices which are least biased by sample size for the localities in this study are preferred.

Species richness

Species richness, a measure of the total number of taxa present, does not take relative abundances into account (Hurlbert, 1971; Odum, 1971; Peet, 1974; Dodd and Stanton, 1981). Comparison of richness in two samples may not be meaningful if sample sizes are not equal, because richness varies with sample size (Hurlbert, 1971).

The simplest measure of richness is the number of taxa in the community, S, estimated from the number of taxa in the sample. S increases with increasing richness.

Odum *et al.* (1960) stressed plotting the number of species against the logarithm of the number of individuals for samples, in order to remove the sample size bias, because the relationship between S and N is approximately lognormal (Figure III-2; Gleason, 1922; Sanders, 1968; Dodd and Stanton, 1981). Odum *et al.* (1960) defined the diversity function as D = S/Log(N). The base of the logarithm used for these indices is not significant providing it is consistent, because it affects the size of the unit only (Pielou, 1966a). This was later expressed as the diversity index S per 1000 individuals or S/N (Odum, 1971) and as the Odum Diversity Index S/N (Kobluk *et al.*, 1988). S/Log(N) and S/N increase with increasing richness (Sanders, 1968).

Margalef's (1957, 1958) diversity, D = (S-1)/Log(N), is another measure of species richness. Dividing by Log(N) reduces the impact of variable sample size on richness. This index increases with increasing sample size (Margalef, 1957, 1958; Sanders, 1968).

Sanders (1968) suggested comparison of species abundance curves (as in Figure III-2) rather than comparison of richness at specific sample sizes. In this rarefaction method, the richness that would have been found at different sample sizes is calculated from the relative abundances of taxa in the sample. A curve is plotted from the set of richness - abundance pairs calculated. Comparison of these curves removes the bias involved in comparing richness for samples of different sizes. This method overestimates the number of rare species present, because it assumes that species are randomly distributed in nature, and not aggregated as they usually are (Hurlbert, 1971; Fager, 1972). Simberloff (1972) reported that Sanders' method overestimated richness in intermediate sample sizes, although it is qualitatively correct, as smaller samples will not necessarily have species in the same proportions as the initial sample. Simberloff (1972) improved on the method by repeatedly drawing samples from a dataset at random, instead of using the proportions in the original sample. The rarefaction method becomes inconvenient when comparing many localities because each locality is represented by a separate plot. For this reason it is not used in this study.

Species evenness

Evenness or equitability is a measure of the relative abundance between taxa. Evenness decreases as sample size (and the number of rare species) increases; thus comparisons between samples of different sizes should be made with care (Hurlbert, 1971).

Simpson's (1949) measure of dominance, $C = \Sigma (n_i/N)^2$, which is a measure of the relative abundances of species in a sample, is the inverse of evenness. The ratio n_i/N is the proportion of species *i* in the sample. The value of $\Sigma (n_i/N)^2$ increases with increasing dominance (decreasing evenness). This index exaggerates the contributions of abundant species, and decreases (increase in evenness) with increasing sample size (Sanders, 1968).

Pielou (1966a, 1966b; Odum, 1971; Dodd and Stanton, 1981) defined the evenness of a sample to be $J' = H'/H'_{max} = H'/Log(S)$, where H' is the Shannon-Wiener diversity index. J' is sometimes denoted as E (Odum. 1971; Dodd and Stanton, 1981).

General diversity

General diversity may be calculated using both richness and evenness. This type of diversity measurement is useful when the species are considered to be of equal importance (Odum, 1971; Dodd and Stanton, 1981).

The Shannon-Wiener diversity index, $H' = -\sum [(n_i/N)\mathrm{Log}(n_i/N)]$, where n_i is the number of individuals present for species *i* in the sample, is an estimate of diversity for samples from populations too large to census. This index is also referred to as the Shannon-Weaver function and Shannon's formula (Shannon and Weaver, 1949; Margalef, 1957, 1958; Pielou, 1966a, 1966b, 1966c). High values indicate high diversity and evenness. Sanders (1968) found that this index is relatively sample-size independent for samples with more than 200 to 400 individuals, and therefore useful.

Comparison of diversity indices

Indices were calculated for all localities but PMP, which is excluded because there is only one individual present (Table III-1).

The indices S, D, and H' all indicate the same trend (Figure III-3). Therefore use of these three indices stresses the same components of diversity. All are biased with respect to sample size, but H' is the least biased. Cross plots of S (Figure III-2), D (Figure III-4a) and H' (Figure III-4b) with sample size indicate that values are biased by sample size for the smallest samples, with more biased samples for S and D than H'. Of these three indices, H' is preferred and is used in this study as a measure of richness/diversity.

Odum's diversity index, which indicates a different trend than S, D, or H' (Figure III-5a), is strongly biased by sample size (Figure III-5b). For the range of sample sizes in this study, this index is inappropriate, as the greatest richness values occur for the smallest samples. Odum's diversity index is not used in this study.

Table III-1. Diversity indices for molluscs at localities in the Ironshore Formation. S = the number of individuals. N = the number of species. D = Margalef's diversity index. H' = the Shannon-Wiener diversity index. J' = evenness. C = Simpson's index of dominance.

LOCALITY	S	N	S(GASTR.)	S(BIV.)	S/N	D	H'	J'	C
ABB	2	4	0	2	0.50	1.7	0.24	0.81	0.63
ACB	7	9	2	5	0.78	6.3	0.82	0.97	0.16
ACH	6	8	1	5	0.75	5.5	0.72	0.93	0.22
B	68	566	22	46	0.12	24.3	1.46	0.80	0.06
BTD	54	244	30	24	0.22	22.2	1.37	0.79	0.10
BTH	5	6	1	4	0.83	5.1	0.68	0.97	0.22
C	72	510	28	44	0.14	26.2	1.41	0.76	0.09
CDS	18	46	10	8	0.39	10.2	1.13	0.90	0.10
CNP	53	1028	22	31	0.05	17.3	1.18	0.68	0.15
CYA	58	1179	19	39	0.05	18.6	1.24	0.71	0.11
CYB	71	505	25	46	0.14	25.9	1.50	0.81	0.05
D	38	173	15	23	0.22	16.5	1.21	0.76	0.12
DPQ	11	27	9	2	0.41	7.0	0.93	0.90	0.14
E	45	328	20	25	0.14	17.5	1.28	0.77	0.09
EOT	23	74	18	5	0.31	11.8	1.20	0.88	0.08
F	92	1130	38	54	0.08	29.8	1.59	0.81	0.04
G	42	264	12	30	0.16	16.9	1.22	0.75	0.10
GC	39	478	11	28	0.08	14.2	1.15	0.72	0.13
H	35	142	14	21	0.25	15.8	1.29	0.84	0.08
K	71	470	27	44	0.15	26.2	1.56	0.84	0.05
L	22	70	7	15	0.31	11.4	1.10	0.82	0.14
M	35	238	10	25	0.15	14.3	1.18	0.77	0.11
MA	55	662	23	32	0.08	19.1	1.41	0.81	0.06
MH	54	334	12	42	0.16	21.0	1.48	0.86	0.05
MOA	68	1025	27	41	0.07	22.3	1.42	0.77	0.06
MON	67	1242	23	44	0.05	21.3	1.32	0.72	0.08
MOS	85	1304	36	49	0.07	27.0	1.55	0.80	0.04
N	4	10	1	3	0.40	3.0	0.47	0.79	0.42
NSE	47	618	15	32	0.08	16.5	1.39	0.83	0.06
OG	53	725	18	35	0.07	18.2	1.42	0.82	0.05
OGA	53	560	18	35	0.10	18.9	1.41	0.82	0.06
PWA	46	608	17	29	0.08	16.2	1.08	0.65	0.20
PWD	47	1016	13	34	0.05	15.3	1.21	0.72	0.10
SD	58	634	25	33	0.09	20.3	1.43	0.81	0.05
SDA	67	607	24	43	0.11	23.7	1.47	0.80	0.06
SDB	66	634	22	44	0.10	23.2	1.47	0.81	0.05
SDC	63	1215	23	40	0.05	20.1	1.29	0.72	0.11
TFB	37	200	27	10	0.19	15.6	1.37	0.87	0.06
TG	58	816	20	38	0.07	19.6	1.44	0.81	0.05
TSE	56	1107	21	35	0.05	18.1	1.30	0.74	0.08
U	19	46	2	17	0.41	10.8	1.18	0.92	0.08
VV	33	95	9	24	0.35	16.2	1.34	0.88	0.07
YY	19	31	4	15	0.61	12.1	1.18	0.92	0.09

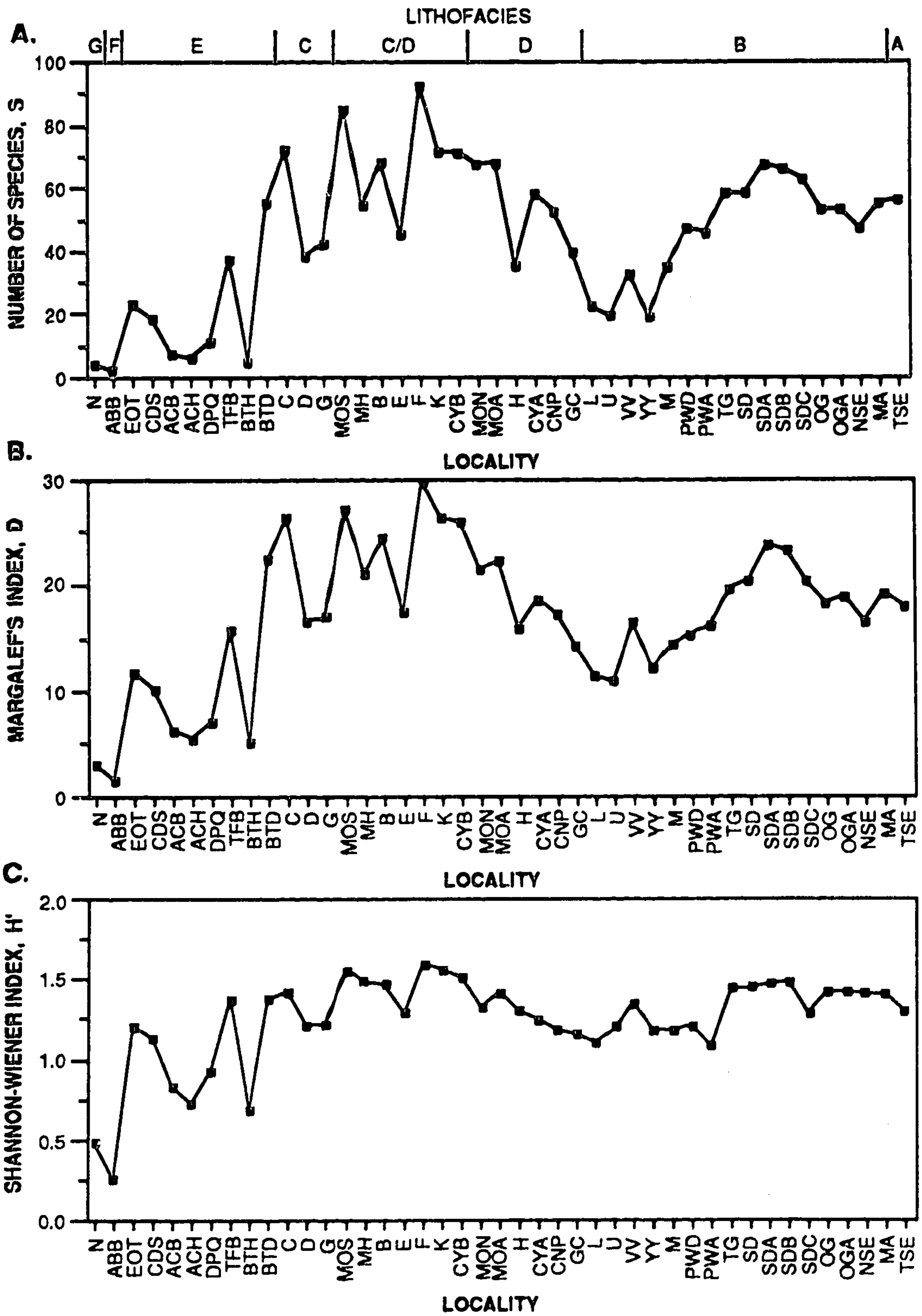
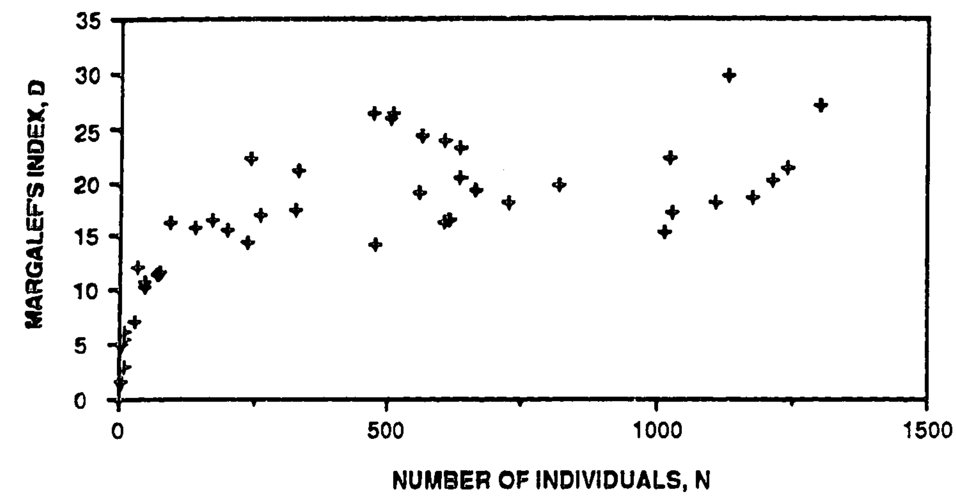


Figure III-3. Diversity for localities in the Ironshore Formation. Localities are grouped by lithofacies (Table 1.1). A. Number of species (S). B. Margalef's index of richness (D). C. Shannon-Wiener diversity index (H').

A.



B.

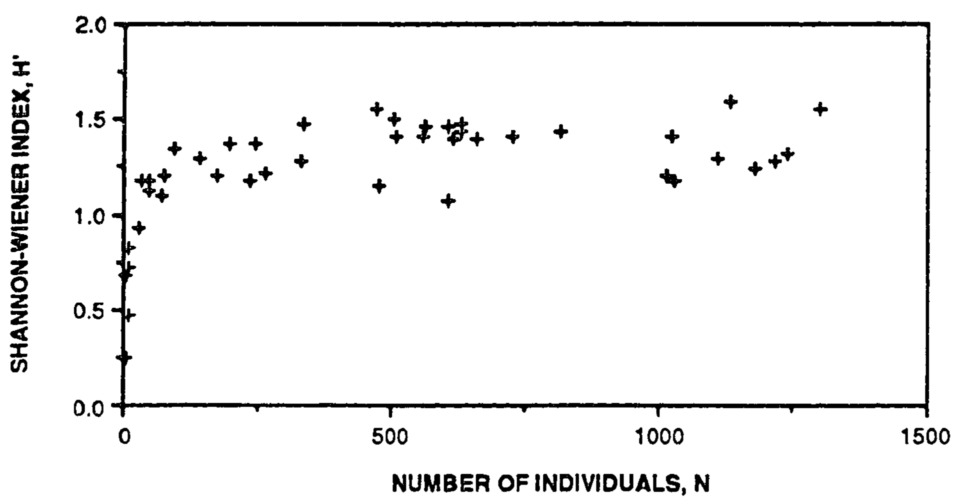
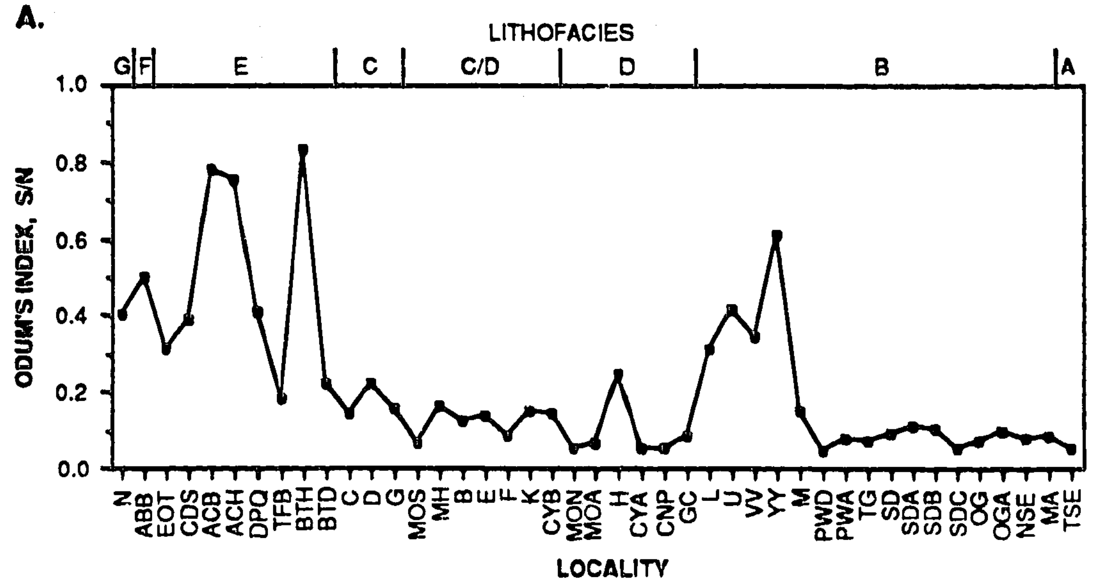


Figure III-4. Cross plots of diversity indices versus sample sizes. A. Margalef's index of richness (D) B. Shannon-Wiener diversity index (H').

A.



B.

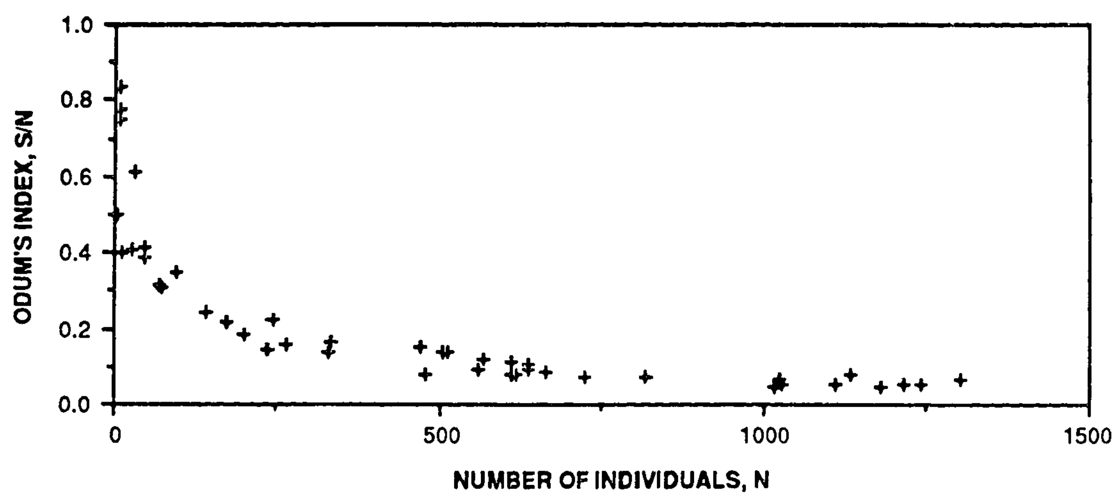


Figure III-5. A. Odum's diversity index, S/N, for localities in the Ironshore Formation. B. Cross-plot of Odum's diversity index versus sample size, N.

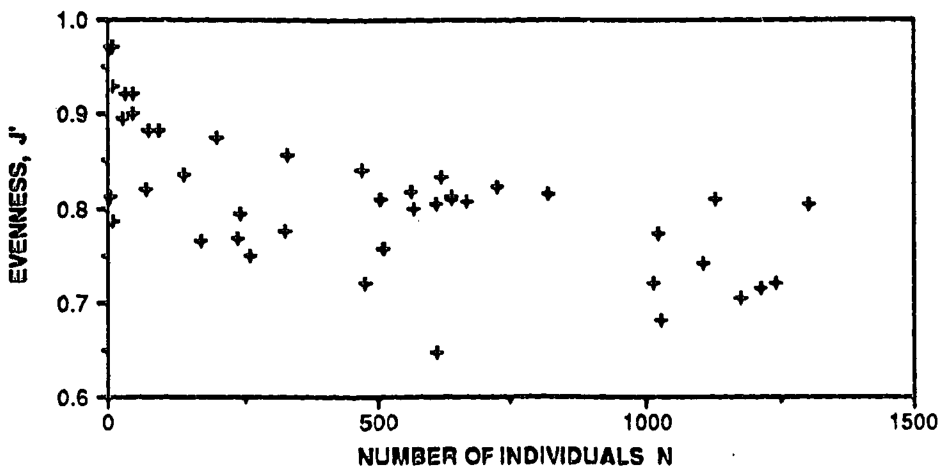
Of the two evenness indices compared, C and J', C is less biased by sample size (Figure III-6). J' appears to follow the same trend as H' for many localities (excluding the smaller samples; Figure III-7a), and is therefore not used in this study. C is used in this study to describe the dominance (evenness)/ diversity of the localities because it is less biased by sample size and because it does not duplicate the other indices (Figure III-7b).

Plots of the above indices for localities from the Ironshore Formation indicate that sample size affects all of the indices. This is most significant for samples from the localities N, ABB, ACB, ACH, and BTH, because these are the smallest samples (Table III-1).

Cluster analysis

Cluster analysis is a quantitative method of finding associations between variables in a data base. In paleontology it has been used in numerical taxonomy for finding distinct groupings in the ranges of morphological traits (e.g. Sokal and Michener, 1958; Rohlf, 1963; Bretsky, 1971; Sneath and Sokal, 1973; Clifford and Stephenson, 1975) and in paleoecology for finding distinct associations of species (e.g. Valentine and Petticord, 1967; Rucker, 1967; Mello and Buzas, 1968; Warme, 1969; Clifford and Stephenson, 1975; Macdonald, 1975; Keen, 1977; Springer and Bambach, 1985; Miller, 1988). Although the basic method is the same for all applications, the actual calculations used depends on the nature of the study. Numerous methods can be used, but some are more appropriate to some studies than others. For example, taxonomic and paleoecologic studies generally use different correlation coefficients (Cheetham and Hazel, 1969). The distribution of mollusc species (bivalves and gastropods) from the Ironshore Formation (this study), and from the modern shoreline (collected and analysed by Brian Jones

A.



B.

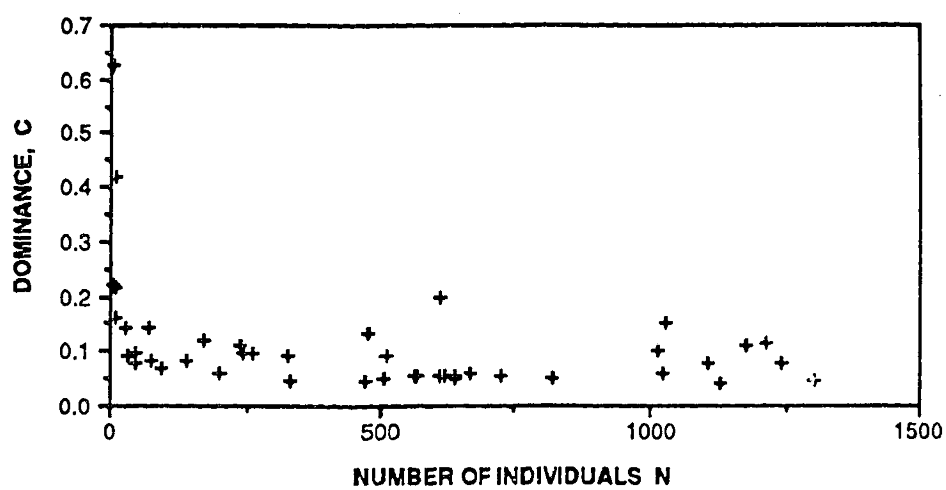
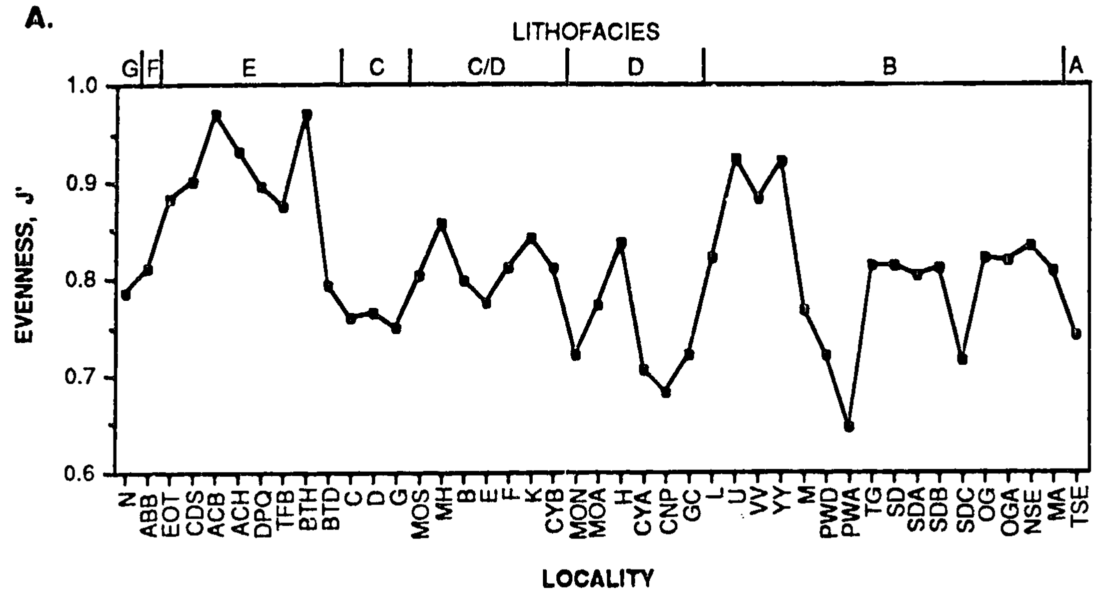


Figure III-6. A. Cross-plot of evenness, J', versus sample size, N.
B. Cross-plot of dominance, C, versus sample size, N.



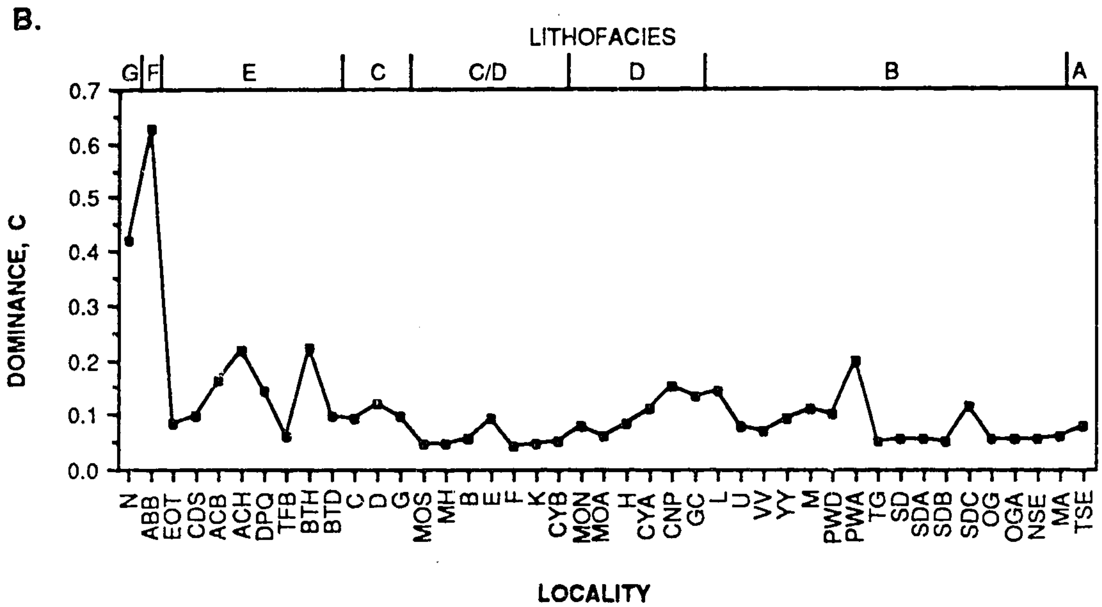


Figure III-7. A. Evenness, J', at localities in the Ironshore Formation.
B. Simpson's dominance index, C, at localities in the Ironshore Formation. Localities are ordered by lithofacies (Table 1.1).

and S. George Pemberton; Jones, 1988), demonstrate the application of cluster analysis to paleoecological data.

Database

Before any useful statistical analysis can be performed, the database must be carefully assembled in order to ensure that it is representative. Samples should be of sufficient size, and identification or measurements accurate and consistent. If the database is not good, then the results of any further analysis will be meaningless, and possibly misleading.

1. Modern shoreline fauna

The modern shoreline molluscan fauna, collected by Jones and Pemberton (*in* Jones, 1988), consists of 17 species collected at 39 localities, with 4,250 individuals (Table III-2). Sample size ranges from 6 to 346 individuals, with half smaller than 80 individuals. Values were not reduced to a percentage because more than half the samples have less than 100 individuals, and percentages would distort abundances of species in smaller samples. Values were standardized during cluster analysis by reducing to zero mean and unit standard deviation before similarity coefficients were calculated. No species or localities were removed from the database because of the much smaller range in richness.

2. Ironshore Formation fauna

The fauna from the Ironshore Formation contains 173 species from 44 localities, with a total of 20,989 individuals (Table III-3). Reducing data to a percentage (standard size of 100 individuals) reduces the effect of variable sample sizes (from 1 to 1304 individuals) and allows direct comparison between localities. Databases with widely varying sample sizes that are not standardized in some way will probably be grouped on the basis of actual composition and not relative composition (i.e. samples with similar sizes will be

Table III-2. Distribution and abundance of modern shoreline species on Grand Cayman. Abundance is tabulated by number of individuals. Data from Jones (1988).

	Localities:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Species:																				
1	Chitons			3	5	16	18	56			7	28									
2	*Nenta peloronta*			26	26			1													
3	*Nerita versicolor*			27	2	3		2	51	3											
4	*Nerita tessellata*			10	5	20	23	37	1	59		2									
5	*Puperita pupa*			11		3															
6	*Littorina ziczac*			13	25	21	1	22	1				4	6	1						
7	*Littorina angulifera*			2	3					1											
8	*Nodolittorina tuberculata*			61	102	10		1					64	198	342	206	163	108	82	33	42
9	*Tectarius muricatus*	6	16															1	2	16	67
10	Top shells							10				2									
11	*Littorina lineolata*							2					9	5	1						
12	*Littorina mespillum*								9	27		2		1	4						
13	*Echinometra*										43										
14	*Patula*										1										
15	Keyhole limpets											5									
16	*Echininus nodulosus*															4	34	18	20	7	7
17	True limpets																				

	Localities:	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
	Species:																			
1	Chitons										3	2	12	11						
2	*Nenta peloronta*																			
3	*Nerita versicolor*																6			1
4	*Nerita tessellata*														133	2	14			
5	*Puperita pupa*																			
6	*Littorina ziczac*			1											77	3	16	99	5	4
7	*Littorina angulifera*																			
8	*Nodolittorina tuberculata*	173	70	280	163	1		4	8	49					78		59	183	6	16
9	*Tectarius muricatus*	3		3	3	70	60	85	70	24					1					15
10	Top shells										13	9	13	5						
11	*Littorina lineolata*			1	2										5		22	2	2	
12	*Littorina mespillum*															126	72	26		2
13	*Echinometra*										5	3	1	7						
14	*Patula*																			
15	Keyhole limpets										1	3								
16	*Echininus nodulosus*	19	12		20															
17	True limpets										5	15		3						

Table III-3. Distribution and abundance of molluscs in the Ironshore Formation, expressed as a percentage. Only those species forming at least 2% at at least one locality are included.

	TFB	BTD	MON	MOA	MOS	MH	B	C	D	E	F	G	H	K	M	CYA
Americardia guppyi		0.4	7.6	2.1	10.5	9.0	14.3	2.2	0.6	1.5	0.4	0.4	3.5	8.7	1.3	27.8
Americardia media														0.2	0.4	0.2
Anadara floridana				0.2	0.1								0.7		1.7	
Anodontia alba			0.1	1.6	0.2		0.2			8.8	0.5		7.7	0.4	1.7	
Arca imbricata	1.0	3.3	0.3	0.2	3.1	3.6	6.0	10.6	11.6	0.6	6.8	12.5		6.2		1.2
Argopecten nucleus				0.1				0.4							0.4	0.2
Barbatia cancellaria	6.0	5.3	0.2	0.1	2.6	2.4	4.8	26.3	29.5	2.1	7.1	9.1	2.8	5.1		0.8
Barbatia candida							0.2	0.2	2.3		0.2					
Barbatia domingensis	2.0	2.9	0.1		2.1	2.4	2.8	2.4	3.5		3.6	14.8	1.4	2.6		0.6
Chama congregata		1.6	0.6		1.8	5.1	1.4	2.5	6.4	0.9	1.0	18.6	1.4	0.9		0.9
Chama macerophylla		2.0	0.2	0.4	2.5	7.5	8.0	6.1	0.2	0.3	6.7	10.6		8.9		1.8
Chama sp.	0.5		0.1									5.3				
Chione cancellata		0.4	6.8	5.4	2.7	3.0	3.2	0.2		0.3	1.3	1.1	0.7	1.7	24.8	6.4
Chione paphia			11.0	5.0	2.1	2.4	3.5				0.5			1.5	2.5	8.2
Codakia costata		0.4	2.8	4.4	4.1	2.1	2.3	1.4	0.6	3.7	2.0	0.8	3.5	1.5	3.4	4.7
Codakia orbicularis	0.5	1.2	0.2	1.6	0.4	0.9	3.4	1.0	1.2		1.2		0.7	0.9	0.4	3.1
Codakia orbiculata		0.4	0.1	0.9	0.5	0.9	0.5	1.0		0.3	0.8			0.4		0.8
Codakia pectinella			0.2	1.9	0.9	0.6	0.7	0.4		0.6	0.9			0.4	3.4	0.3
Crassinella martinicensis		0.4	7.6	7.5	3.1	1.5	4.6	0.2		0.3	1.4	0.4		2.1	15.1	8.9
Cumingia coarctata	0.5				0.2	1.2	0.5	4.5			1.1	0.8		1.3		
Dendostrea frons		0.8			0.2	2.4	0.2	0.2		0.3	0.1	1.5		1.3		
Diplodonta punctata			0.8	0.5	0.3	2.7	0.5				1.4			0.9	0.8	3.1
Divaricella quadrisulcata	0.5	0.4		0.2	1.0	0.6	0.4				0.2			0.2	0.4	0.3
Ervilia concentrica		0.8	1.9	2.9	5.7	2.7	3.5	0.4		0.3	1.6	0.4		2.8	1.7	1.3
Gouldia cerina			0.2	1.1	0.3	0.6	0.4	0.2	0.6		1.0	0.4		0.2	1.3	1.5
Gregariella coralliophaga								0.2				2.3				
Laevicardium laevigatum			0.8	0.9	0.8			0.6			0.4		1.4	0.6		0.5
Leporimetis intastriata		0.4	0.2	0.3	0.4		0.5			4.3	0.2		5.6	0.9		
Linga pensylvanica		0.8	17.5	12.0	11.0	3.3	8.7	2.2	2.3	4.0	8.1	0.4	19.7	11.3	7.6	8.0
Periglypta listeri		0.4	0.1			0.6		0.4	0.6					0.2		0.2
Pitar fulminatus			4.2	1.8	6.5	5.7	4.2	0.6		0.9	3.2		0.7	3.4	4.6	2.6
Pseudochama radians variegata		3.3		0.4	0.2	1.2	1.2	3.9	0.6	0.6	0.4	2.3		1.9	0.8	0.4
Semele proficua			0.1		0.1			0.2			0.1			0.4		0.2
Strigilla mirabilis					0.3											
Tellina candeana			0.6	1.4	1.7	0.6	0.4			1.8	0.3				1.3	0.4
Tellina radiata					0.5								3.5	0.2		
Tellina similis			0.5	0.3	1.3		0.4	0.4		3.7	0.8			0.2		
Tellina sybaritica			1.2	0.9	2.1	3.3	0.5	0.6		0.3	1.3	0.4	0.7	0.9	1.3	0.6
Transennella gerrardi			2.6	0.3	3.8	10.2	1.2	0.4			0.3			0.9		
unidentified Chamidae			0.2	0.1	0.2	8.1	0.2			0.3	0.6	2.3		1.7		0.2
Anachis hotessieriana?	3.5	4.1	0.3	0.5	1.8	0.3	1.1	1.8	2.3		5.2			1.3		0.1
Atys sp.			1.5	0.2	1.9		0.2	1.6		1.2	0.7		1.4	2.1		0.3
Bulla striata	2.5	27.0	1.7	1.6	0.8	0.3	0.5	0.6		21.0	1.5		14.1	1.3	0.4	1.9
Cerithium eburneum			2.7	7.7	2.6			1.2		14.6	2.3	0.8	3.5		10.5	0.2
Cerithium eburneum algicola	4.0	0.8		7.7	0.5	1.2	1.1			1.8	1.4			3.2	3.4	1.5
Cerithium litteratum	8.0	7.0	1.9	6.0	3.0	2.1	4.6	2.0	2.3	7.3	2.8	0.8	0.7	3.8	4.6	4.2
Cerithium lutosum		0.4	11.4	10.3	2.7		0.9	0.8	0.6	5.2	0.2		2.1		0.8	
Columbella mercatoria	9.5	1.6			0.1			0.4	1.7		0.1			0.2		0.1
Cymatium pileare		2.9				0.3	0.2	0.4	0.6		0.2			0.2		
Cyphoma gibbosum	2.5	3.3														
Cypraea sp. B	2.5	1.2			0.1							0.4				
Diodora listeri	4.0	4.5			0.2	0.3	1.1	1.4	5.2	0.6	0.5	2.7	1.4	1.3		0.1
Diodora minuta		1.2			0.2		0.4	1.8	0.6	0.3	2.5		1.4			
Hipponix antiquatus	4.0	2.0		0.1	0.2			3.1	2.9	0.3	2.3	0.4	2.1	0.4		
Latirus carinifer	3.5										0.6	0.4		0.2		
Leucozonia nassa leucozonalis	5.0	4.1						1.0			0.4			1.1		
Lithopoma tectum	15.0	0.4			0.1		0.2	0.4			0.4	0.4		1.1		
Lucapina suffusa	2.0					0.9	0.2	1.2	1.7		0.1	0.8				0.1
Modulus modulus	3.5		0.4	1.5	0.2		0.4	0.2		0.6	1.0		0.7	0.6	0.4	1.4
Nassarius albus	1.5	1.6	1.9	0.4	1.1	0.3	0.4			1.2	1.2			2.1		0.4
Olivella sp. A	1.0	0.8	2.6	1.4	1.8	0.3	0.9		0.6	0.6	1.0	0.4	7.0	1.5	0.4	0.9
Patelloida pustulata	5.0			0.1												
Polinices lacteus	2.0	1.6	0.7	0.3	1.0	0.3	0.2	0.4		1.2	0.1		2.8	0.4		0.3
Tricolia thalassicola			1.5	2.4	2.0	0.3	0.9	0.4		1.8	1.2			0.2		0.7
Zebina browniana			0.7	0.9	1.0		0.2	0.2		0.6				0.2		

Table III-3 (cont'd.). Distribution and abundance of molluscs in the Ironshore Formation, expressed as a percentage. Only those species forming at least 2% at at least one locality are included.

	CYB	CNP	GC	VV	PWD	PWA	TG	SD	SDA	SDB	SDC	CG	OGA	NSE	MA	TSE
Americardia guppyi	11.5	2.7	4.6	1.1	0.5	0.7	0.5	1.6	6.4	3.0	1.1	1.4	2.1	1.0	0.3	1.4
Americardia media	0.2	0.6		2.1	0.8	0.8	2.5	0.5	0.2	0.2	0.3	0.6	0.4	1.9		0.6
Anadara floridana	2.0	0.6	0.2	2.1	2.9	0.7	5.0	0.5	0.3	0.2	1.2	2.2	0.5	6.1		0.6
Anodontia alba	0.4	1.3	2.3	3.2	1.5	1.5	3.4	7.9	0.8	3.2	3.5	10.6	8.6		1.8	10.5
Arca imbricata	7.9				0.3		0.5	0.3	1.0	1.3	0.2	0.3	0.2			
Argopecten nucleus		0.1			0.4		2.0			0.2	0.7	1.1	0.9	3.2		0.3
Barbatia cancellaria	4.6	0.2		1.1	0.1			0.2	0.8	1.4		0.1	0.4			
Barbatia candida	0.6								0.2							
Barbatia domingensis	8.5			1.1			0.2	0.5	1.0	1.3					0.2	0.1
Chama congregata	7.1			3.2	0.1	0.2	0.1	0.3	1.5	2.1	0.1	0.3	0.4	0.5	0.2	
Chama macerophylla	8.7	0.2	0.8		0.1		0.5	0.5	1.6	0.8		0.3	0.5			
Chama sp.	0.4															
Chione cancellata	3.6	6.1	8.4	6.3	4.6	3.5	7.7	2.2	5.4	4.6	3.9	6.9	6.4	8.1	1.8	14.1
Chione paphia	3.4	8.0	12.1		0.3	1.0	0.4	7.1	12.4	9.9	0.6	4.8	3.9	3.6	0.2	2.0
Codakia costata	2.6	4.2	2.3	3.2	4.1	6.4	4.0	1.6	2.6	2.7	2.6	3.2	5.2	3.7	5.7	3.8
Codakia orbicularis	0.4	4.6	7.7	5.3	6.4	6.6	5.9	4.3	2.0	1.3	1.8	5.8	3.9	3.9	0.6	0.7
Codakia orbiculata	0.8	1.6	2.1	2.1	1.1	1.2	4.0	1.3	1.8	1.1	1.7	2.2	1.8	8.4	3.2	0.8
Codakia pectinella	0.2	1.1	0.4	1.1	7.2	3.1	6.6	5.2	2.0	3.5	5.1	4.1	6.8	3.2	0.6	0.3
Crassinella martinicensis	0.8	35.6	30.3	1.1	22.1	41.9	7.2	7.6	11.7	8.0	6.7	11.2	11.8	10.7	0.3	0.5
Cumingia coarctata	0.6							0.2	0.2	0.6	0.1			0.2	0.2	0.1
Dendostrea frons	0.4									1.1			0.2			
Diplodonta punctata	4.0	4.7	0.8		0.1	0.3	0.1	0.3	0.3	0.6			0.4	1.5	0.2	
Divaricella quadrisulcata															9.5	0.1
Ervilia concentrica	0.4	0.2	0.4		0.1		0.9	0.9	2.0	6.8	0.7	0.6	0.4		1.4	0.4
Gouldia cerina	0.8	3.4	3.8	2.1	9.6	4.9	8.0	2.1	1.8	1.4	3.3	2.1	2.0	11.7		0.1
Gregariella coralliophaga	1.4								0.2							
Laevicardium laevigatum	0.2	1.0	1.7	16.8	0.7	0.8	2.0	12.6	4.9	4.3	0.9	5.1	7.5	1.9	0.2	0.7
Leporimetis intastriata			0.8	1.1		0.3	0.1	0.9	1.3	1.6		2.8	1.3	0.6		1.3
Linga pensylvanica	4.4	1.3	6.3		0.5	1.3	0.1	1.3	1.8	2.8	0.4	1.1	0.7	0.2	7.4	11.9
Periglypta listeri		0.4	0.2	4.2	0.1	0.5	0.1		0.2	0.5	0.2			0.2		0.2
Pitar fulminatus	2.4	5.0	1.0	1.1	3.1	3.0	2.8	4.6	6.9	6.6	4.3	2.9	4.8	2.1	4.1	1.5
Pseudochama radians variegata	1.4	0.1	0.2	3.2					0.2		0.2					
Semele proficua	0.6	1.0	0.8	2.1	0.1	0.3	0.6			0.3		0.3		0.8	0.2	
Strigilla mirabilis															2.3	
Tellina candeana					0.2	0.2	0.6	1.4	0.3	1.1	0.5	0.8	1.3		15.7	2.4
Tellina radiata															0.6	
Tellina similis								1.9	0.8	0.8		0.4			1.1	1.2
Tellina sybaritica		0.4	0.2			0.7	2.3	6.9	5.9	11.7	5.0	4.4	5.5	0.8	0.9	0.3
Transennella gerrardi	0.4		0.2						0.2		0.1					
unidentified Chamidae		0.1					0.1	0.2	0.2							
Anachis hotessieriana?	1.0	0.5	0.2	5.3	0.3		0.6	1.1	0.5	0.5	0.7	0.1		0.2	1.7	0.1
Atys sp.		0.3				0.2	0.4	0.2		0.3	0.2	0.4	0.9		0.5	0.7
Bulla striata	0.4	1.8	1.0	5.3		0.3	1.1	3.5	2.1	0.2	0.5	0.4	0.2	0.8		12.2
Cerithium eburneum	0.8	2.6	3.6	3.2	15.6	5.8	6.9	3.0		1.4	6.5	5.0	3.8	4.0	2.9	7.0
Cerithium eburneum algicola	0.2	2.1	1.7		3.5	2.8	2.0	0.3	2.5	0.2	4.7	0.1	1.8	5.5	3.5	6.2
Cerithium litteratum	1.6	2.5	1.7	12.6	3.1	4.1	8.7	5.7	4.3	3.3	29.8	7.2	6.1	1.5	2.9	5.8
Cerithium lutosum		0.1		1.1		0.2	0.2	0.6		0.3	0.7				9.2	0.6
Columbella mercatoria		0.1														
Cymatium pileare	0.2				0.1				0.2							
Cyphoma gibbosum	0.4															
Cypraea sp. B																
Diodora listeri	1.2			2.1		0.2		0.2	0.3	0.3						
Diodora minuta	0.8		0.2					0.2	0.2							
Hipponix antiquatus						0.2				0.2					0.3	
Latirus carinifer		0.1							0.2		0.2					
Leucozonia nassa leucozonalis							0.1		0.2					0.2		
Lithopoma tectum	0.6								0.3							
Lucapina suffusa	0.4			1.1												
Modulus modulus	0.2	1.4	0.4		2.1	1.5	2.0	0.3		0.2	1.2	1.7	0.7	2.6	1.7	0.7
Nassarius albus					0.1	0.2	0.5	0.6	0.5		0.5		0.2		0.5	3.5
Olivella sp. A	0.2	0.4	0.4					0.3	0.3		0.2		0.2		1.2	0.6
Patelloida pustulata																
Polinices lacteus	0.2	0.3	0.2	1.1	0.1	0.3	0.1	0.3	0.8	0.2	0.1	0.1	0.2	0.2		
Tricolia thalassicola		0.1			1.8	2.1	1.5	3.0	1.3	0.3	2.1	2.1	0.5	0.3	4.1	0.2
Zebina browniana					1.9		2.3	1.6	1.0	0.8	1.0	1.1	0.7	1.1	2.6	0.5

grouped together because they have the same numbers of species, though not necessarily similar proportions; Jones, 1988).

A cross-plot of richness (number of species) versus abundance (number of individuals) indicates that samples with fewer than 95 individuals have a much lower richness than larger samples (Figure III-2). This suggests that these samples are not representative since richness appears to be controlled by sample size rather than the original richness. For this reason samples with less than 95 individuals were removed from the database prior to detailed statistical analysis.

The fauna contains a large number of species that are represented by only a few individuals at any given locality. The distribution of rare species such as these is probably not representative, because they occur infrequently (Buzas *et al.*, 1982; Koch, 1987). For this reason all species forming less than 2% of the fauna at all localities were removed from the database prior to analysis. However, species that occur rarely, but are abundant where they do occur can be useful in paleoecology (Buzas *et al.*, 1982) and should not be excluded, as they are by some workers (e.g. Keen, 1977). For this reason, species in this study which are rare at some localities and common at others (≥2%) were not removed from the database. Reducing the database also simplifies the calculations involved. A database of 65 species at 32 localities is considerably easier to manipulate than one with 173 species and 44 localities.

3. Standardizing data

Continuous data may need to be standardized before similarity coefficients are calculated (Sneath and Sokal, 1973; J. C. Davis, 1973). This is particularly true if squared euclidean distance is used to calculate correlations between variables, because it emphasizes few large differences over many small differences (Clifford and Stephenson, 1975). Data may initially be standardized by reducing all variables to a percentage if sample sizes warrant. This is particularly important when the size of samples varies widely. Reducing data to a percentage may not be sufficient for the data if there is a wide range in richness between samples, as samples may still be clustered by richness and not by composition (as was found for early trial runs for the Ironshore Formation data). Standardizing the data prior to calculating the similarity matrix should lessen this problem. In CLUSTAN the default standardization method is to standardize to zero mean and unit standard deviation (subtract the mean of data values from value, then divide by the standard deviation; Weishart, 1987). Thus all values are centered in distribution about the origin in a normal curve (J. C. Davis, 1973).

4. Nature of data

Data may be either binary or continuous. Binary data indicate presence (1) or absence (0) only. Continuous data indicate the number of shells present. This may be expressed as a number (e.g. measurement; number of individuals) or percentage. When samples have fewer than 100 individuals, percentages may not be representative. But with large and/or highly variable sample sizes, percentages are preferable to numbers of individuals, because a database reduced to percentages will remove the effect of variable sample sizes, so that a value of 3.1% in one sample is equivalent to 3.1% in another.

Use of binary data considers the presence or absence of each variable to be equally significant. Therefore it is useful when the measured abundance of variables may not be accurate (e.g. because of sampling biases, or small sample sizes; Valentine and Petticord, 1967). It is also useful when the most important variables are not necessarily the most abundant ones and/or communities are not defined on basis of abundance. Use of continuous data, on the other hand, stresses the most abundant species. This is useful if the less abundant variables are less significant, as it reduces their impact on the results (Jones, 1988). Continuous data are generally preferred for ecological work, because binary data commonly do not give sufficient information (Petersen, 1914; Williams *et al.*, 1973; Clifford and Stephenson, 1975). Even so, binary data should still be considered, because they may offer additional insights into the nature of the distribution.

General method

The basic method for cluster analysis consists of the calculation of correlation coefficients for each possible pair of variables followed by the clustering of like variables in a dendrogram on the basis of their correlations. For a data matrix of n variables, with m cases for each (e.g. n species from m localities; Figure III-8), correlation coefficients for n(n-1)/2 pairs of variables are calculated and stored in a similarity matrix (Figure III-9). These coefficients are then clustered in a dendrogram (Figure III-10), which links together associated variables; strong associations are linked at high correlations (high similarity or low dissimilarity) in the dendrogram, whereas weak associations are linked at low correlations. This allows easy visual interpretation of the similarity matrix. The accuracy of the dendrogram may be measured by calculating the cophenetic correlation coefficient, which indicates the correlation between the original similarity matrix and the correlations after clustering has been completed (J. C. Davis, 1973; Sneath and Sokal, 1973; Weishart, 1987).

The data may be analysed by both Q-mode and R-mode analysis. Q-mode analysis measures the correlation between localities (columns in data matrix), whereas R-mode analysis determines the degree of association between species (rows in matrix; Sneath and Sokal, 1973). The clusters of species derived by R-mode can be cross-correlated with the clusters of localities derived by Q-mode analysis, by reordering the original data matrix

		Cases					
		1	2	3	.	.	m
Variables	1	$X_{1,1}$	$X_{1,2}$	$X_{1,3}$	.	.	$X_{1,m}$
	2	$X_{2,1}$	$X_{2,2}$	$X_{2,3}$	.	.	$X_{2,m}$
	.	.	.	.	.	.	.
	i	$X_{i,1}$	$X_{i,2}$	$X_{i,3}$	.	.	$X_{i,m}$
	j	$X_{j,1}$	$X_{j,2}$	$X_{j,3}$	.	.	$X_{j,m}$
	k	$X_{k,1}$	$X_{k,2}$	$X_{k,3}$	.	.	$X_{k,m}$
	.	.	.	.	.	.	.
	n	$X_{n,1}$	$X_{n,2}$	$X_{n,3}$	.	.	$X_{n,m}$

Figure III-8. Type of database used in cluster analysis. In Q-mode analysis, cases are clustered and an m x m similarity matrix is calculated. In R-mode analysis, variables are grouped, and an n x n similarity matrix is calculated.

(i)

A	1	$S_{a,b}$	$S_{a,c}$	$S_{a,j}$
B	$S_{a,b}$	1	$S_{b,c}$	$S_{b,j}$
C	$S_{a,c}$	$S_{b,c}$	1	$S_{c,j}$
J	$S_{a,j}$	$S_{b,j}$	$S_{c,j}$	1
	A	B	C	J

(ii)

AB	1	$S_{ab,c}$	$S_{ab,j}$
C	$S_{ab,c}$	1	$S_{c,j}$
J	$S_{ab,j}$	$S_{c,j}$	1
	AB	C	J

Figure III-9. Clustering of hypothetical similarity matrix: (i) Similarity matrix for variables A, B, C, J. $S_{a,b}$ is the similarity between the variables A and B. (ii) Recalculated similarity matrix after fusion of variables A and B by weighted pair-group method of clustering (WPGMA).

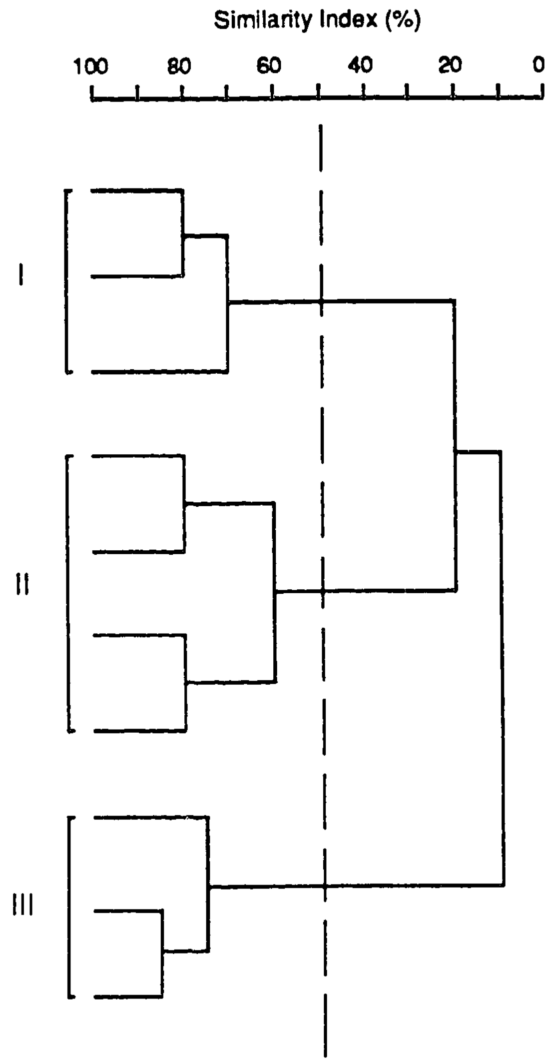


Figure III-10. Hypothetical dendrogram illustrating phenon line at 50% similarity, dividing diagram into three clusters: I, II, and III.

according to the order of species and localities in the dendrograms (Figure III-11; Springer and Bambach, 1985; Jones, 1988; Miller, 1988). Distribution of data in the matrix should reflect the results of the analysis, and illustrate groups in the matrix. Cross-correlating the two dendrograms allows visualization of communities, illustrating the effectiveness of the clustering, and reduces the danger of basing interpretations on inaccuracies in the dendrogram.

Computer analysis

In this study, cluster analysis was performed on the University of Alberta mainframe computer, using CLUSTAN (version 3.2) by Weishart (1987). This program allows the use of binary or continuous data, and the choice of 42 correlation coefficients and nine clustering methods. The program also calculates the cophenetic correlation coefficient, and other statistics. An additional advantage to using this program is that it is widely available and used by many workers, allowing comparison of results from different authors. The disadvantage to using programs like CLUSTAN is that an element of trust is required. The user cannot control all the mathematics involved, and the possibility exists that the procedure may change slightly from version to version as the program is modified. This is so for the data analysed by Jones (1988), using version 1.2. When the data were reanalyzed for this study, using version 2.0, the dendrograms did not match completely the original results for localities clustered using binary data, Jaccard's coefficient, and Ward's method of clustering (this study, Figure III-12; Jones 1988, Figure 17a).

Correlation coefficient

The correlation coefficient measures the similarity or dissimilarity between two variables. Numerous coefficients are available for both binary and continuous data (Cheetham and Hazel, 1969; Sneath and Sokal, 1973; Weishart, 1987).

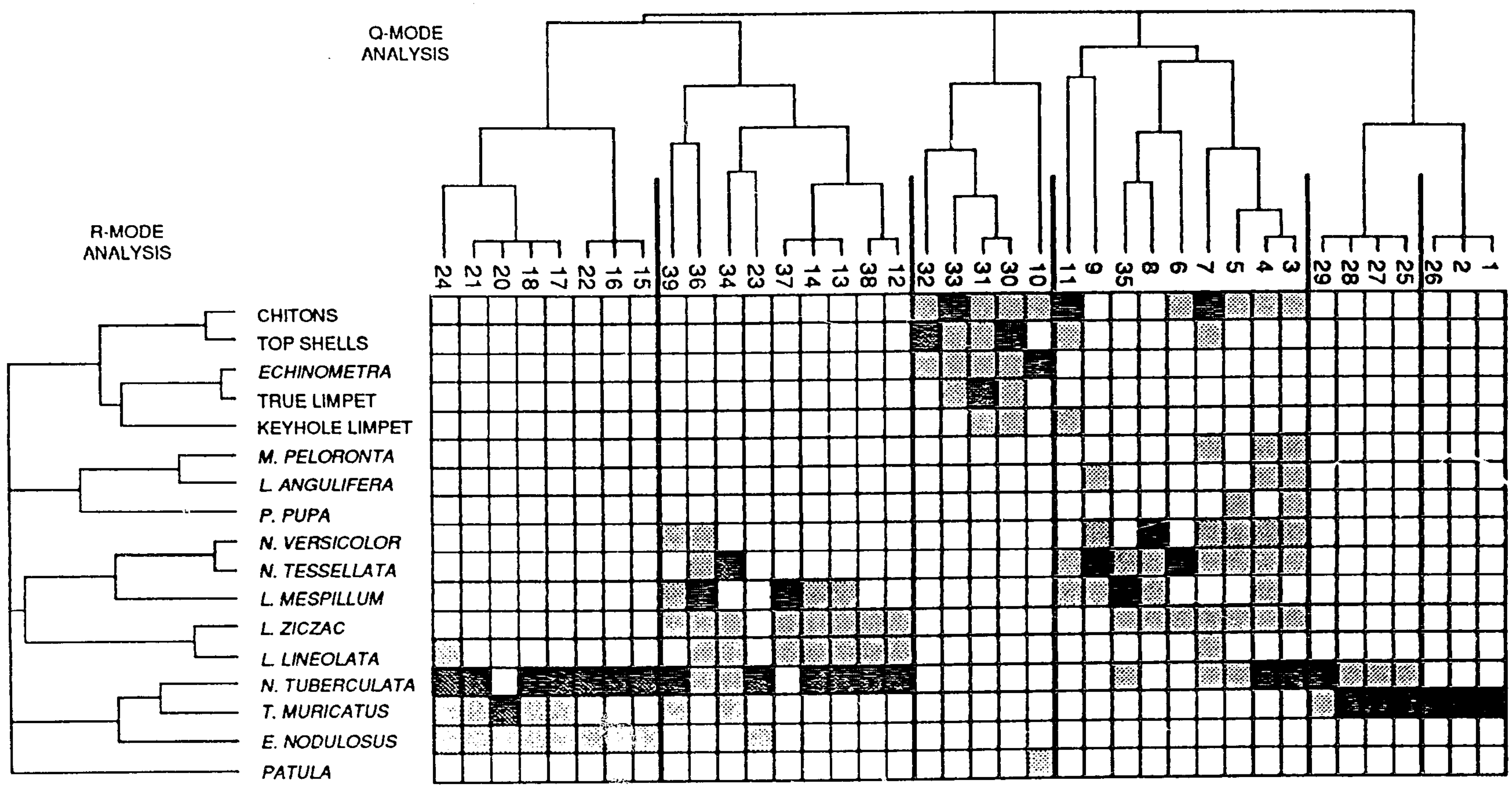


Figure III-11. Cross-correlation of Q-mode and R-mode analyses of modern shoreline fauna. Species and localities are ordered on the basis of the dendrograms. Dark shading denotes the most abundant species at a locality. Light shading denotes all other species present at a locality. Modified after Jones (1988).

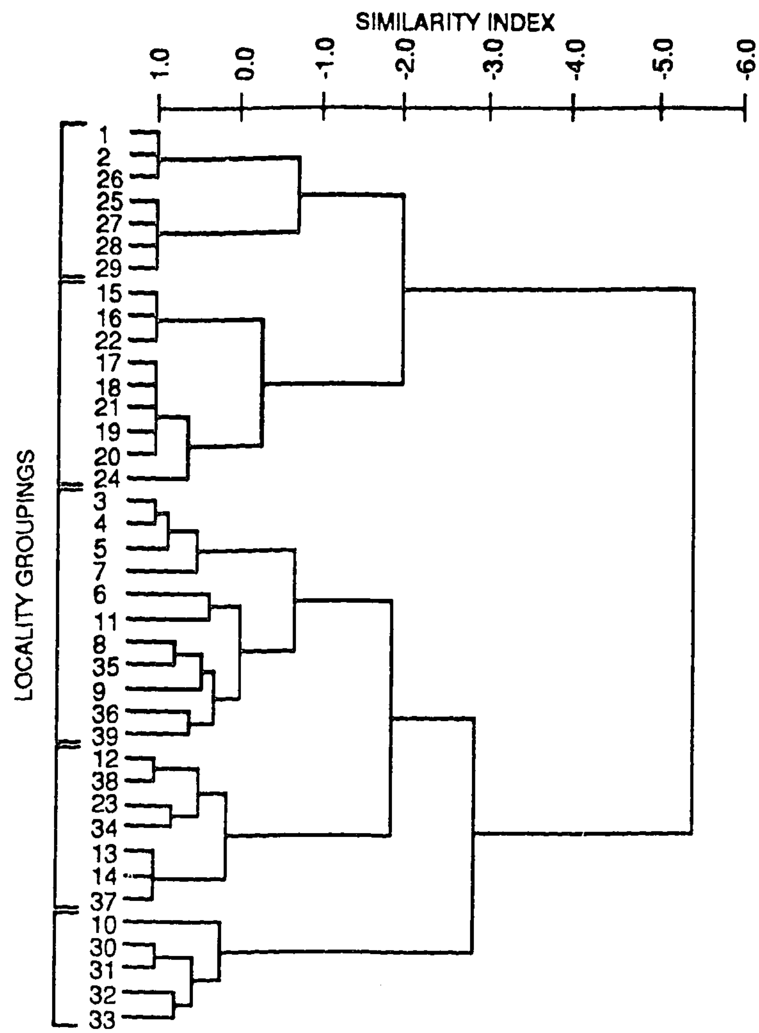


Figure III-12. Dendrogram for modern shoreline localities, binary data, correlated by Jaccard's coefficient, and clustered by Ward's method.

1. Binary data.

Because a binary data matrix indicates the presence or absence of variables only (and not abundance) in samples, correlation coefficients are calculated from four numbers (Table III-4).

Table III-4. Definition of components A, B, C, D, and M that are used in calculating correlation coefficients for binary data.

		Variable i	
		present	absent
Variable k	present	A	B
	absent	C	D
		M = A + B + C + D	

There are 28 binary coefficients available in CLUSTAN (Weishart, 1987). Calculation of several coefficients for two pairs of localities demonstrates the variability between coefficients (Table III-5).

One of the most commonly used coefficients is Jaccard's coefficient [A/(A+B+C)] (Jaccard, 1908; Cheetham and Hazel, 1969; Sneath and Sokal, 1973; Clifford and Stephenson, 1975). This coefficient measures the similarity between variables, but ignores all cases where both variables are absent. Values range from 0 (variables not present together) to 1 (variables always present together). This coefficient is most useful when joint absences are common or not important in the analysis. The Czekanowski-Dice coefficient

Table III-5. Calculation of five correlation coefficients for two pairs of localities from the Ironshore Formation. Note variation in values (all values range between 0 and 1).

	Pairs of Localities	
Correlation Coefficient	MON - MOS	F - G
Jaccard's Coefficient	0.71	0.45
Simple Matching Coefficient	0.75	0.52
Binary Euclidean Distance	0.25	0.48
Russel and Rao's Coefficient	0.60	0.38
Sokal and Sneath's Fourth Coefficient	0.73	0.59

[2A/(2A+B+C)] produces similar results (Sneath and Sokal, 1973; Weishart, 1987).

The binary euclidean distance [(B+C)/M] measures the difference between two variables (Weishart, 1987). Cases where both variables are present or absent together are ignored. Values range from 0 (variables always occur together) to 1 (variables never occur together). This coefficient is the binary equivalent of euclidean distance (used with continuous data).

The simple matching coefficient [(A+D)/M] is equivalent to 1-less-the binary euclidean distance, because it counts all cases where variables always occur together or not at all (Sokal and Michener, 1958; Sneath and Sokal, 1973; Clifford and Stephenson, 1975; Weishart, 1987). It produces the same results as the binary euclidean distance, except that it measures similarity.

Sokal and Sneath's fourth coefficient (Weishart, 1987)

$$\frac{1}{4}\left[\frac{A}{A+B}+\frac{A}{A+C}+\frac{D}{B+D}+\frac{D}{C+D}\right]$$

is an example of a more complex coefficient. This coefficient has values ranging from 0 to 1, and measures similarity.

The Russel and Rao coefficient [A/M], is an example of a more simplistic coefficient (Russel and Rao, 1940; Clifford and Stephenson, 1975). It counts only those cases where both variables are present, but does not factor in the total number of mismatches (only one variable present), as Jaccard's coefficient does. This coefficient ranges from 0 to 1, and measures similarity (Weishart, 1987).

2. Continuous data.

Probably the most common coefficient used to compare continuous variables is euclidean distance (Sokal, 1961; Sokal and Sneath, 1963; Rohlf and Sokal, 1965; Sneath and Sokal, 1973). Squared euclidean distance is the square of the direct distance between the two points represented by the two variables in m-dimensional space (there are n variables, m cases per variable). Variables with identical distributions have a distance of 0, with values increasing indefinitely as variables differ increasingly.

Another coefficient that can be used is product-moment correlation (Stephenson, 1936; Sneath and Sokal, 1973). This measures the similarity between pairs of cases. This coefficient automatically assumes the presence of clustered correlations, and so introduces a bias into the similarity matrix. It can be useful for clarifying patterns in the data (Weishart, 1987).

Dendrograms

Once a similarity matrix has been calculated these data are then presented in a hierarchal diagram, called a dendrogram. This diagram approximates visually the similarity/dissimilarity between variables. There are different methods, all of which follow the same general procedure: the pair(s) or group(s) of variables with the highest correlation (highest similarity/lowest distance or dissimilarity) is (are) grouped together in the dendrogram. This pair (group) may then be given a joint value (e.g. average value of the correlation coefficients) with which it is then compared to the remaining variables as a unit (Figure III-9). This step introduces distortion of correlations into the dendrogram. This cycle is continued until all variables are correlated in the dendrogram (J. C. Davis, 1973; Sneath and Sokal, 1973). How the clustering is performed depends on the specific method used. Pair-group methods group pairs, whereas variable-group methods can group more than two variables or clusters of variables at the same time (Sokal and Michener, 1958). All of the methods used in this study are pair-group methods in CLUSTAN (Weishart, 1987).

In the single linkage method (Florek *et al.*, 1951a, 1951b; Sneath, 1957) the two variables with the highest correlation (e.g. A and B) are linked first. Then the two variables with the next highest correlation (one of which may already be grouped, e.g. A and C) are grouped. If one of these variables was already grouped, the variable it was grouped with is given the same correlation with the new variable as it is, thus introducing distortion into the hierarchy. If A is grouped with B, then A and B are grouped with C, the correlation of A with C ($S_{a,c}$) and the correlation of B with C ($S_{b,c}$) both take on the higher value; and the joint correlation of the cluster and another variable (J) takes on the highest of the individual correlations with J ($S_{abc,j}$ = the highest value of $S_{a,j}$; $S_{b,j}$; and $S_{c,j}$). This method tends to produce straggly clusters (chaining) and may not be useful in finding clusters (Sneath and Sokal, 1973).

In the average linkage method (unweighted pair group arithmetic average clustering method, or UPGMA: Sokal, and Michener, 1958; Rohlf, 1963), once a pair of variables has been linked, its correlation with other variables is based on the average of the similarity coefficients for all pairs of variables in the cluster. For example, if A and B are linked, their correlations with other variables become the average of what they were for A and B separately ($S_{ab,j} = (S_{a,j}+S_{b,j})/2$). If these are subsequently linked with C, the cluster assumes the correlation of

$$S_{abc,j} = (S_{a,j}+S_{b,j}+S_{c,j})/3 = S_{a,j}/3+S_{b,j}/3+S_{c,j}/3.$$

In the weighted average method (weighted pair-group arithmetic average linkage clustering method, or WPGMA: McQuitty, 1966), the correlation between a pair previously correlated (A and B) and a third variable (C) is the average of the correlation between the previous pair and the third:

$$S_{ab,j} = (S_{a,j}+S_{b,j})/2;\ S_{abc,j} = (S_{ab,j}+S_{c,j})/2 = S_{a,j}/4+S_{b,j}/4+S_{c,j}/2.$$

This is also known as McQuitty's method.

Ward's method clusters variables on the basis of the euclidean sum of squares, which is the sum of the squared distances from each variable to the centre of the cluster it is in (if it has already been clustered; Ward, 1963). Ward's method combines the two clusters/variables which result in the smallest increase in the euclidean sum of squares for the new cluster. This method is only intended for correlations defined by squared euclidean distance, but may also be used for other coefficients (Weishart, 1987).

Once the correlation between variables is expressed in a dendrogram, clusters may be chosen by drawing a line across the diagram at a chosen level of correlation (Figure III-10). This cut-off line is called a phenon line, and the clusters so delineated are called phenons (Sokal and Rohlf, 1962). Alternatively, clusters may be chosen qualitatively without a phenon line.

Cophenetic correlation coefficient

All methods of classifying a similarity matrix into a hierarchy introduce distortion of the data in the dendrogram, because all methods involve changing some coefficients as a part of the procedure. Sokal and Rohlf (1962) introduced a method of determining which clustering method introduces the least distortion. The cophenetic correlation coefficient (product moment correlation coefficient) is calculated from the differences between the hierarchal coefficients and the calculated similarity matrix coefficients for pairs of variables. Values for this coefficient range from -1 to +1. A value of -1 indicates perfect negative correlation; 0 indicates no correlation; and +1 indicates perfect positive correlation. Ideally a clustering method should produce a cophenetic correlation coefficient close to 1. For large databases values around 0.75 may be appropriate, but for small studies (e.g. 10 localities) values should be much higher (Kaesler, 1970). The cophenetic correlation coefficient should not be used to reorder the dendrogram, because optimizing the cophenetic correlation coefficient in this way may lead to grouping by dissimilarity (Sokal, 1969). The most accurate clustering method (with the highest cophenetic correlation coefficient) may not necessarily provide well defined clusters. This situation, or consistently low coefficients, may indicate that another statistical method may be more useful for this set of data, e.g. ordination methods (Kaesler, 1970) or factor analysis (J. C. Davis, 1973).

Determination of optimum method

1. Modern coastal fauna of Grand Cayman

Shoreline faunas are characteristically vertically zoned into distinct communities because their physical environment is dictated by tidal and wave influence (Stephenson and Stephenson, 1949, 1950). For this reason the database assembled by Jones and Pemberton (Jones, 1988) is useful to demonstrate cluster analysis.

Localities were clustered using binary data, the WPGMA method of clustering, and a variety of coefficients. Dendrograms derived using Jaccard's coefficient, binary euclidean distance, and Sokal and Sneath's fourth coefficient are similar, with well defined clusters (Figures III-13 to III-15). However, clusters in the dendrogram derived using Russel and Rao's coefficient are not so well defined (Figure III-16), suggesting that this coefficient is too simplistic to differentiate between variables. For the modern shoreline binary data, any of the commonly used coefficients (e.g. Jaccard's, binary euclidean distance) appear to be equally useful (Figures III-13, III-14).

Localities were also clustered using binary data, Jaccard's coefficient, and three methods of clustering: Ward's method, WPGMA, and UPGMA. Dendrograms derived by the three methods of clustering are similar (Figures III-12, III-13, III-17) and all but Ward's method produced high cophenetic correlation coefficients (Table III-6). Clusters are well defined by all three methods, but best defined by Ward's method and least well defined by UPGMA. Cross-plots of calculated and plotted correlations for Ward's method and UPGMA (Figure III-18) indicates greater distortion for low correlations, but little distortion for high correlations. The distortion introduced by Ward's method is due in part to negative correlation values in the dendrogram (Ward's method was not designed for Jaccard's coefficient, Weishart, 1987). Despite the distortion it introduces, Ward's method is as useful as UPGMA and WPGMA for determining clusters in this database, provided the later clusters (at lower correlation values) are not considered important.

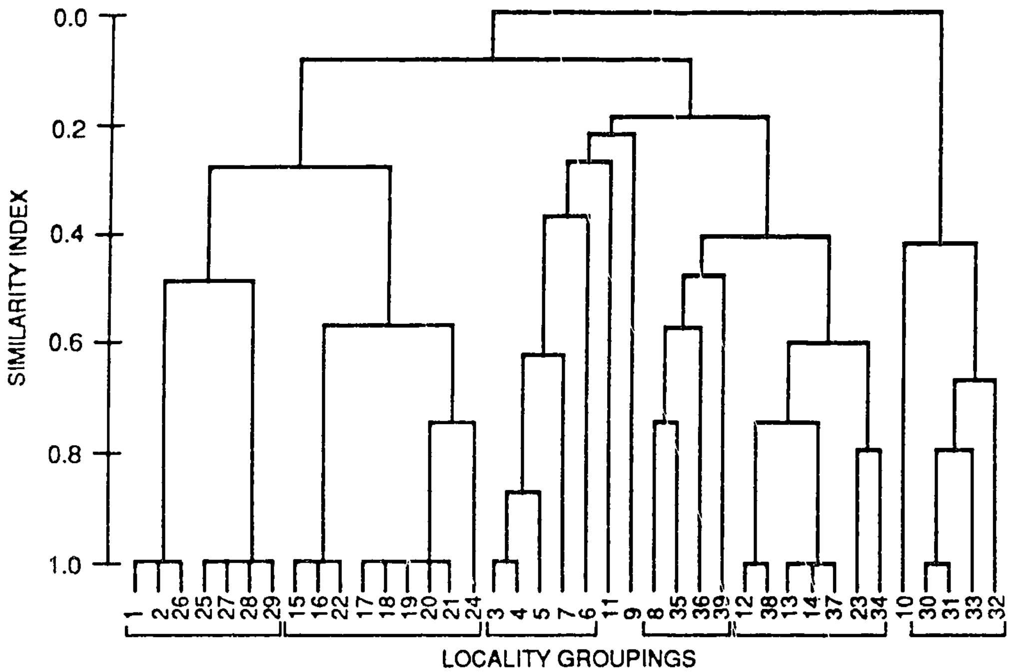


Figure III-13. Dendrogram for modern shoreline localities, binary data, correlated by Jaccard's coefficient, and clustered by the WPGMA method.

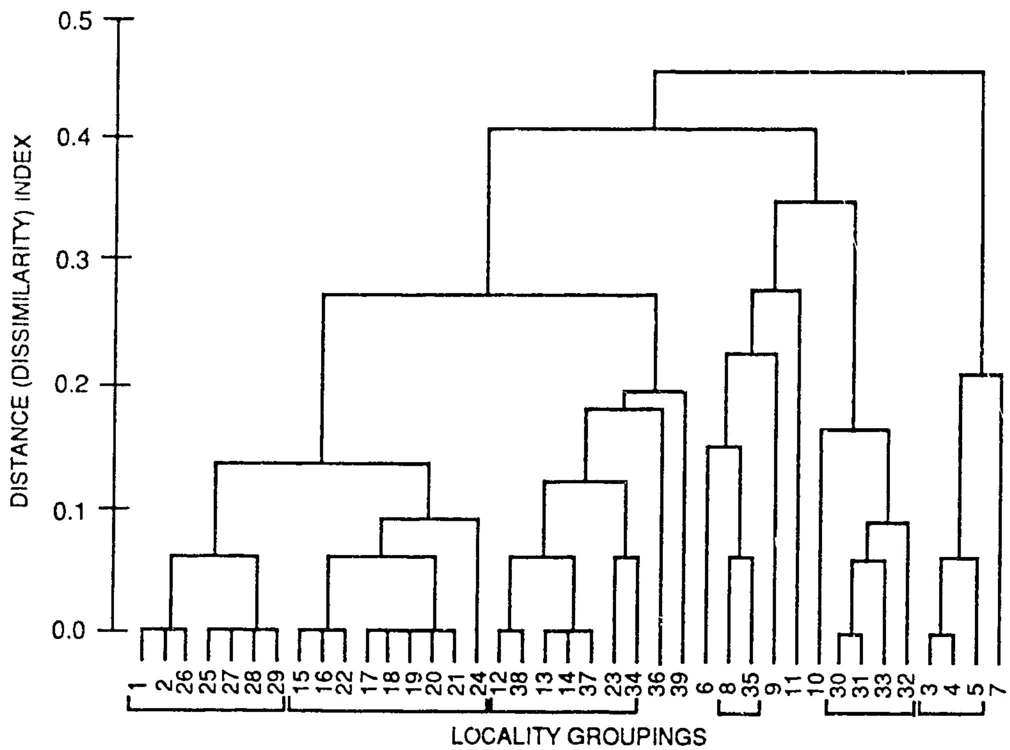


Figure III-14. Dendrogram for modern shoreline localities, binary data, correlated by binary euclidean distance, and clustered by the WPGMA method.

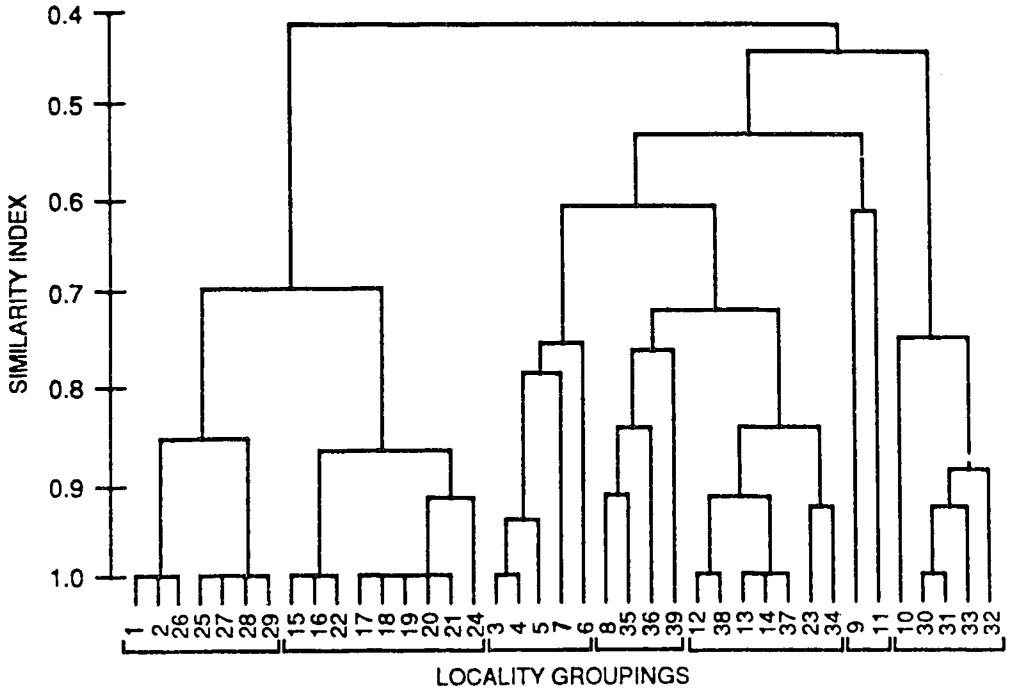


Figure III-15. Dendrogram for modern shoreline localities, binary data, correlated by Sokal and Sneath's fourth coefficient, and clustered by the WPGMA method.

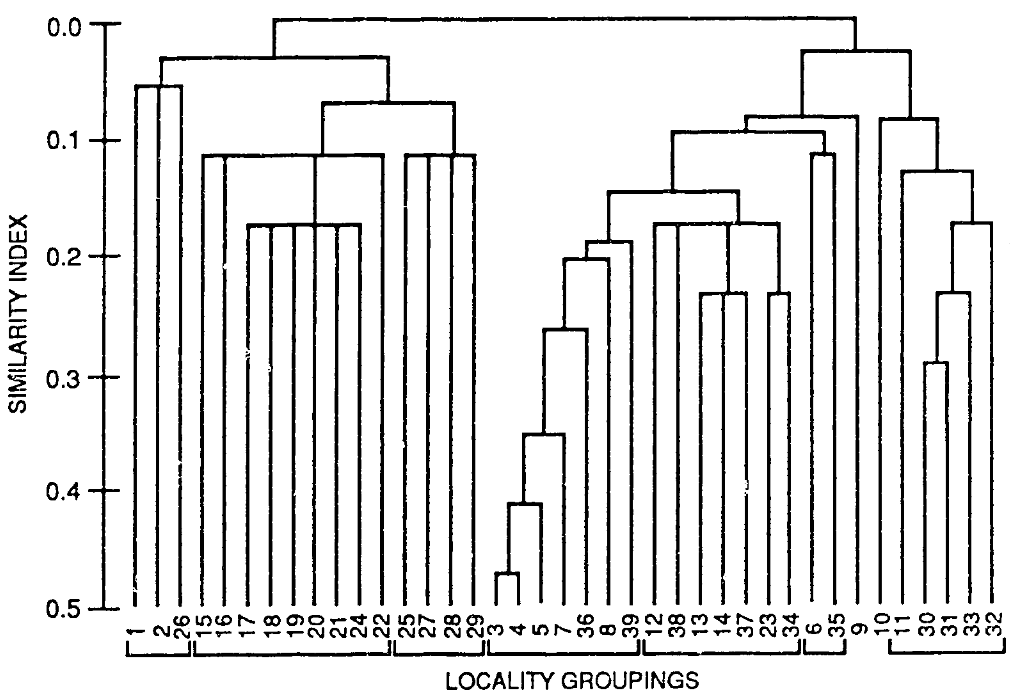


Figure III-16. Dendrogram for modern shoreline localities, binary data, correlated by Russel and Rao's coefficient, and clustered by the WPGMA method.

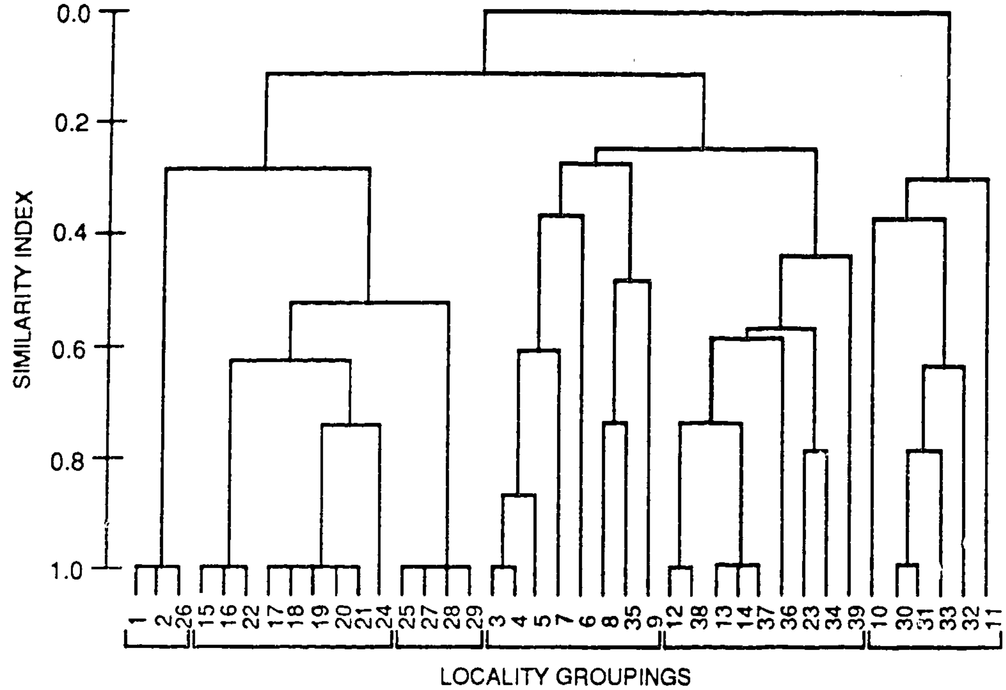


Figure III-17. Dendrogram for modern shoreline localities, binary data, correlated by Jaccard's coefficient, and clustered by the UPGMA method.

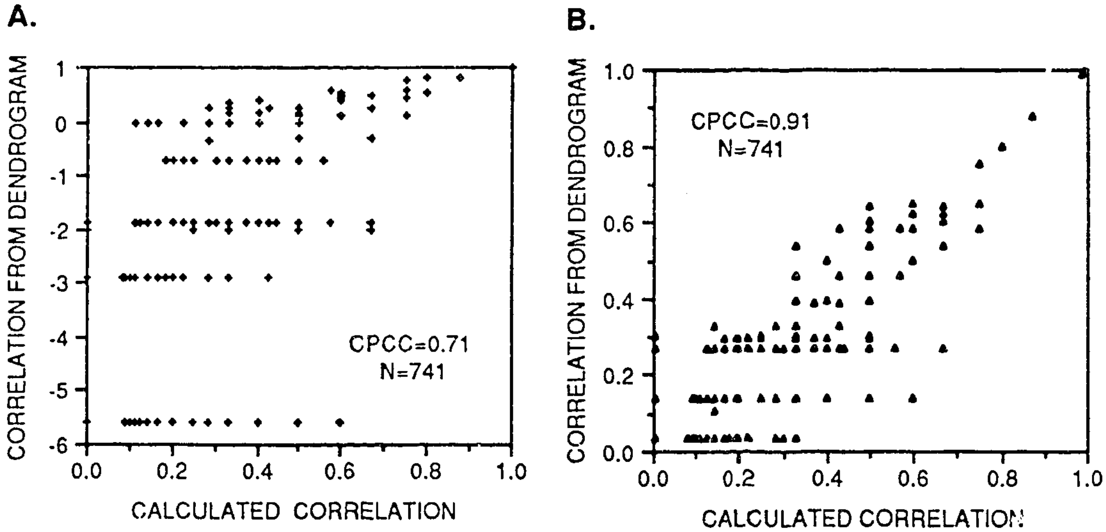


Figure III-18. Cross-plots of correlations between pairs of localities in the similarity matrix against correlations of the same pairs in the dendrograms: a visual assessment of distortion. Data are for the modern shoreline fauna, binary data, correlated by Jaccard's coefficient, and clustered by: A. Ward's method, and B. the UPGMA method. CPCC = the cophenetic correlation coefficient. N = the number of points plotted.

Dendrograms constructed using UPGMA, WPGMA and Ward's methods for species clustered using standardized continuous data and correlated by squared euclidean distance are also similar (Figure III-19 - III-21). Cophenetic correlation coefficients indicate that dendrograms produced by all three methods used are not significantly distorted (Table III-6). UPGMA and WPGMA methods introduced the least distortion, but the results from Ward's method are not much worse, and Ward's method produces the best defined clusters. There is a small degree of distortion in Ward's (Figure III-22a) but overall it is similar to that for UPGMA (Figure III-22b).

Table III-6. Cophenetic correlation coefficients for dendrograms constructed for the modern shoreline fauna, Grand Cayman.

	Binary (Jaccard's)	Continuous (squared euclidean distance)
Clustering	Localities	Species
Ward's	0.71	0.98
UPGMA	0.91	0.99
WPGMA	0.88	0.99

The nature of the fauna (with distinct groupings) and the smaller size of the database ensure high cophenetic correlation coefficients for the dendrograms, so that any of the three clustering methods produces good results. For a fauna with strongly distinct groupings, such as this one, a variety of methods will tend to produce the same or similar results.

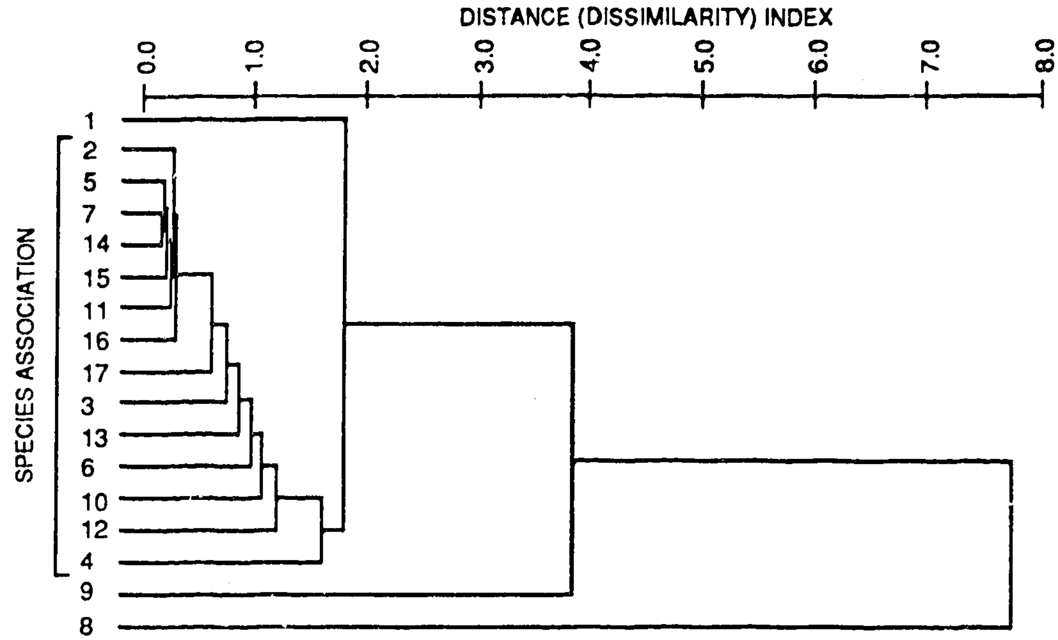


Figure III-19. Dendrogram for modern shoreline species, continuous data, correlated by squared euclidean distance, and clustered by the UPGMA method.

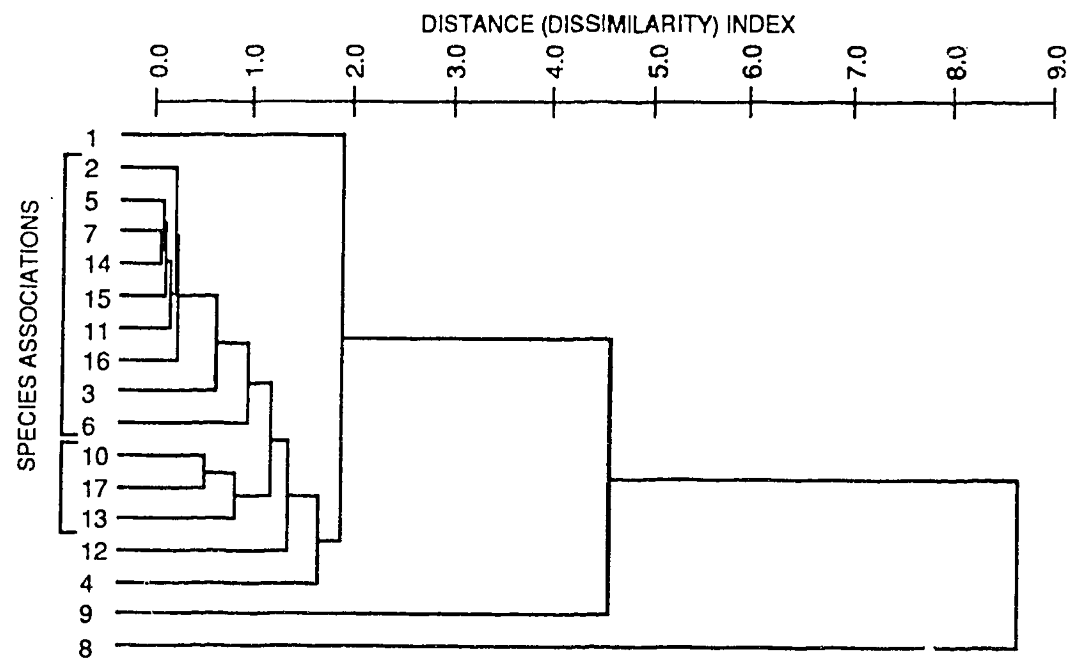


Figure III-20. Dendrogram for modern shoreline species, continuous data, correlated by squared euclidean distance, and clustered by the WPGMA method.

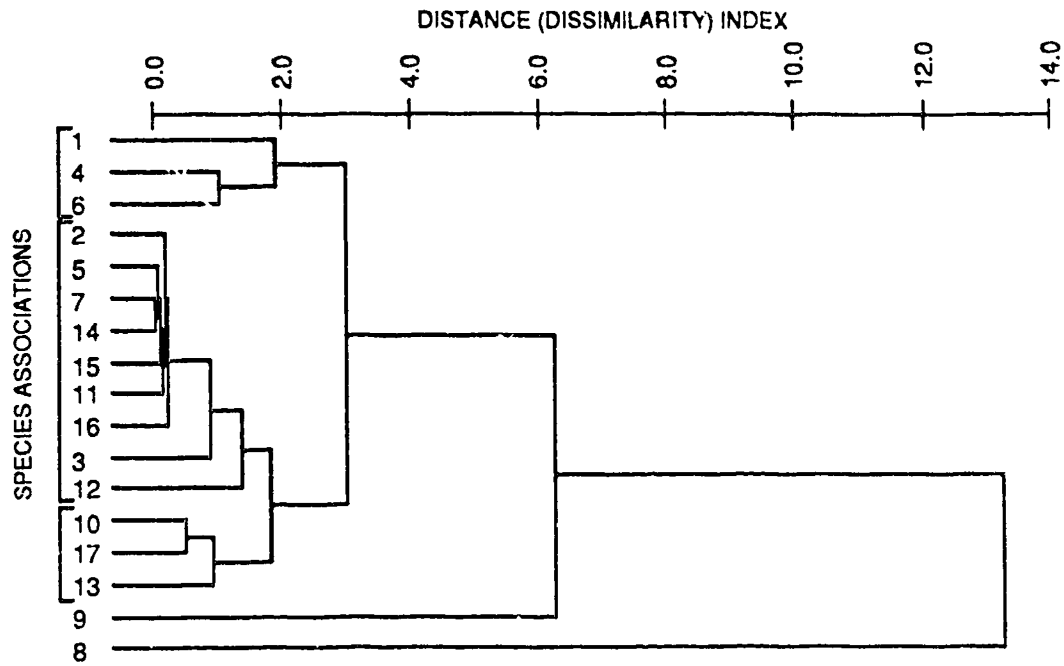


Figure III-21. Dendrogram for modern shoreline species, continuous data, correlated by squared euclidean distance, and clustered by Ward's method.

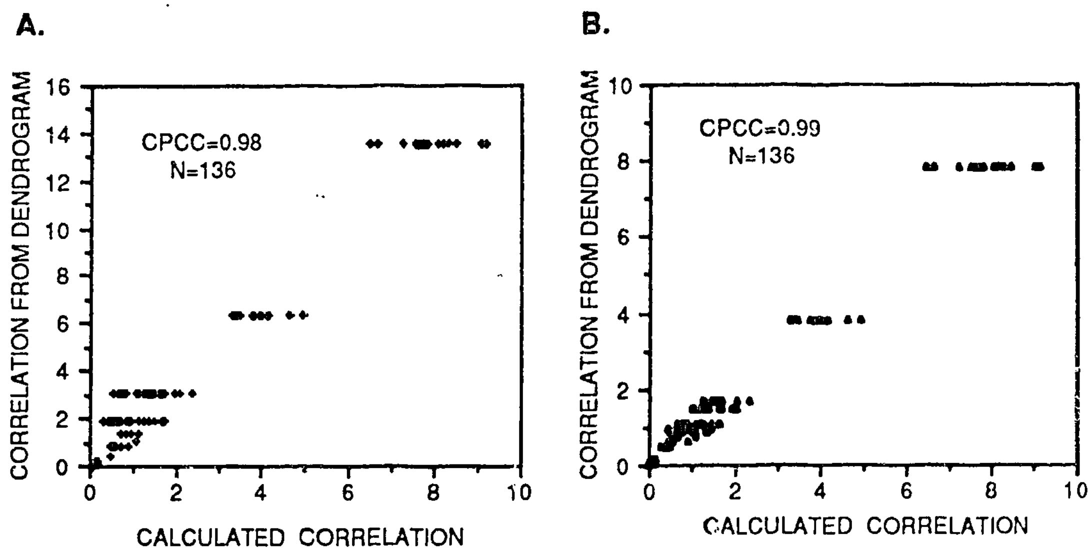


Figure III-22. Cross-plots of correlations between pairs of species in the similarity matrix against correlations of the same pairs in the dendrogram. Data is for the modern shoreline fauna, continuous data, correlated by squared euclidean distance, and clustered by A. Ward's method, and B. the UPGMA method. CPCC = the cophenetic correlation coefficient. N = the number of points plotted.

2. The Ironshore Formation mollusc fauna

Associations in the mollusc fauna of the Ironshore Formation are not as obvious as they are in the modern coastal fauna. For this reason, the data are more sensitive to the choice of procedure, and the choice of correlation coefficient and clustering method is more important. The Ironshore Formation fauna was analysed using a number of correlation coefficients, and Ward's method of clustering (which tends to produce good clusters, Weishart, 1987), to determine the best correlation coefficient for these data.

Correlation of binary data indicates that Jaccard's coefficient (Figure III-23) and binary euclidean distance (Figure III-24) produce similar results. Sokal and Sneath's fourth coefficient produced slightly different, but still potentially useful, results (Figure III-25). It is harder to intuitively understand what this coefficient stresses, which probably explains why it is less popular than Jaccard's coefficient or binary euclidean distance/simple matching coefficient. Russel and Rao's coefficient produced a dendrogram with less well defined clusters (Figure III-26), a product of the coefficient, not the method of clustering, as Ward's method typically produces good clusters (Weishart, 1987). This suggests that Russel and Rao's coefficient is not very useful in distinguishing between groups in this database. Although Jaccard's, binary euclidean distance and the simple matching coefficient produce similar results, Jaccard's is preferred because it ignores negative matches and therefore avoids the danger of grouping on the basis of absences (Mello and Buzas, 1968; Field, 1969; Macdonald, 1975). Coefficients like Jaccard's, that exclude negative matches, are commonly used in ecological studies for this reason (Cheetham and Hazel, 1969).

Squared euclidean distance and the product moment correlation coefficient were both calculated for continuous data, and clustered by Ward's

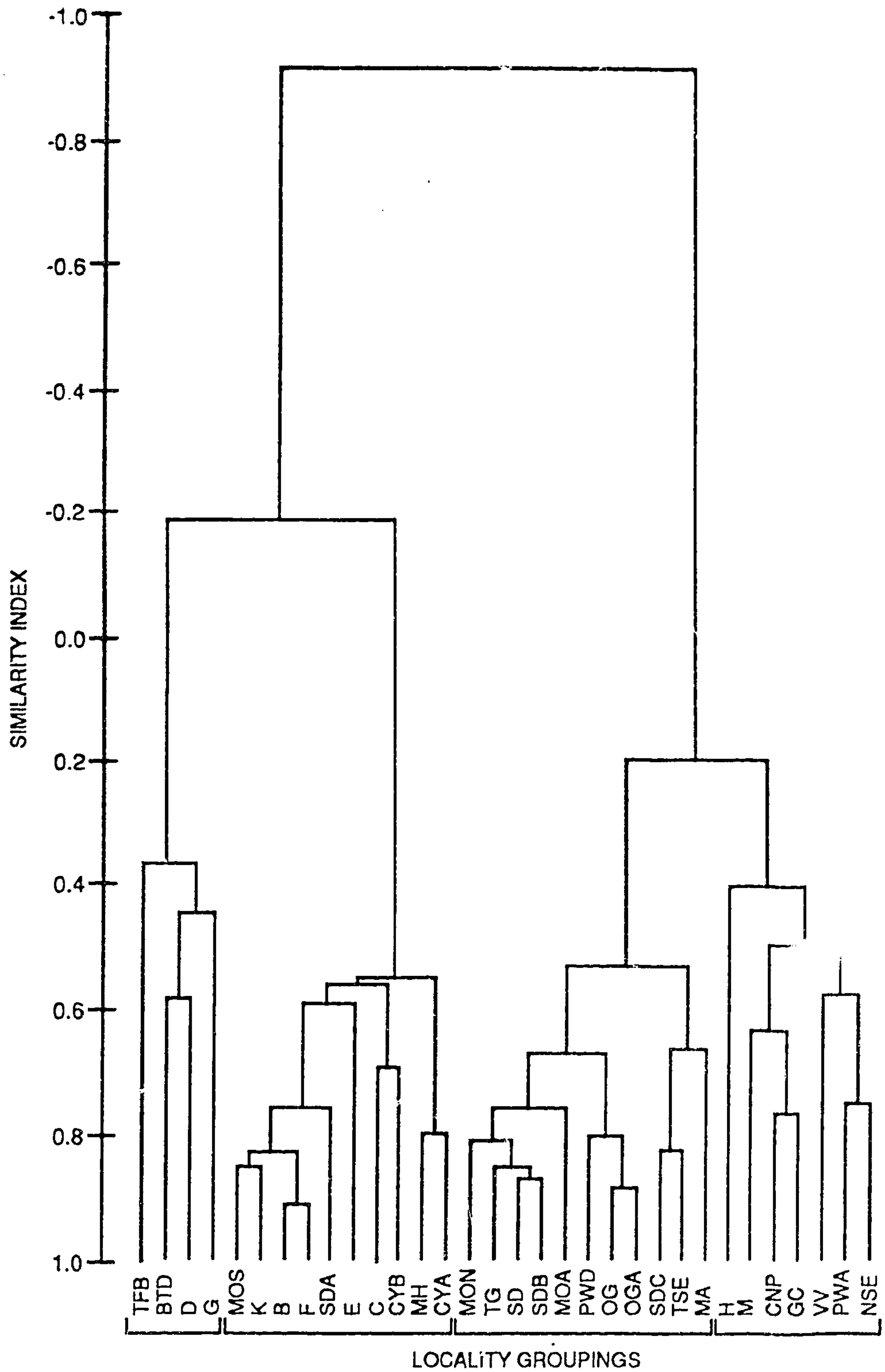


Figure III-23. Dendrogram for Ironshore Formation localities, binary data, correlated by Jaccard's coefficient, and clustered by Ward's method.

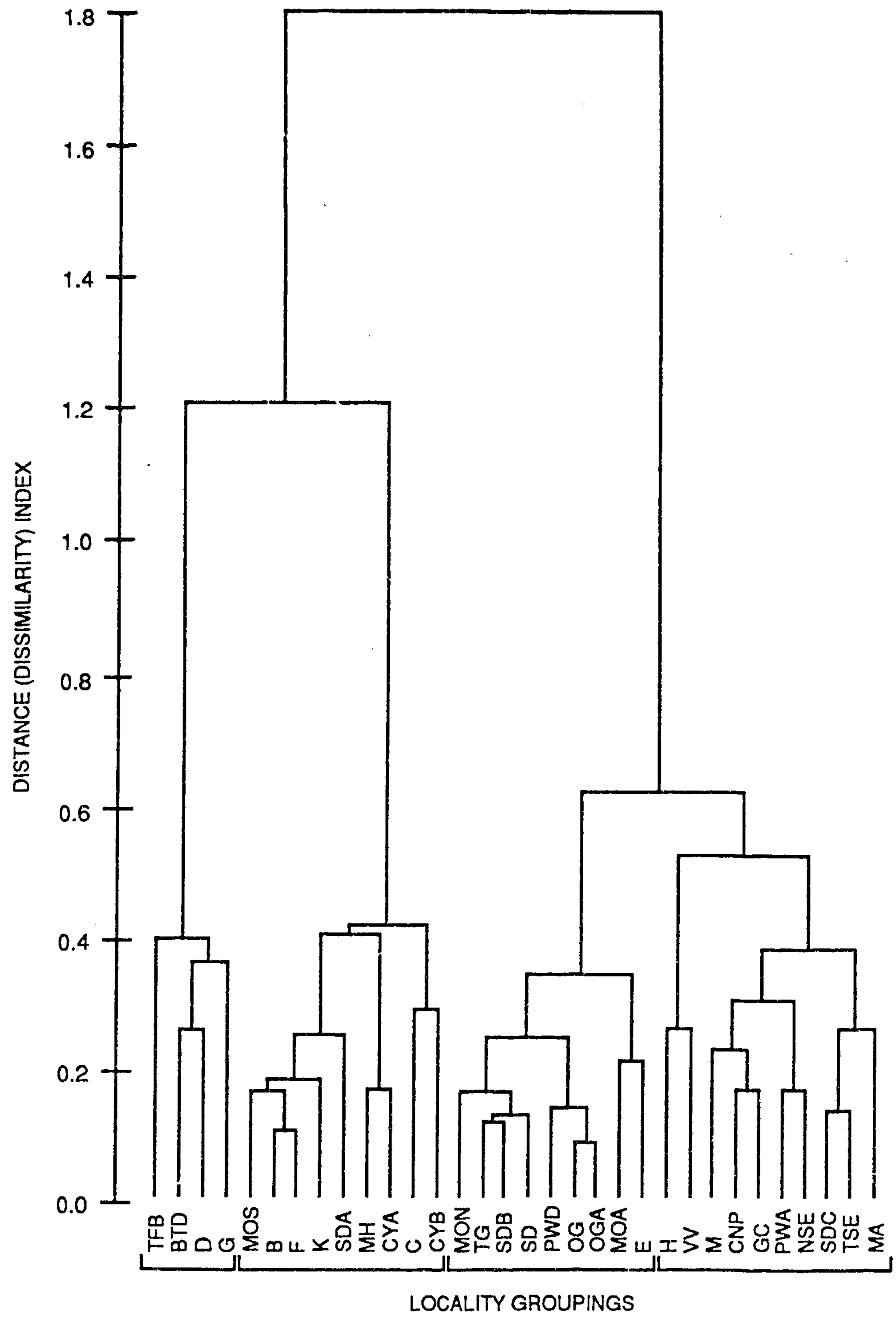


Figure III-24. Dendrogram for Ironshore Formation localities, binary data, correlated by binary euclidean distance, and clustered by Ward's method.

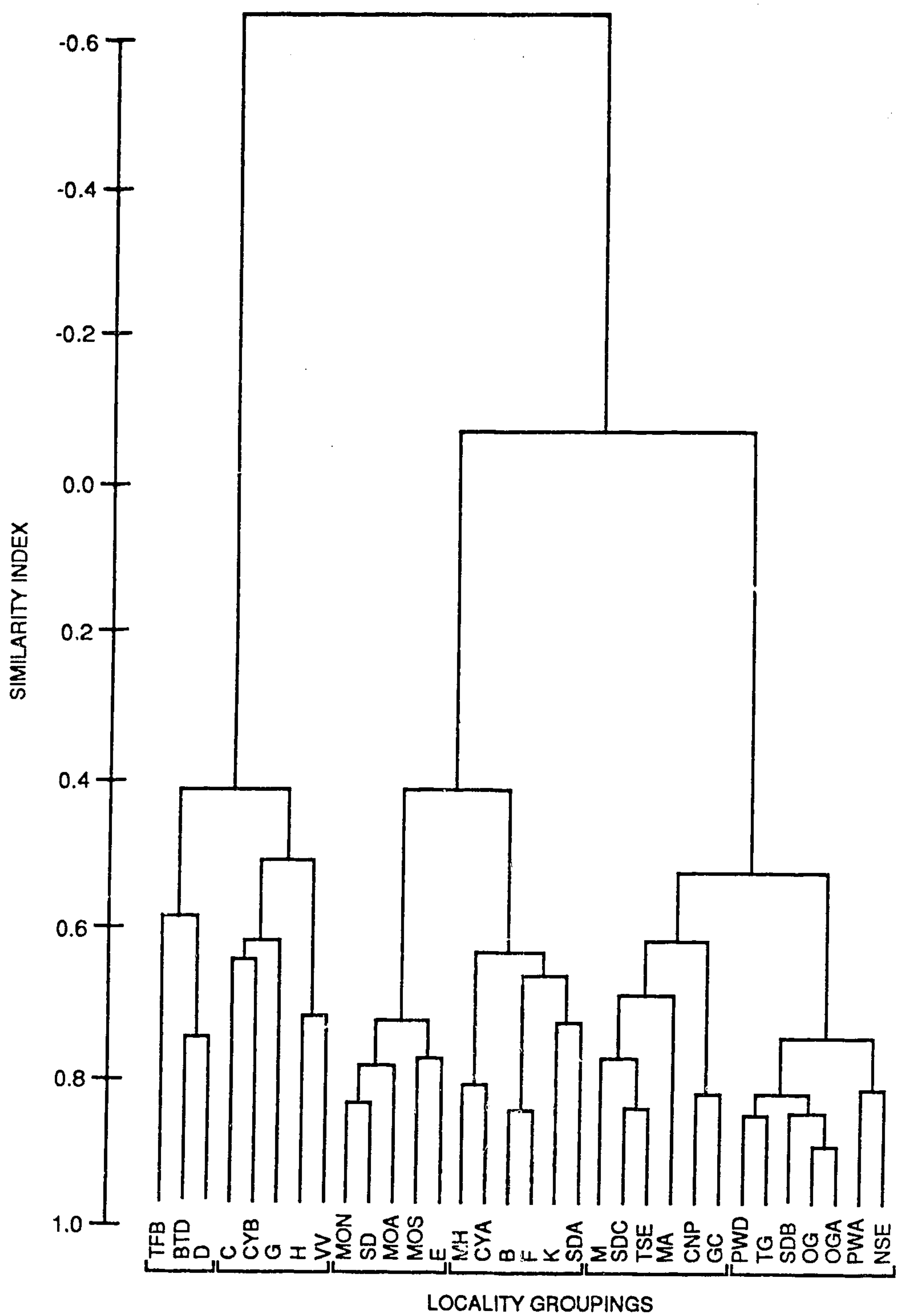


Figure III-25. Dendrogram for Ironshore Formation localities, binary data, correlated by Sokal and Sneath's fourth coefficient, and clustered by Ward's method.

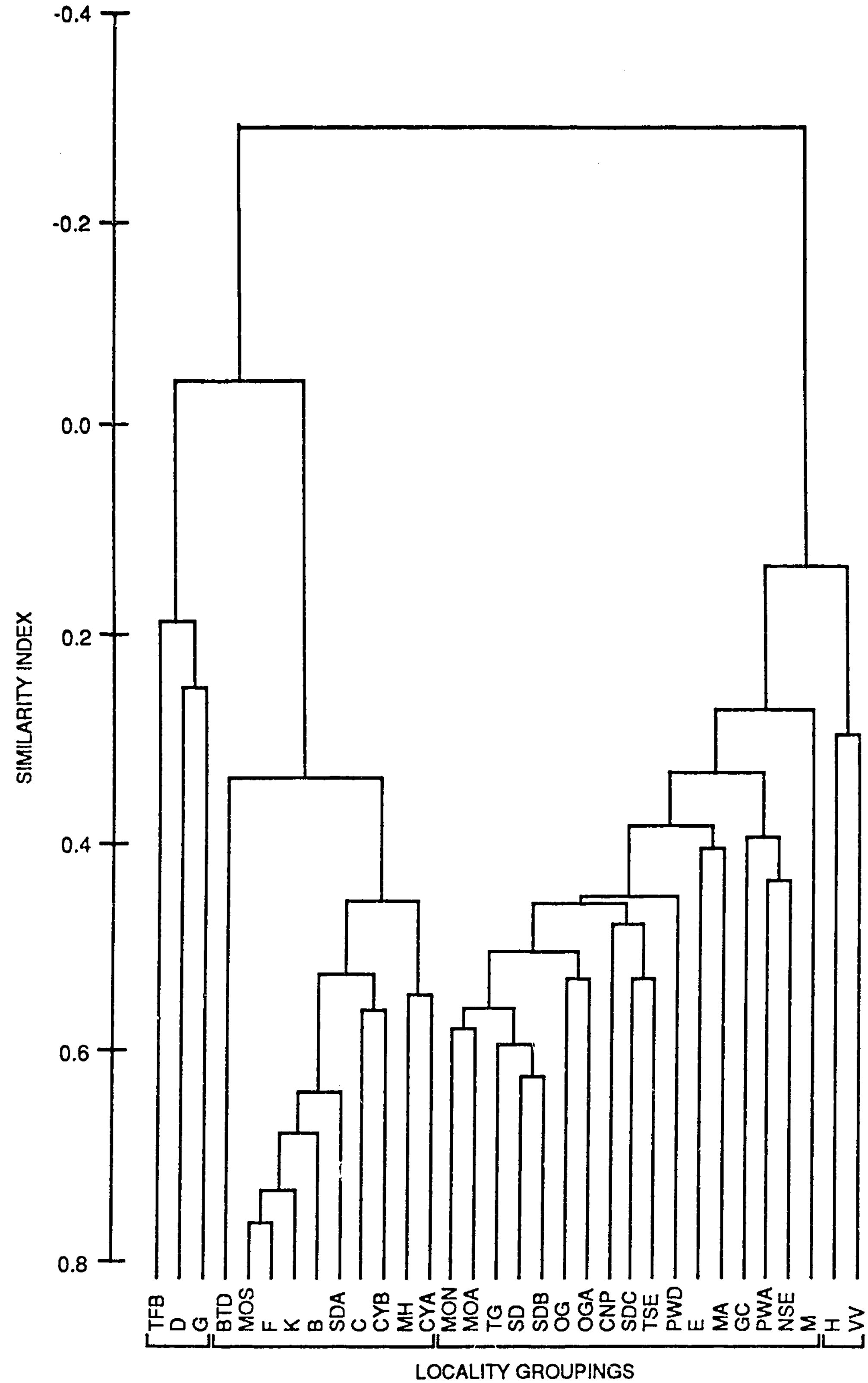


Figure III-26. Dendrogram for Ironshore Formation localities, binary data, correlated by Russel and Rao's coefficient, and clustered by Ward's method.

method. The product moment correlation produced a higher cophenetic correlation coefficient with Ward's (0.60) than did squared euclidean distance (0.49), indicating an inherent tendency to produce clusters within the similarity matrix - useful for exaggerating results but not necessarily representative. Squared euclidean distance is therefore preferable, although product moment correlation may be useful for clarifying groupings.

The similarity matrix calculated from binary data by Jaccard's coefficient was clustered by three methods: Ward's; UPGMA; and WPGMA. Cophenetic correlation coefficients were calculated for each method. Ward's method produced well defined clusters, but the cophenetic correlation coefficient was low (Figure III-23; Table III-7). UPGMA and WPGMA methods yielded much higher cophenetic correlation coefficients but produced dendrograms with poorly defined clusters (Figures III-27, III-28). Cophenetic correlation coefficients in the range of 0.8 to 0.9 are quite good for databases as large as

Table III-7. Cophenetic correlation coefficients calculated for dendrograms constructed for the Ironshore Formation mollusc fauna.

	Binary (Jaccard's)		Continuous (squared euclidean distance)	
Clustering	Species	Localities	Species	Localities
Ward's		0.48	0.49	0.50
UPGMA		0.89	0.97	
WPGMA	0.87	0.85	0.85	0.89

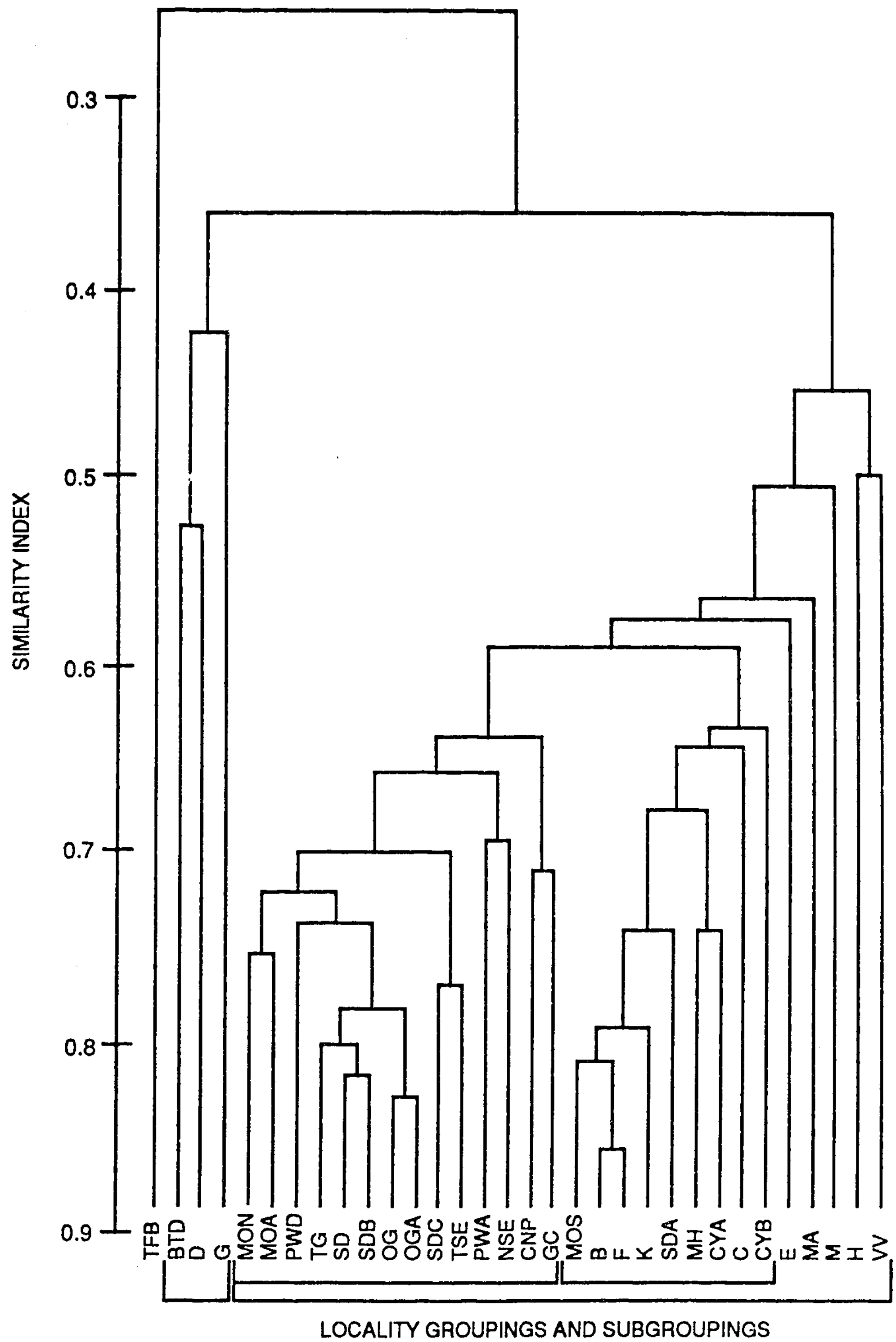


Figure III-27. Dendrogram for Ironshore Formation localities, binary data, corelated by Jaccard's coefficient, and clustered by the UPGMA method.

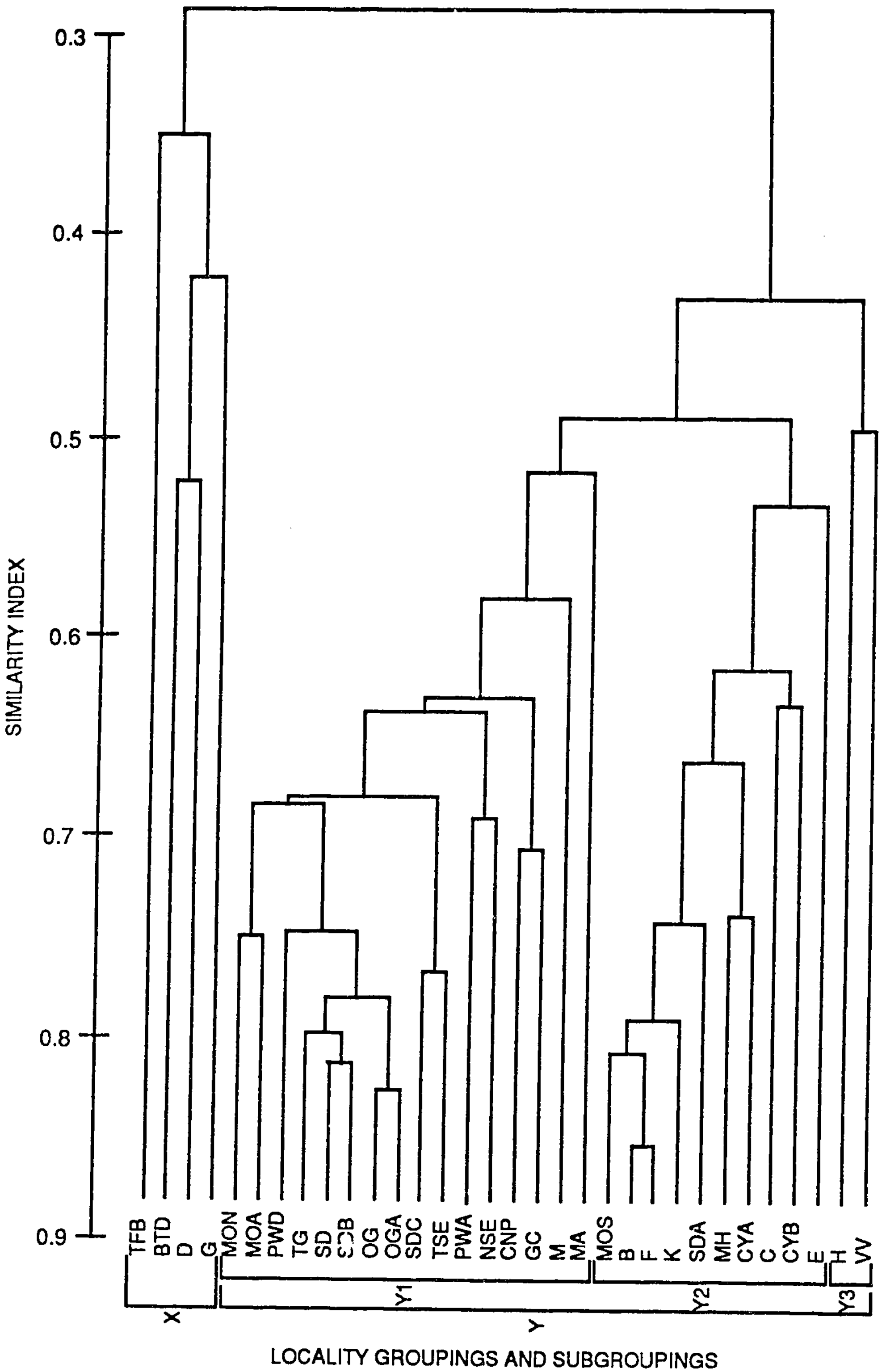


Figure III-28. Dendrogram for Ironshore Formation localities, binary data, correlated by Jaccard's coefficient, and clustered by the WPGMA method.

the one used here, since the degree of distortion increases with the size of the similarity matrix (Kaesler, 1970). However the accurate dendrograms (those with higher cophenetic correlation coefficients) do not indicate many well defined associations. This suggests that either the method is ineffective or the fauna does not contain any distinct associations.

Clustering of the similarity matrix calculated by squared euclidean distance for continuous data by three methods - Ward's, UPGMA, and WPGMA - indicated results similar to those for localities using binary data. Ward's produced well defined clusters (Figure III-29) with a low cophenetic correlation coefficient (Table III-7), whereas UPGMA (Figure III-30) and WPGMA (Figure III-31) produced dendrograms with poorly defined clusters, and higher cophenetic correlation coefficients. The cophenetic correlation coefficients indicate high distortion in the dendrogram with well defined clusters, and low distortion in the dendrograms with poorly defined clusters. Cross-plots of correlations from the similarity matrix with correlations expressed in the dendrogram for each pair of variables (Figure III-32) clearly indicate a high degree of distortion for Ward's clusters developing early in the procedure. Distortion does not become significant in the clusters produced by the other methods until later in the procedure (Figure III-32C). This suggests that the dendrograms with poorly defined clusters more accurately represent the actual nature of the data (assuming the similarity matrix introduces no significant undesirable distortion) than do the neat clusters produced by Ward's method, and that UPGMA and WPGMA are the most accurate methods of clustering. The dendrograms produced by these methods suggest that the data do not occur naturally in distinct clusters. Cross-plots such as these could be useful in determining the placement of the phenon line - at a level before any significant distortion occurs.

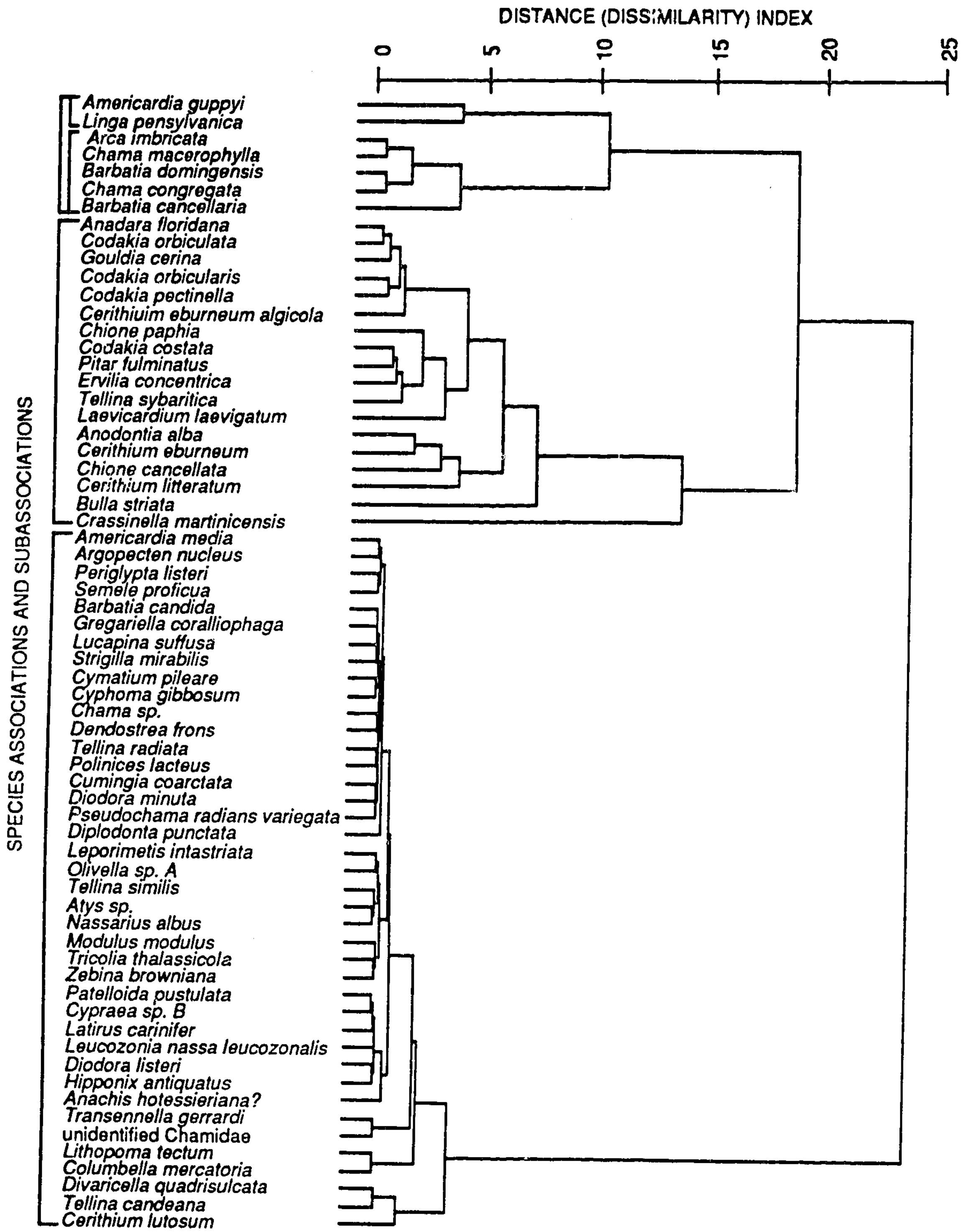


Figure III-29. Dendrogram for Ironshore Formation species, continuous data, correlated by squared euclidean distance, and clustered by Ward's method.

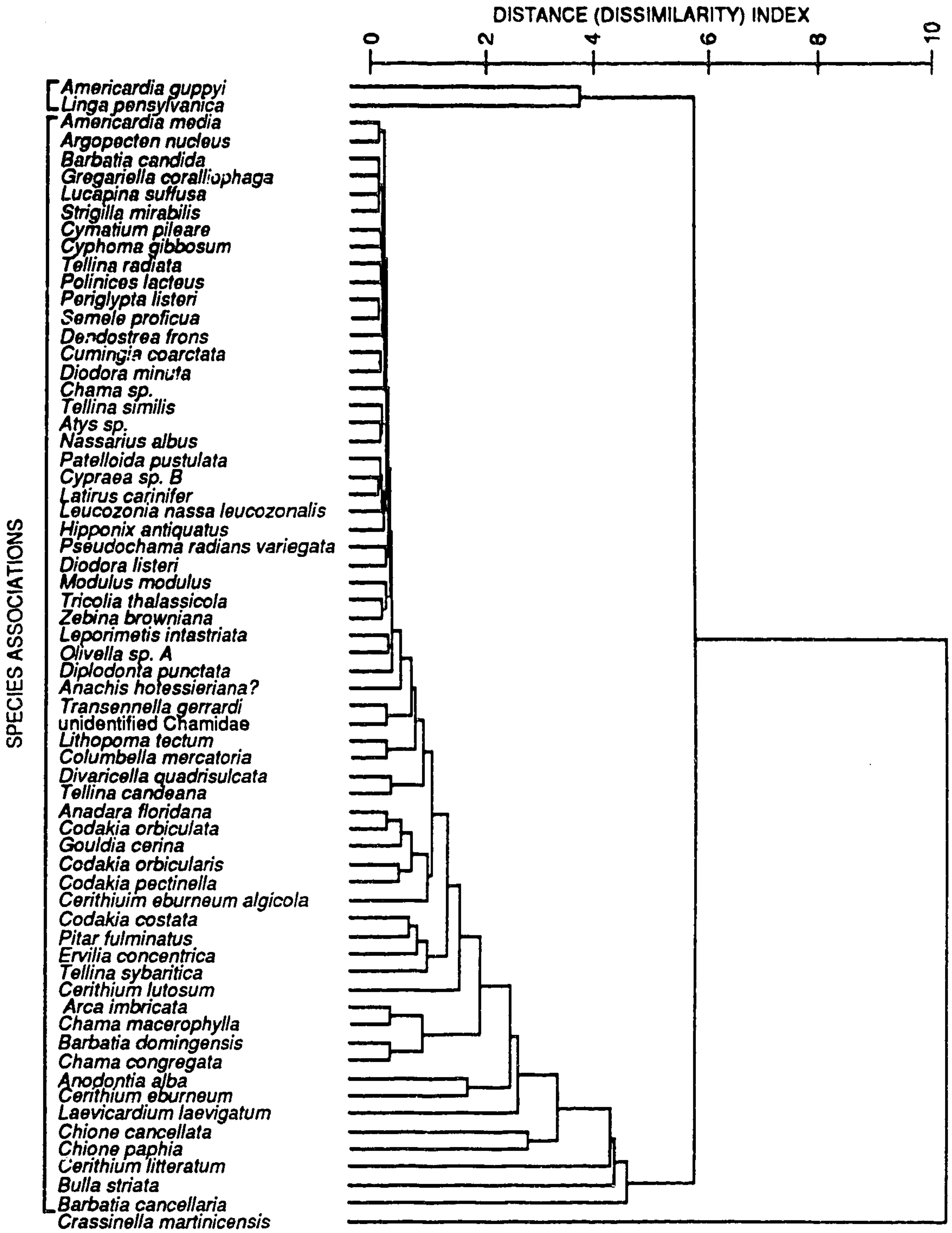


Figure III-30. Dendrogram for Ironshore Formation species, continuous data, correlated by squared euclidean distance, and clustered by the UPGMA method.

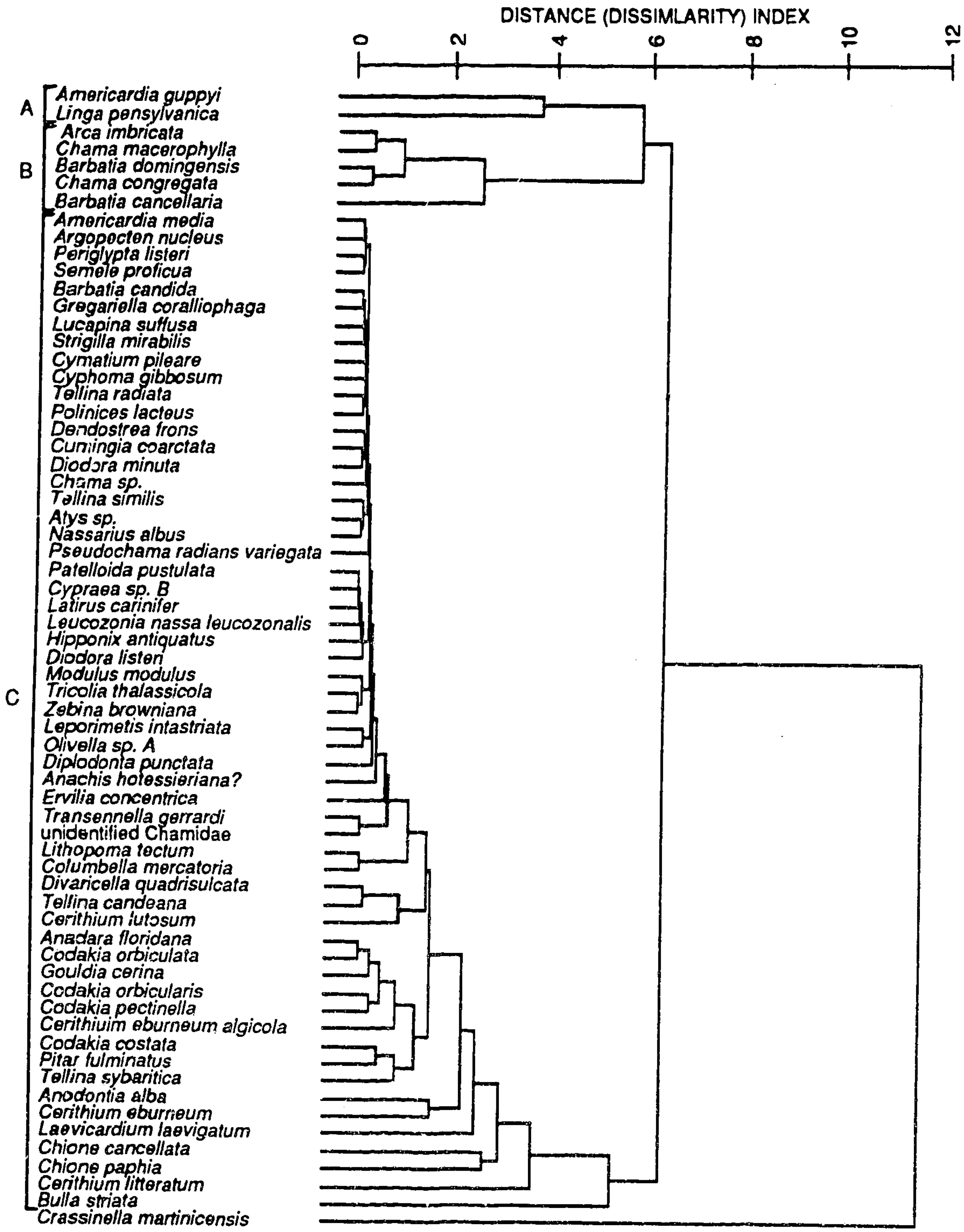


Figure III-31. Dendrogram for Ironshore Formation species, continuous data, correlated by squared euclidean distance, and clustered by the WPGMA method.

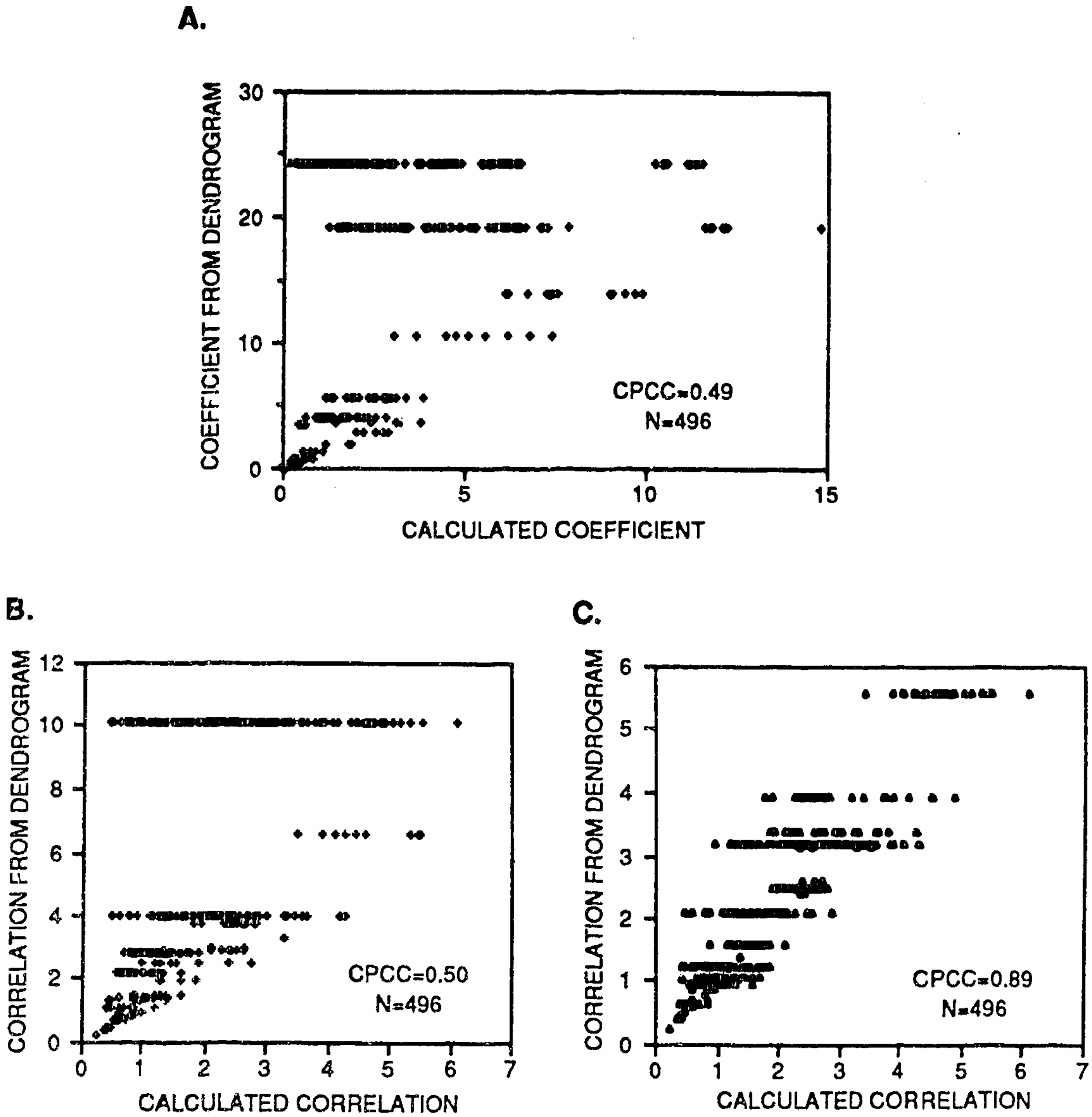


Figure III-32. Cross-plots of correlation coefficients in the similarity matrix versus correlation coefficients as expressed in the dendrogram. Data is for the Ironshore Formation fauna, continuous data, correlated by squared euclidean distance. A. Species clustered by Ward's method. B. Localities clustered by Ward's method. C. Localities clustered by the WPGMA method. CPCC = the cophenetic correlation coefficient. N = the number of points plotted.

Synopsis

Measurement of diversity

The Shannon-Wiener diversity index, H', and Simpson's index of dominance, C, are used in this study to measure the richness and dominance (evenness) components respectively. Neither of these indices are strongly biased by sample size for the samples in this study. Other indices examined either illustrated the same trend as H', or were strongly biased by sample sizes for the samples in this study.

Cluster analysis

The database for Pleistocene Ironshore molluscs was reduced prior to cluster analysis to ensure representative data and to simplify analysis. Localities with less than 95 individuals were removed, because these may not have representative richness. Species constituting less than 2% of any locality remaining in the database were also removed.

Analysis of the modern shoreline fauna, already known to contain distinct groupings, indicates that a number of correlation coefficients and clustering methods produce the same or similar results.

The Ironshore Formation fauna is more sensitive to the choice of method, because the communities are not as obvious. Jaccard's coefficient is chosen for binary data because it ignores negative matches. Squared euclidean distance is chosen for continuous data. Both UPGMA and WPGMA methods of clustering produce accurate dendrograms. WPGMA is chosen for the Ironshore Formation fauna because it forms slightly better clusters than does UPGMA.

Analysis of faunal groupings is based on cross-correlation of dendrograms for species and localities, in order to reduce the effect of distortion in the dendrograms.

IV. CLUSTER ANALYSIS OF IRONSHORE FORMATION FAUNA

Binary Data

Species

Clustering of species using binary data (Figure IV-1) indicates an absence of distinct associations. It is difficult to subdivide groups, or to categorize all species because the dendrogram is chained (Figure IV-1). It is interesting to note, however, that 31 lagoonal species have been grouped together (association A) as have 9 reef species (association B). These associations could not be delineated without prior knowledge of the ecological setting of the fauna.

Localities

Clustering of localities using binary data (Figure III-28) indicates two distinct sets of localities, groupings X and Y, one of which (Y) may be further divided into three subgroups. Locality grouping X consists of four loosely grouped localities from patch reef and reef tract environments, facies C and E. Locality grouping Y contains the remaining 28 localities. Subgroup Y-1 consists of 16 localities from lagoon and interreef environments, facies A, B, and D. Subgroup Y-2 contains ten localities from patch reef, interreef and lagoon environments, facies B, C, C/D, and D. Subgroup Y-3 includes two localities, one from the interreef environment (facies D), and one from the lagoon environment (facies B).

Cross-correlation of dendrograms

Cross-correlation of the clusters (Figure IV-2) indicates two broadly defined species associations, one lagoonal (A, contained in locality grouping Y-1), one reef (B, contained in locality grouping X), with a large number of localities (locality groupings Y-2 and Y-3) containing both associations.

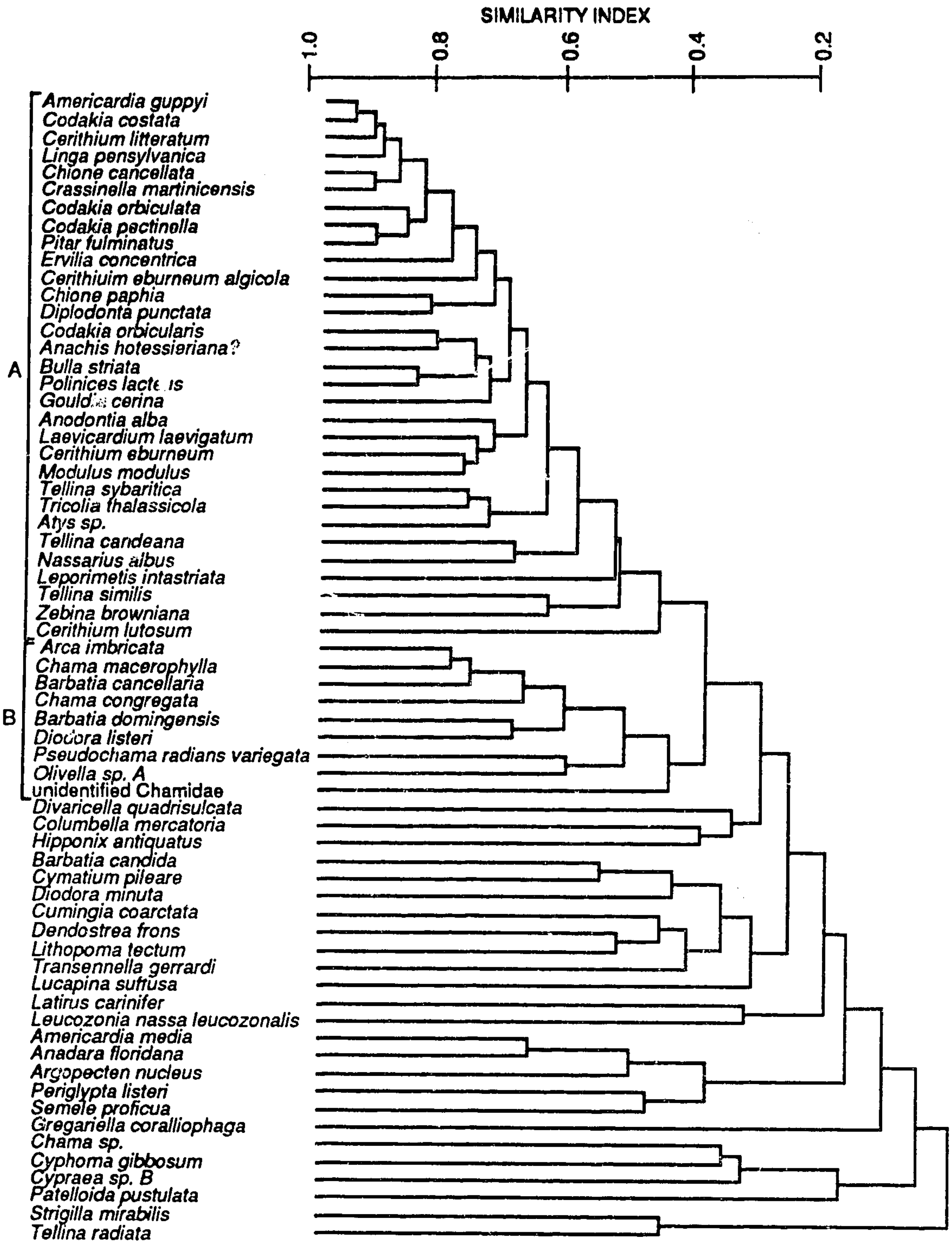


Figure IV-1. Dendrogram for Ironshore Formation species, binary data, correlated by Jaccard's coefficient, and clustered by the WPGMA method.

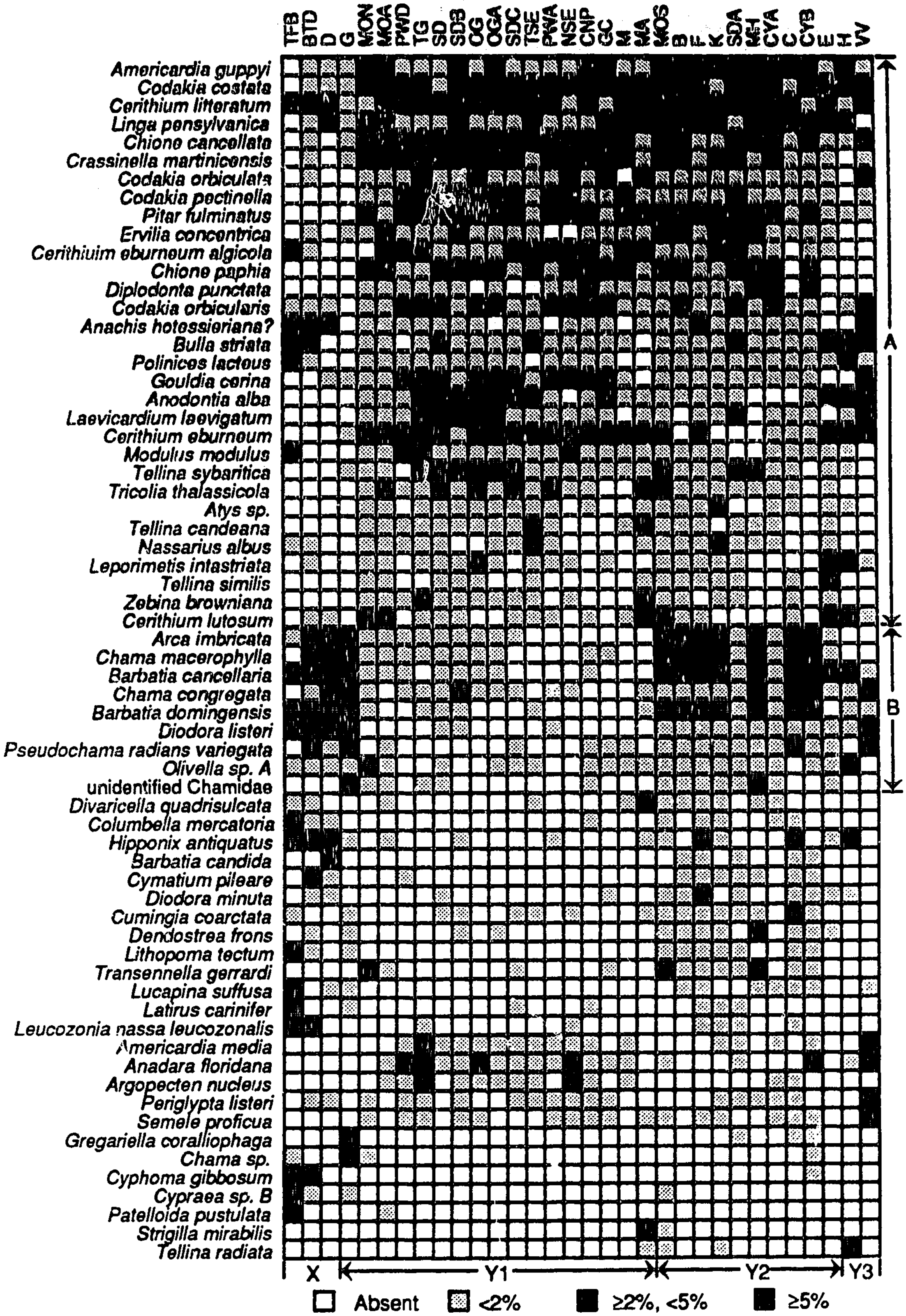


Figure IV-2. Cross-correlation of species associations (figure IV-1) and locality groupings (figure III-28), with shading reflecting abundances.

Species associations are not clearly defined because many species occur at virtually all localities.

Continuous data

Species

The dendrogram for species clustered using continuous data (Figure III-31) indicates four associations. Two lagoonal species are grouped (association A), as are five reef species (association B). *Crassinella martinicensis* is clustered separately, probably because it is typically much more abundant than the other species (abundant enough to be grouped separately even after standardization). The remaining 57 species are clustered into the final association (association C).

Localities

Clustering of localities (Figure IV-3) indicates two major locality groupings. Locality grouping X consists of reef tract, patch reef, and interreef localities (facies C, C/D, and E). Locality grouping Y contains localities from lagoon, patch reef and interreef environments (facies B, C/D, and D). Localities TFB, H, and MA are each clustered separately. Locality grouping Y can be divided into three subgroups, with the localities E and VV separate. Subgroup Y-1 contains lagoonal and interreef localities (facies B, C/D, and D). Subgroup Y-2 consists of interreef localities (facies C/D and D). The third subgroup, Y-3, consists of two localities from the lagoon environment (facies B).

Cross-correlation of dendrograms

Cross-correlation of these dendrograms (Figure IV-4) suggests two broadly defined species associations (lagoon, reef), each corresponding to a locality grouping, with a third locality grouping containing species from both

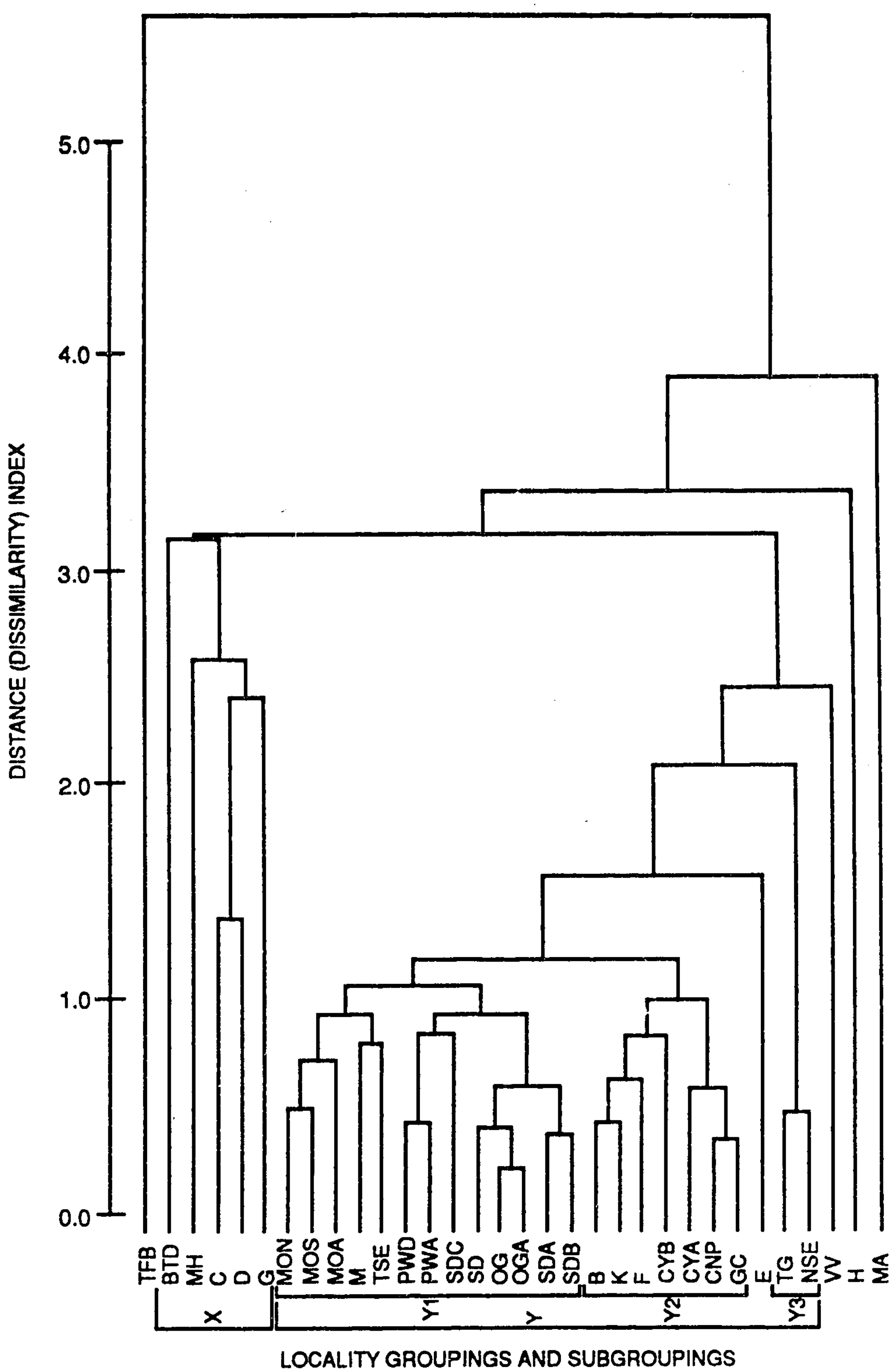


Figure IV-3. Dendrogram for Ironshore Formation localities, continuous data, correlated by squared euclidean distance, and clustered by the WPGMA method.

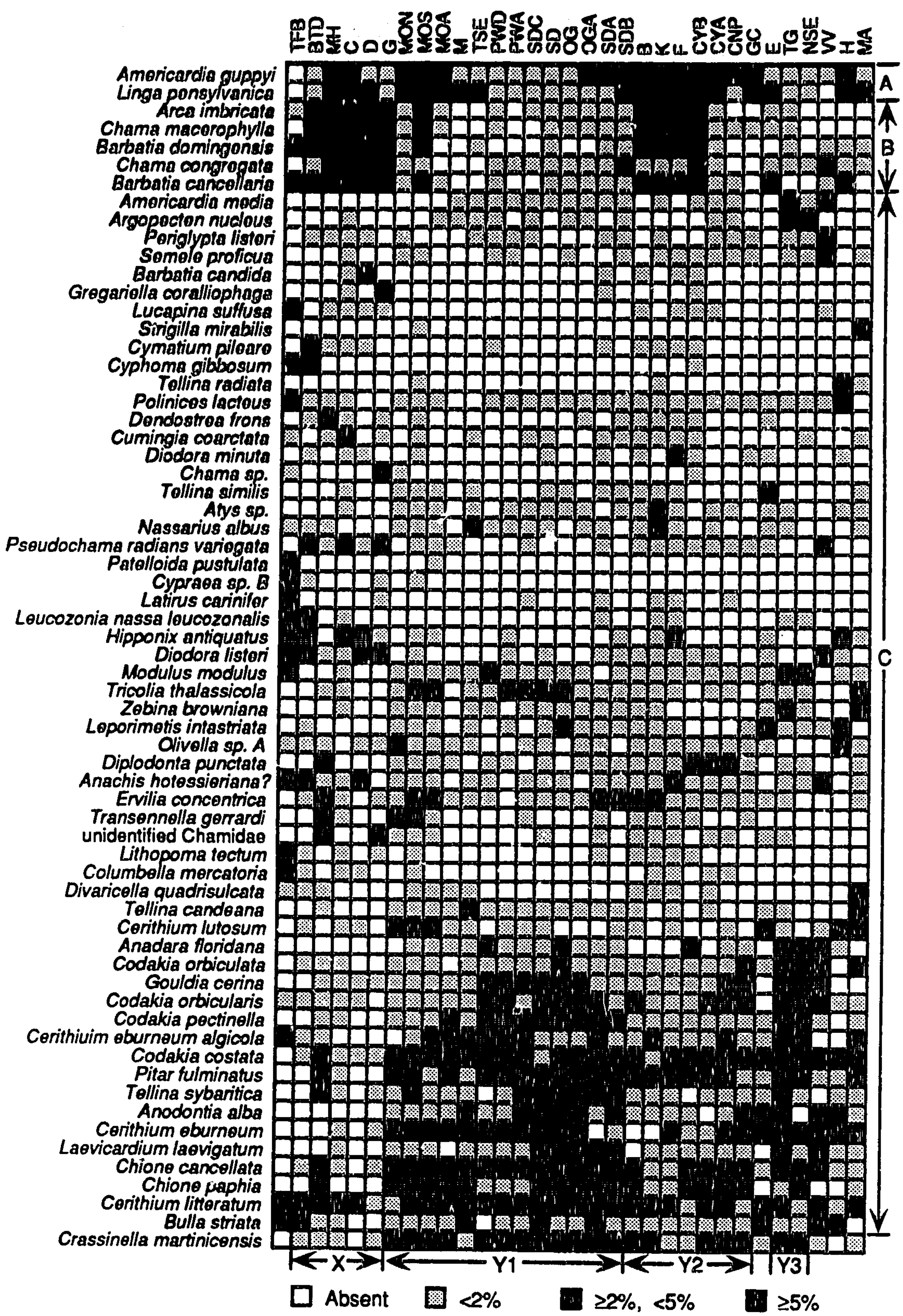


Figure IV-4. Cross-correlation of species associations (figure III-31) and locality groupings (figure IV-3), with shading reflecting abundances.

associations. The reef association is distinguished from the lagoon association by the presence of the arcids *Arca imbricata*, *Barbatia domingensis*, and *Barbatia cancellaria*, and the chamids *Chama macerophylla* and *Chama congregata* in high abundances. The rest of the fauna is undifferentiated.

Discussion

Clustering of both binary and continuous data allows the distinction of two major species associations, essentially defined on the abundance of five reef species. The first association is defined by the occurrence of *Arca imbricata*, *Barbatia cancellaria*, *Barbatia domingensis*, *Chama congregata*, and *Chama macerophylla* in high percentages (typically ≥2%). The second association is defined by the absence of these species, or their occurrence in lower percentages. Localities which contain the first association are typically from the reef tract or patch reefs environments (facies C and E). The second association occurs at localities in the interreef and lagoonal environments (facies A, B, and D). There are a number of localities where the fauna contains both associations. These are localities in facies C/D where both small patch reefs and surrounding interreef sediments were sampled at the same time.

Distribution of dominant species

Although the distribution of five reef species is clear, most of the remaining species are classified as one large group using continuous data, and not classified at all using binary data. The five reef species that were grouped effectively are widely distributed, and abundant (> 2%) at 1/3 or more of the localities at which they occur. In contrast, many of the species not clustered are widely distributed but rarely abundant, or are rare and scattered. Many species are grouped together because of their widespread distribution (binary data) or low abundances (continuous data), not because they are associated with each other.

Examination of the distribution of only the dominant species may be of use describing the associations present. In order to clarify the distribution of the dominant species, the database was reduced a second time. For each locality, only those species constituting at least 2% of the fauna were retained (Table IV-1). The 2% level was chosen for this reduction because it was consistent with the initial removal of rare species (Table III-3), and because use of the 5% level removed too many species. If a species was common at one locality, it was included for that locality. If the same species was rare (<2%) at a second locality, it was removed for the second locality. In this way, only the dominant species were included in the revised database. This reduced database was clustered using both binary and continuous data.

Binary data

Clustering of the dominant species using binary data revealed five distinct associations, with four species clustered individually (Figure IV-5). Associations A, B, and C consist of lagoonal species, whereas associations D and E contain reef species.

Clustering of localities by this method (Figure IV-6) indicate five locality groupings, with five other localities each clustered separately. Locality grouping V contains localities from reef environments, and corresponds to facies C and E. Locality groupings X and Z consist of interreef localities (facies D, with one locality from facies C/D), whereas locality grouping W contains mixed reef/interreef localities, facies C/D. The localities in grouping Y are from facies B.

The cross-correlation of the two sets of clusters (Figure IV-7) illustrates these associations and clarifies the nature of the clusters derived for species.

Table IV-1. Distribution and abundance of dominant molluscs in the Ironshore Formation, expressed as a percentage. For each locality, only those species forming at least 2% are included.

	TFB	BTD	MON	MOA	MOS	MH	B	C	D	E	F	G	H	K	M	CYA
Americardia guppyi			7.6	2.1	10.5	9.0	14.3	2.2			9.4		3.5	8.7		27.8
Americardia media																
Anadara floridana																
Anodontia alba										8.8			7.7			
Arca imbricata		3.3			3.1	3.6	6.9	10.6	11.6		6.8	12.5		6.2		
Argopocten nucleus																
Barbatia cancellaria	6.0	5.3			2.6	2.4	4.8	26.3	29.5	2.1	7.1	9.1	2.8	5.1		
Barbatia candida									2.3							
Barbatia domingensis	2.0	2.9			2.1	2.4	2.8	2.4	3.5		3.6	14.8		2.6		
Chama congregata						5.1		2.5	6.4			18.6				
Chama macerophylla		2.0			2.5	7.5	8.0	6.1	9.2		6.7	10.6		8.0		
Chama sp.												5.3				
Chione cancellata			6.8	5.4	2.7	3.0	3.2								24.8	6.4
Chione paphia			11.0	5.0	2.1	2.4	3.5								2.5	8.2
Codakia costata			2.8	4.4	4.1	2.1	2.3			3.7	2.0		3.5		3.4	4.7
Codakia orbicularis							3.4									3.1
Codakia orbiculata																
Codakia pectinella															3.4	
Crassinella martinicensis			7.6	7.5	3.1		4.6							2.1	15.1	8.9
Cumingia coarctata								4.5								
Dendostrea frons						2.4										
Diplodonta punctata						2.7										3.1
Divaricella quadrisulcata																
Ervilia concentrica				2.9	5.7	2.7	3.5							2.8		
Gouldia cerina																
Gregariella coralliophaga												2.3				
Laevicardium laevigatum																
Leporimetis intastriata										4.3			5.6			
Linga pensylvanica			17.5	12.0	11.0	3.3	8.7	2.2	2.3	4.0	8.1		19.7	11.3	7.6	8.0
Periglypta listeri																
Pitar fulminatus			4.2		6.5	5.7	4.2				3.2			3.4	4.6	2.6
Pseudochama radians variegata		3.3						3.9				2.3				
Semele proficua																
Strigilla mirabilis																
Tellina candeana																
Tellina radiata													3.5			
Tellina similis										3.7						
Tellina sybaritica					2.1	3.3										
Transennella gerrardi			2.6		3.8	10.2										
unidentified Chamidae						8.1						2.3				
Anachis hotessieriana?	3.5	4.1							2.3		5.2					
Atys sp.														2.1		
Bulla striata	2.5	27.0								21.0			14.1			
Cerithium eburneum			2.7	7.7	2.6					14.6	2.3		3.5		10.5	
Cerithium eburneum algicola	4.0			7.7										3.2	3.4	
Cerithium litteratum	8.0	7.0		6.0	3.0	2.1	4.6	2.0	2.3	7.3	2.8			3.8	4.6	4.2
Cerithium lutosum			11.4	10.3	2.7					5.2			2.1			
Columbella mercatoria	9.5															
Cymatium pileare		2.9														
Cyphoma gibbosum	2.5	3.3														
Cypraea sp. B	2.5															
Diodora listeri	4.0	4.5							5.2			2.7				
Diodora minuta											2.5					
Hipponix antiquatus	4.0	2.0						3.1	2.9		2.3		2.1			
Latirus carinifer	3.5															
Leucozonia nassa leucozonalis	5.0	4.1														
Lithopoma tectum	15.0															
Lucapina suffusa	2.0															
Modulus modulus	3.5															
Nassarius albus														2.1		
Olivella sp. A			2.6										7.0			
Patelloida pustulata	5.0															
Polinices lacteus	2.0												2.8			
Tricolia thalassicola				2.4	2.0											
Zebina browniana																

Table IV-1 (cont'd.). Distribution and abundance of dominant molluscs in the Ironshore Formation, expressed as a percentage. For each locality, only those species forming at least 2% are included.

	CYB	CNP	GC	VV	PWD	PWA	TG	SD	SDA	SDB	SDC	OG	OGA	NSE	MA	TSE
Americardia guppyi	11.5	2.7	4.6						6.4	3.0			2.1			
Americardia media				2.1			2.5									
Anadara floridana	2.0			2.1	2.0		5.0					2.2		6.1		
Anodontia alba			2.3	3.2			3.4	7.9		3.2	3.5	10.6	8.6			10.5
Arca imbricata	7.9															
Argopecten nucleus							2.0							3.2		
Barbatia cancellaria	4.6															
Barbatia candida																
Barbatia domingensis	8.5															
Chama congregata	7.1			3.2						2.1						
Chama macerophylla	8.7															
Chama sp.																
Chione cancellata	3.6	6.1	8.4	6.3	4.6	3.5	7.7	2.2	5.4	4.6	3.9	6.9	6.4	8.1		14.1
Chione paphia	3.4	8.0	12.1					7.1	12.4	9.9		4.8	3.9	3.6		2.0
Codakia costata	2.6	4.2	2.3	3.2	4.1	6.4	4.0		2.6	2.7	2.6	3.2	5.2	3.7	5.7	3.8
Codakia orbicularis		4.6	7.7	5.3	6.4	6.6	5.9	4.3	2.0			5.8	3.9	3.9		
Codakia orbiculata			2.1	2.1			4.0					2.2		8.4	3.2	
Codakia pectinella					7.2	3.1	6.6	5.2	2.0	3.5	5.1	4.1	6.8	3.2		
Crassinella martinicensis		35.6	30.3		22.1	41.9	7.2	7.6	11.7	8.0	6.7	11.2	11.8	10.7		
Cumingia coarctata																
Dendostrea frons																
Diplodonta punctata	4.0	4.7														
Divaricella quadrisulcata															9.5	
Ervilia concentrica									2.0	6.8						
Gouldia cerina		3.4	3.8	2.1	9.6	4.9	8.0	2.1			3.3	2.1	2.0	11.7		
Gregariella coralliophaga																
Laevicardium laevigatum				16.8			2.0	12.6	4.9	4.3		5.1	7.5			
Leporimetis intastriata												2.8				
Linga pensylvanica	4.4		6.3							2.8					7.4	11.9
Periglypta listeri				4.2												
Pitar fulminatus	2.4	5.0			3.1	3.0	2.8	4.6	6.9	6.6	4.3	2.9	4.8	2.1	4.1	
Pseudochama radians variegata				3.2												
Semele proficua				2.1												
Strigilla mirabilis															2.3	
Tellina candeana															15.7	2.4
Tellina radiata																
Tellina similis																
Tellina sybaritica							2.3	6.9	5.9	11.7	5.0	4.4	5.5			
Transennella gerrardi																
unidentified Chamidae																
Anachis hotessieriana?				5.3												
Atys sp.																
Bulla striata				5.3				3.5	2.1							12.2
Cerithium eburneum		2.6	3.6	3.2	15.6	5.8	6.9	3.0			6.5	5.0	3.8	4.0	2.9	7.0
Cerithium eburneum algicola		2.1			3.5	2.8	2.0		2.5		4.7			5.5	3.5	6.2
Cerithium litteratum		2.5		12.6	3.1	4.1	8.7	5.7	4.3	3.3	29.8	7.2	6.1		2.9	5.8
Cerithium lutosum															9.2	
Columbella mercatoria																
Cymatium pileare																
Cyphoma gibbosum																
Cypraea sp. B																
Diodora listeri																
Diodora minuta																
Hipponix antiquatus																
Latirus carinifer																
Leucozonia nassa leucozonalis																
Lithopoma tectum																
Lucapina suffusa																
Modulus modulus					2.1		2.0							2.6		
Nassarius albus																3.5
Olivella sp. A																
Patelloida pustulata																
Polinices lacteus																
Tricolia thalassicola						2.1		3.0			2.1	2.1			4.1	
Zebina browniana							2.3								2.6	

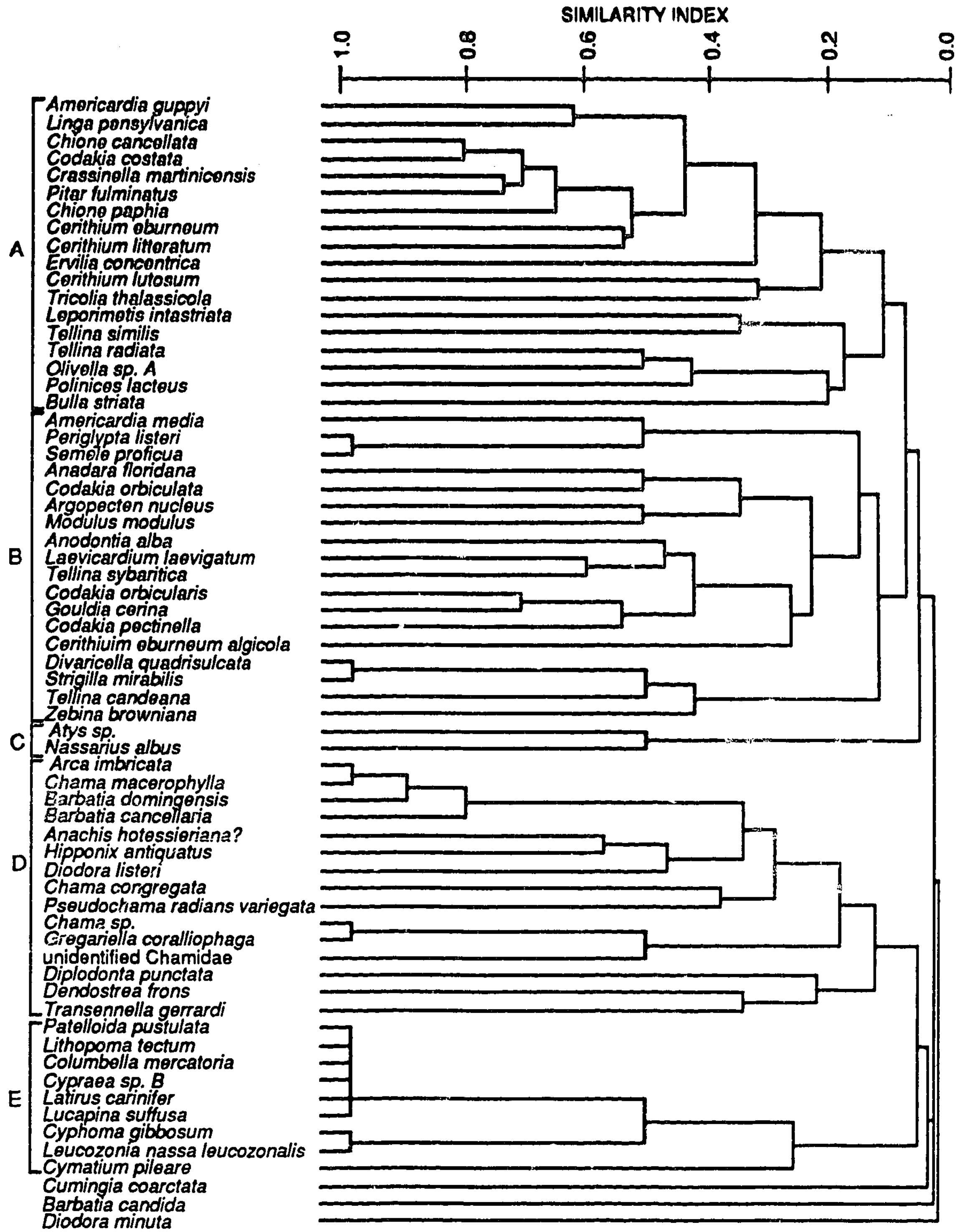


Figure IV-5. Dendrogram for Ironshore Formation species, based on dominant species only, binary data, correlated by Jaccard's coefficient, and clustered by the WPGMA method.

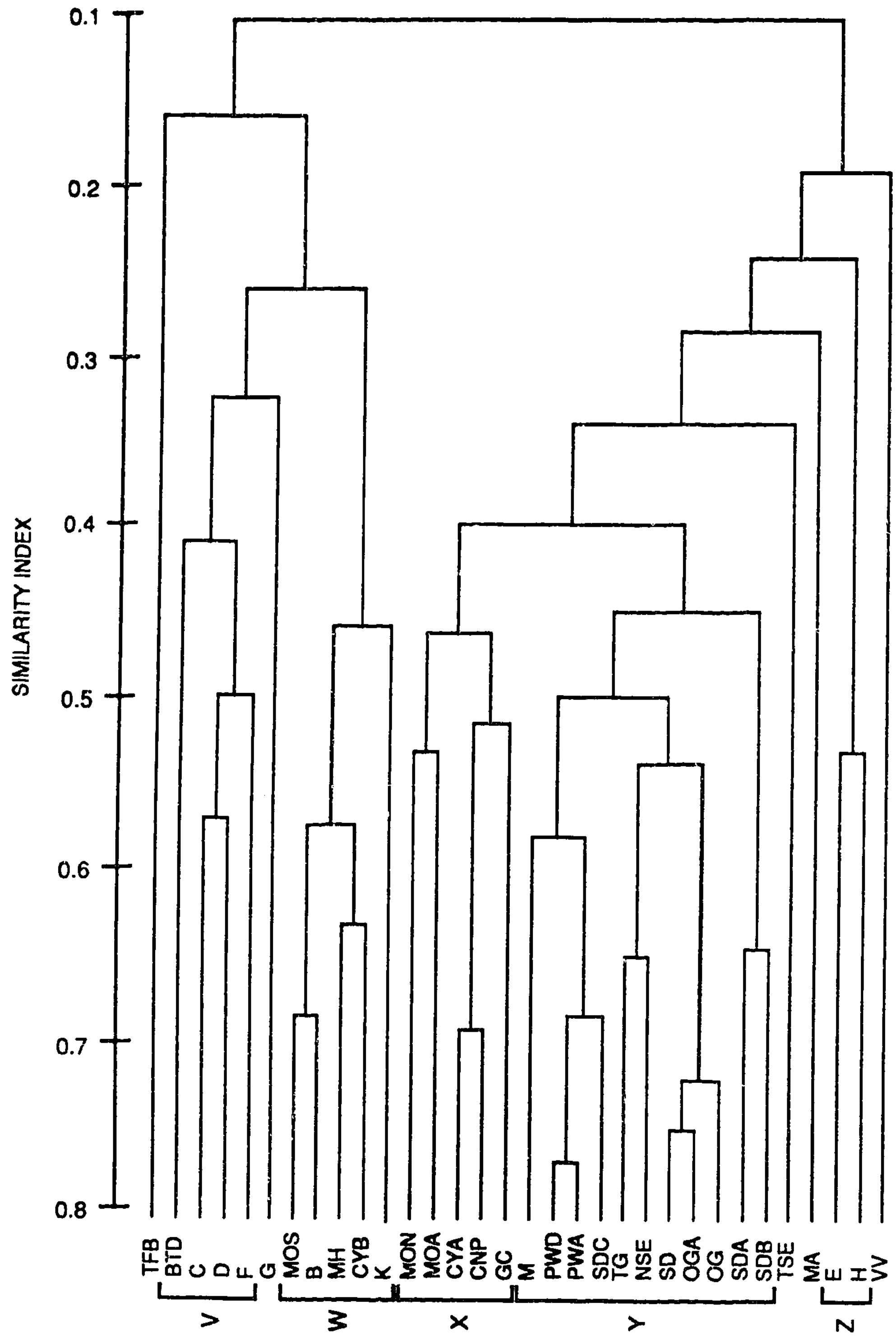


Figure IV-6. Dendrogram for Ironshore Formation localities, based on dominant species only, binary data, correlated by Jaccard's coefficient, and clustered by the WPGMA method.

Species associations A and B consist of soft-bottom species, but those in association A are ubiquitous (facies A, B, C/D, and D), whereas those in association B are common in only some localities (facies A and B). The boundary between these two associations is gradational. Species association C contains ubiquitous reef species whereas association D consists of reef species dominant only in the reef tract (locality BTD). The fauna of locality F appears to be intermediate in composition between the faunas of reef and mixed reef/interreef localities, but should be placed with the mixed reef/interreef localities on the basis of the occurrence of the dominant species. Locality G seems to be the best reef sample, with no abundant lagoonal species at all. The dominant species in locality MA, which is clustered separately, are smaller than the dominant species elsewhere, because a sieved sample was relied on for the bulk of the sample. Locality MA probably belongs with the lagoonal localities.

Continuous data

Clustering of the dominant species using continuous data duplicates the results derived using the whole database with continuous data (Figure IV-8, compare with figure III-31), and so does not contribute any new information.

Clustering of localities with only the dominant species using continuous data indicates three locality groupings plus 15 separate localities (Figure IV-9). Locality grouping X contains localities from the interreef and mixed reef/interreef environments, plus one from the lagoon (facies C/D and D). Locality grouping Y consists of localities from the interreef and lagoon environments (facies B and D). Locality grouping Z corresponds with lagoonal groupings indicated by the other three methods (facies B).

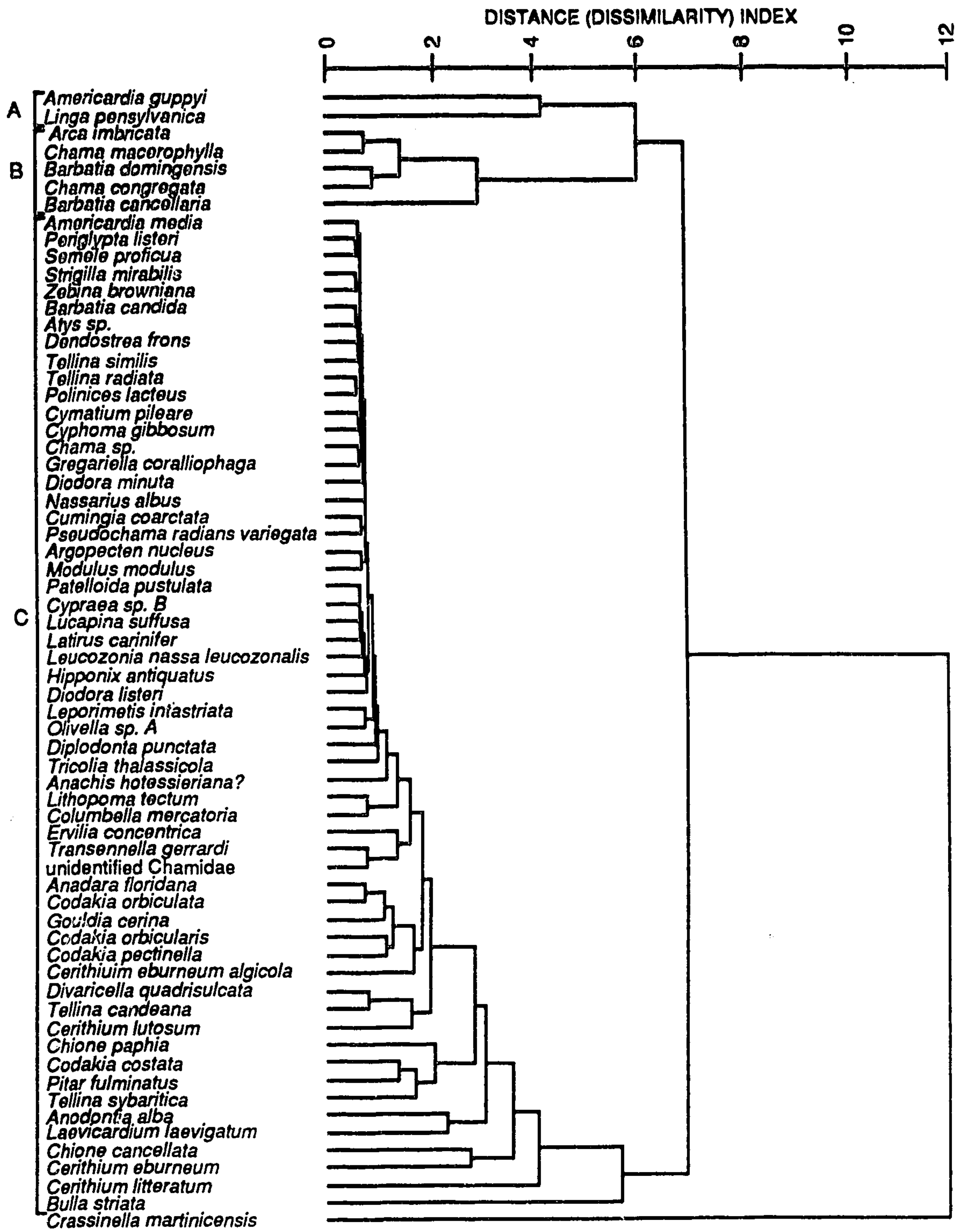


Figure IV-8. Dendrogram for Ironshore Formation species, based on dominant species only, continuous data, correlated by squared euclidean distance, and clustered by the WPGMA method.

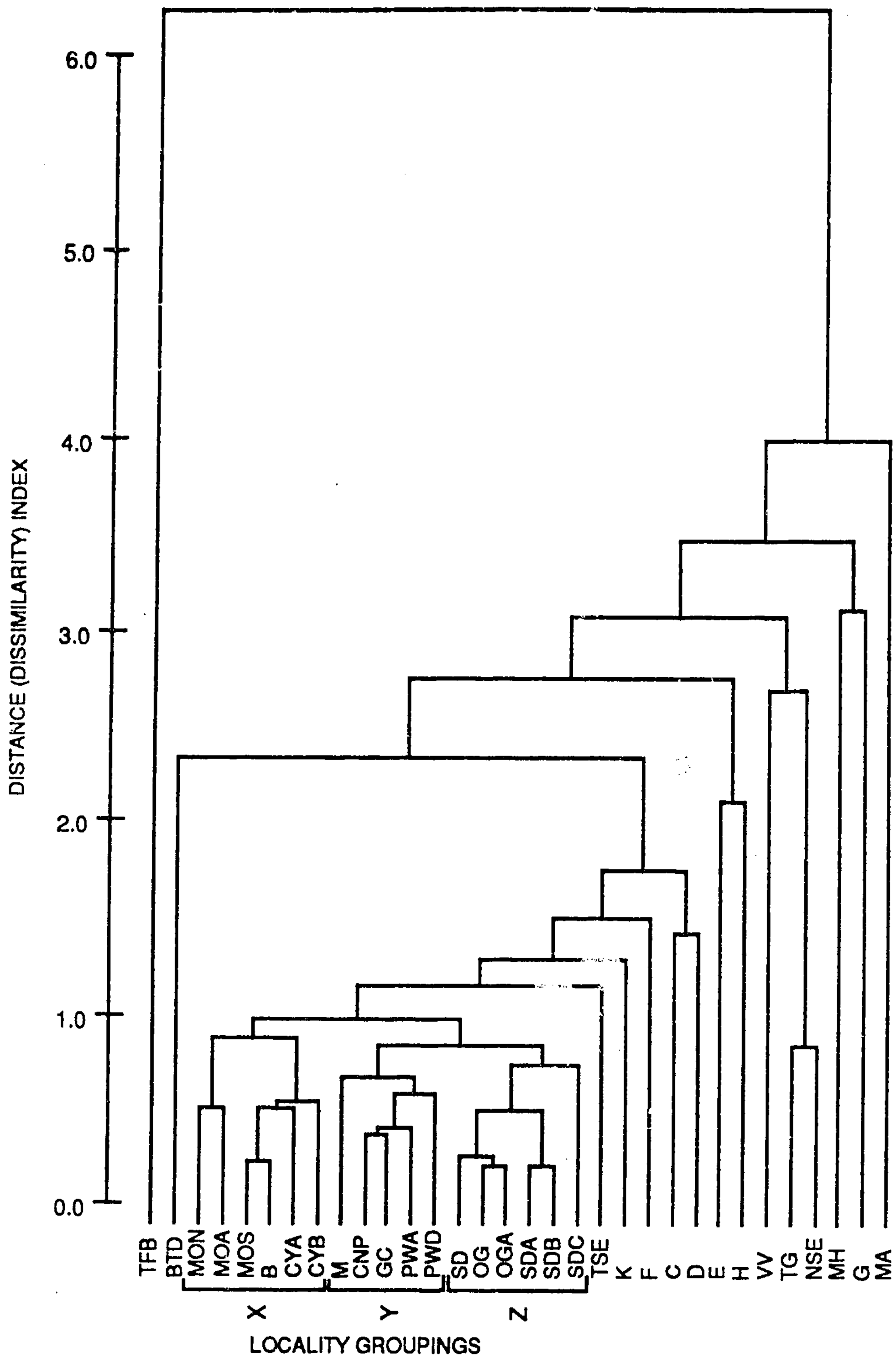


Figure IV-9. Dendrogram for Ironshore Formation localities, based on dominant species only, continuous data, correlated by squared euclidean distance, and clustered by the WPGMA method.

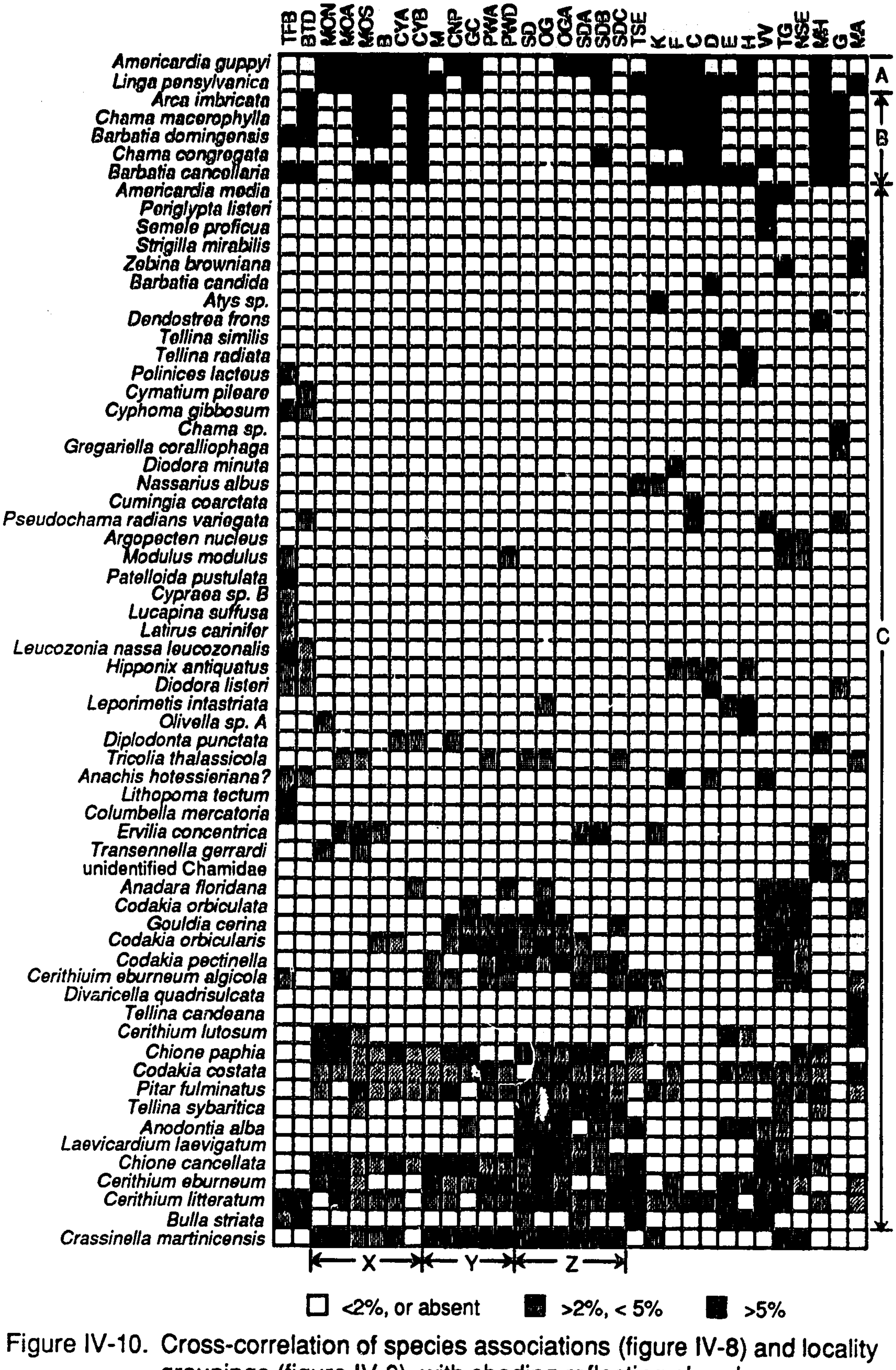


Figure IV-10. Cross-correlation of species associations (figure IV-8) and locality groupings (figure IV-9), with shading reflecting abundances.

Distinct associations are not indicated by this method (Figure IV-10), as they are by clustering the initial database using continuous data (Figure IV-3), and by clustering the dominant species using binary data (Figure IV-7).

Discussion

Cluster analysis of the dominant species indicates four major species associations (Figure IV-7). Inclusion of abundances less than 2% in the cross-correlation for dominant species, binary data (Figure IV-11), emphasizes that differences between associations are for the most part gradational, defined on the basis of the relative abundances of species and not on their presence or absence.

Statistically defined associations

Of the methods used, cluster analysis of the dominant species using binary data (Figure IV-11) most effectively delineates the faunal associations in the mollusc fauna of the Ironshore Formation (Table IV-2). Locality groupings are defined on the basis of the associations they contain (Figure IV-11, Table IV-3).

Species association I, dominated by *Americardia media*, *Cerithium spp.*, *Chione spp.*, *Crassinella martinicensis*, and *Linga pensylvanica*, occurs in the interreef and lagoon environments. Species association II, characterized by *Bulla striata* and *Leporimetis intastriata*, also occurs in the interreef environment. Species association III, dominated by *Anodontia alba*, *Codakia spp.*, *Gouldia cerina*, *Laevicardium laevigatum*, and *Tellina sybaritica*, occurs with association I in the lagoon environment, but does not extend to the interreef environment. Species association IV, consisting of *Atys sp.* and *Nassarius albus*, occurs in generally low numbers in the interreef and lagoonal environments.

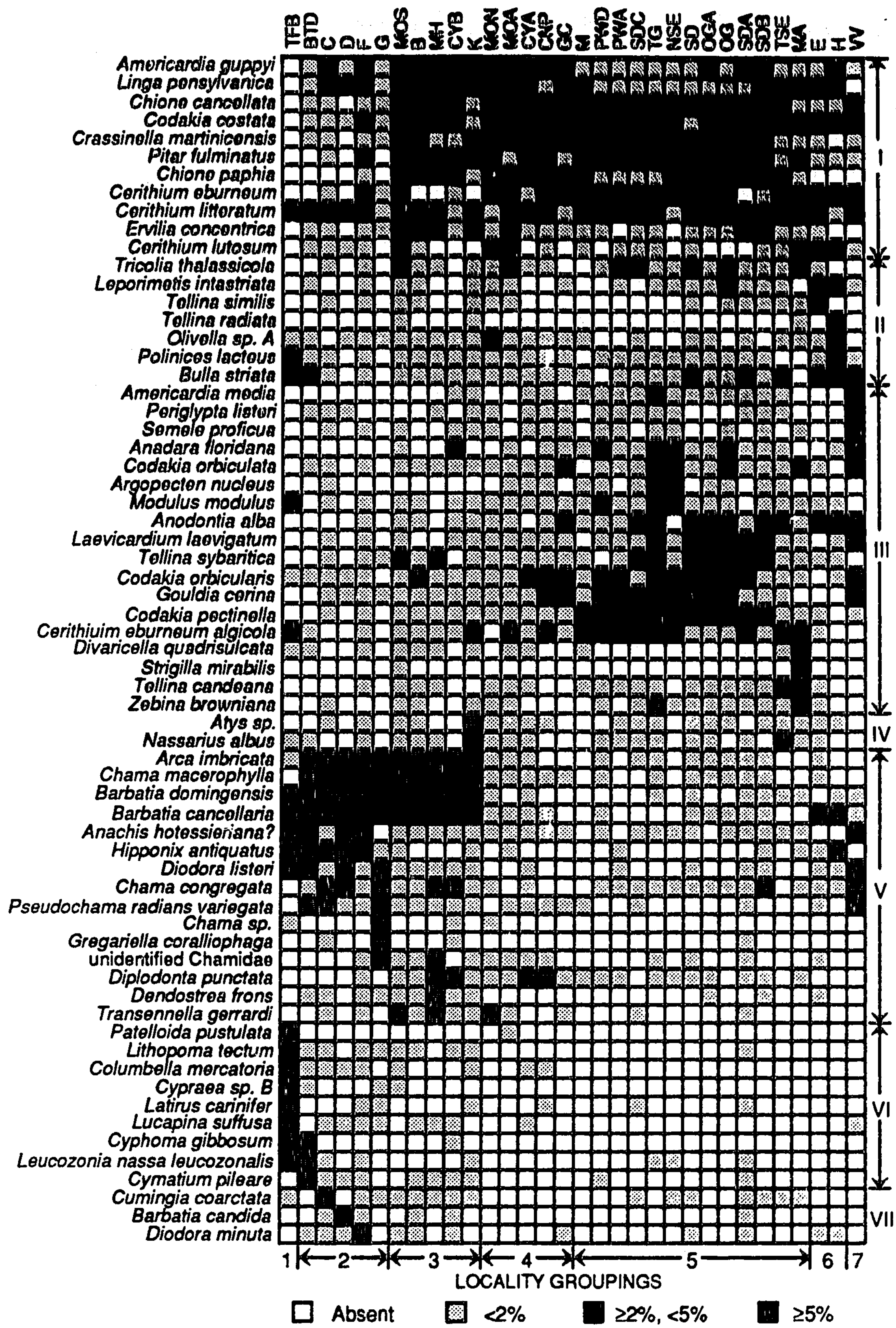


Figure IV-11. Cross-correlation of species associations (Figure IV-5) and locality groupings (Figure IV-6), with rarer occurrences included.

Table IV-2. Summary of mollusc associations in the Ironshore Formation (Figure IV-11), and their distribution with respect to localities and physical environments. Dominant species are listed in bold type.

SPECIES			DISTRIBUTION	ENVIRONMENT	
GROUP	ASSOCIATION	CONSTITUENT SPECIES	LOCALITY GROUPINGS	LITHOFACIES	INTERPRETATION
1	I.	***Americardia guppyi*** ***Cerithium eburneum*** ***Cerithium litteratum*** ***Chione cancellata*** ***Chione paphia*** ***Codakia costata*** ***Crassinella martinicensis*** ***Linga pensylvanica*** ***Pitar fulminatus*** *Cerithium lutosum* *Ervilia concentrica* *Tricolia thalassicola*	3, 4, 5, 7	A, B, C/D, D	MIXED REEF/ INTERREEF, INTERREEF, LAGOON
1	II.	***Bulla striata*** ***Leporimetis intastriata*** *Olivella sp. A* *Polinices lacteus* *Tellina radiata* *Tellina similis*	6	C/D, D	INTERREEF
1	III.	***Anodontia alba*** ***Cerithium eburnem algicola*** ***Codakia orbicularis*** ***Codakia pectinella*** ***Gouldia cerina*** ***Laevicardium laevigatum*** ***Tellina sybaritica*** *Americardia media* *Anadara floridana* *Argopecten nucleus* *Codakia orbiculata* *Divaricella quadrisulcata* *Modulus modulus* *Periglypta listeri* *Semele proficua* *Strigilla mirabilis* *Tellina candeana* *Zebina browniana*	5, 7	A, B	LAGOON
1	IV.	*Atys sp.* *Nassarius albus*	3, 5	A, B, C/D	MIXED REEF/ INTERREEF, LAGOON

Table IV-2 (cont'd.). Summary of mollusc associations in the Ironshore Formation (Figure IV-11), and their distribution with respect to localities and physical environments. Dominant species are listed in bold type.

SPECIES			DISTRIBUTION	ENVIRONMENT	
GROUP	ASSOCIATION	CONSTITUENT SPECIES	LOCALITY GROUPINGS	LITHOFACIES	INTERPRETATION
2	V.	***Arca imbricata*** ***Barbatia cancellaria*** ***Barbatia domingensis*** ***Chama macerophylla*** *Anachis hotessieriana?* *Chama congregata* *Chama sp.* *Dendostrea frons* *Diodora listeri* *Diplodonta punctata* *Gregariella coralliophaga* *Hipponix antiquatus* *Pseudochama radians variegata* *Transennella gerrardi*	1, 2, 3, 7	B, C, C/D, E	REEF TRACT, PATCH REEFS, MIXED REEF/ INTERREEF, LAGOON
2	VI.	***Columbella mercatoria*** ***Leucozonia nassa leucozonalis*** ***Lithopoma tectum*** ***Patelloida pustulata*** *Cymatium pileare* *Cyphoma gibbosum* *Cypraea sp. B* *Latirus carinifer* *Lucapina suffusa*	1	E	REEF TRACT
2	VII.	*Barbatia candida* *Cumingia coarctata* *Diodora minuta*	2	C	PATCH REEFS

Table IV-3. Summary of locality groupings in the Ironshore Formation (Figure IV-11), their distribution with respect to physical environments, and the species associations present. Localities in brackets are classified qualitatively.

LOCALITY GROUPINGS	LOCALITIES	ENVIRONMENT		ASSOCIATIONS PRESENT
		LITHOFACIES	INTERPRETATION	
1	TFB (EOT) (DPQ)	E	REEF TRACT	V, VI
2	BTD C D F G	C, C/D, E	REEF (ONE MIXED REEF/INTERREEF LOCALITY)	V, VII
3	MOS MH B K CYB (CDS)	C/D (E)	MIXED REEF/ INTERREEF	I, IV, V
4	MON MOA CYA CNP GC (L)	D (B)	INTERREEF	I
5	M PWD PWA TG SD SDA SDC SDC OG OGA NSE MA TSE	A, B	LAGOON	I, III, IV
6	E H	C/D, D	INTERREEF	II (I, III)
7	VV (U) (YY)	B	LAGOON	I, III, V

Species association V is dominated by reef species, in particular the bivalves *Arca imbricata*, *Barbatia cancellaria*, *Barbatia domingensis* and *Chama macerophylla*, and occurs in the reef environments in the Ironshore Lagoon (facies C and E). Association VI, characterized by a diverse gastropod fauna, occurs with association V at most reef tract localities. Association VII, consisting of three species clustered individually (*Barbatia candida*, *Cumingia coarctata*, and *Diodora minuta*), occurs with association V at patch reef localities.

The species associations are assigned to two species groups. Species group 1 is characterized by genera such as *Cerithium*, *Chione*, and *Codakia*, includes associations I, II, III, and IV, and is found in lagoonal and interreef environments Species group 2 is characterized by *Arca*, *Barbatia*, and *Chama*, includes associations V, VI, and VII, and occurs in reef environments..

Locality groupings are defined by the presence of one or more species associations (Table IV-3). Association V occurs in both locality groupings 1 and 2, but with association VI in locality grouping 1, and with association VII in locality grouping 2. Locality groupings 1 and 2 occur in the reef tract (facies E) and patch reef (facies C) environments respectively.

Locality grouping 3, with associations I, III, and V present, occurs where small patch reefs interfinger with reef deposits (facies C/D). Collections at these localities invariably include shells from both the reefs and the surrounding interreef deposits. This mixing was accentuated by excavation.

Locality grouping 4, with only association I present, occurs in the interreef environment (facies D). Locality grouping 5, containing associations I, III, and IV, occurs in the lagoon environment (facies A and B). Locality grouping 6, defined by the presence of association II, but also including species from associations I and III, occurs in the interreef environment (facies D). Locality grouping 7, defined by a fauna with characteristics of associations I, III, and V, occurs in the lagoon environment (facies B).

Boundaries between locality groupings are gradational. Locality F is a good example of a locality which could be placed in more than one locality grouping, depending on the criteria used. Clustering of localities (dominant species only) using binary data placed locality F in locality grouping 2, but species from association I are sufficiently abundant to warrant including locality F in locality grouping 3. In reality, the fauna at this locality is probably intermediate in nature. The boundary between locality groupings 4 and 5 is also gradational (Figure IV-11).

Of the 12 localities not clustered because sample sizes were too small, six are categorized on the basis of the fauna. Localities EOT and DPQ contain associations V and VI, and are therefore included in locality grouping 1. Locality CDS contains both associations I, IV and V, and so is included in locality grouping 3. Locality L contains the fauna in association I, and so is included in locality grouping 4. Localities U and VV contain associations I, III, and V, and are included in locality grouping 7. Samples from localities ABB, ACB, ACH, BTH, N, and PMP are too small to allow identification of their relation to the associations and locality groupings defined here. These six localities are not included in ecological analyses because they cannot be placed in locality groupings.

V. ECOLOGICAL ASPECTS OF SPECIES ASSOCIATIONS AND LOCALITY GROUPINGS IN THE IRONSHORE FORMATION

Relative number of bivalve and gastropod species

There are more bivalve species than gastropod species at most localities in the Ironshore Formation (Figure V-1). Localities EOT, DPQ, TFB, BTD and CDS, in locality groupings 1, 2, and 3, contain more gastropod species than bivalve species (Figure V-1). These localities all occur in facies E (reef tract environment), whereas the other localities in locality groupings 2 and 3 (Table IV-3) are from facies C (patch reef environment) and C/D (mixed patch reef/interreef).

Localities EOT, DPQ, TFB, BTD and CDS differ from other localities in two respects. First, they are reef or mixed reef/interreef localities that contained many epifaunal niches. Most localities, in environments with soft sediment substrates, had few epifaunal niches. Most bivalves in general (Stanley, 1970) and in this study (Table V-1) are infaunal in nature. Many gastropods, however, are epifaunal (Purchon, 1977), including those from the Ironshore Formation. They are more likely to find suitable grazing or hunting sites in coral reefs. Predatory gastropods in particular are well represented on coral reefs (Barnes and Hughes, 1988). Therefore, it is not surprising to find a relatively higher numbers of gastropod species in the reefs of the Ironshore Formation. Secondly, reef tract localities may also be less hospitable for bivalves. Energy levels would be higher in the reef tract than in the patch reefs or soft-sediment environments because they are not as sheltered as the other environments. Therefore, less sediment may be available for burrowing bivalves in the reef tract than elsewhere. Although bivalve species from species association V

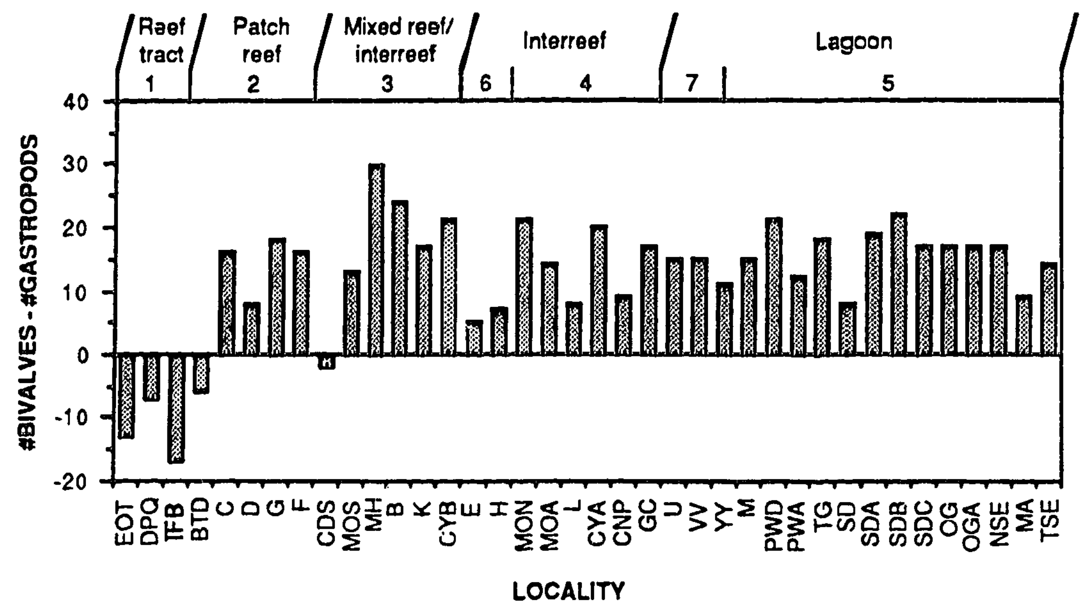


Figure V-1. Relative number of bivalve and gastropod species at localities in the Ironshore Formation. Value is the number of bivalve species less the number of gastropod species. Localities are ordered west to east, by locality groupings (Table IV-3).

Table V-1. Feeding types and life habits for bivalve molluscs in the Ironshore Formation. DE = epifaunal deposit feeding; DI = infaunal deposit feeding; SE = epifaunal suspension feeding; SS = shallow infaunal/semiinfaunal suspension feeding; SD = deep infaunal suspension feeding; H = grazing herbivore; O = grazing omnivore; C = grazing carnivore/predator; P = parasite.

Taxa	Feeding Type	Life Habit	Taxa	Feeding Type	Life Habit
Nuculidae	DI	burrowing	Cyclostrematidae	H	free living
Mytilidae:	-	-	Turbinidae	H	free living
Botula, Gregariella, Lithophaga	SE	boring	Phasianellidae	H	free living
Brachidontes, Musculus	SS	byssate	Neritidae	H	free living
Arcidae:	-	-	Rissoidae	H	free living
Anadara	SS	burrowing	Modulidae	DE	free living
Arca, Arcopsis, Barbatia	SE	byssate	Cerithiidae	DE	free living
Glycymerididae	SS	burrowing	Cerithiopsidae	P	symbiotic
Pteridae	SE	byssate	Triphoridae	P	symbiotic
Limidae	SE	byssate	Epitoniidae	P	symbiotic
Pectinidae	SE	reclining	Eulimidae	P	symbiotic
Plicatulidae	SE	cementing	Strombidae	H	free living
Spondylidae	SE	cementing	Hipponicidae	H	cementing
Anomiidae	SE	byssate	Calyptraeidae	SE	cementing
Ostreidae	SE	other	Triviidae	C	free living
Lucinidae	SD	burrowing	Cypraeidae	O	free living
Ungulinidae	SD	burrowing	Ovulidae	C	free living
Chamidae	SE	cementing	Naticidae	C	free living
Sportellidae	SS?	burrowing	Ranellidae	C	free living
Crassitellidae	SE	other	Muricidae	C	free living
Cardiidae	SS	burrowing	Coralliophilidae	P	symbiotic
Mesodesmatidae	SS	burrowing	Columbellidae	O	free living
Tellinidae	DI	burrowing	Buccinidae	C	free living
Semelidae	DI	burrowing	Nassariidae	C	free living
Solecurtidae	SD	burrowing	Fasciolariidae	C	free living
Trapeziidae	SE	nestling	Olividae	C	free living
Veneridae:	-	-	Mitridae	C	free living
Agriopoma, Periglypta	SD	burrowing	Marginellidae	C	free living
Chione, Gouldia, Pitar, Transennella	SS	burrowing	Conidae	C	free living
Petricoliidae	SE	boring	Turridae	C	free living
Gastrochaenidae	SE	boring	Pyramellidae	P	symbiotic
Poromyidae	SS	burrowing	Scaphandridae	H?	free living
Fissurellidae	H	free living	Bullidae	H	free living
Acmaeidae	H	free living	Atydae	H?	free living

Sources: Abbott, 1974; J. D. Davis, 1973; Hatfield, 1979; Houbrick, 1974; Houbrick, 1980; Houbrick and Fretter, 1969; Kosuge, 1966; Purchon, 1977; Robertson, 1980; Rudman, 1971; Stanley, 1970; Taylor and Reid, 1984; Yonge and Thompson, 1976.

occur in both the patch reefs and the reef tract , they are less abundant and diverse in the less favourable reef tract.

Diversity

Richness

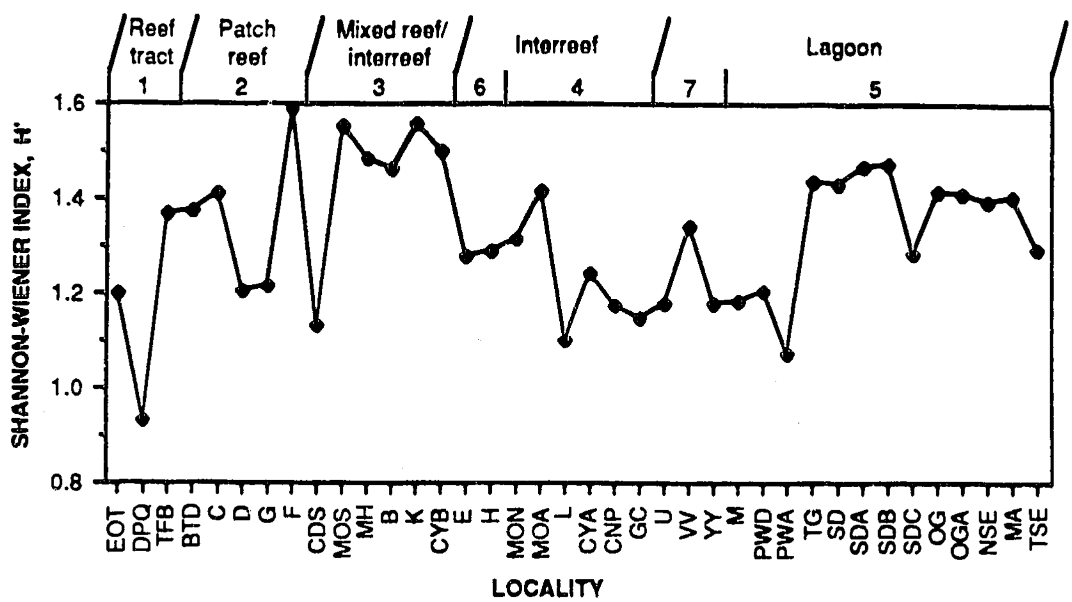
The Shannon-Wiener index (H') indicates that diversity (richness) varies considerably between localities (Figure V-2a).

Localities from locality groupings 3 and 5 generally have higher diversity than those from groupings 1, 2, 4, 6 or 7. High diversity for those localities in locality grouping 3 is probably due to the presence of three species associations (I, IV, and V) from two species groups. Other locality groupings in the western part of the Ironshore Lagoon are characterized by only one or two associations. High diversity at locality F in locality grouping 2 is due to a fauna intermediate in composition between locality groupings 2 and 3. Diversity at the eastern localities in locality grouping 5 (TG to TSE) is generally high, reflecting the presence of three species associations (I, III, and IV) and constant, suggesting a more uniform fauna in that area. The three western localities in locality grouping 5 (M, PWD and PWA) have diversities similar to those for localities in locality groupings 4 and 7, illustrating the transitional nature of the boundaries between locality groupings.

Dominance

Simpson's dominance index (C) indicates that overall, dominance is low at localities in locality grouping 3 and at the eastern localities in locality grouping 5, and higher and more variable elsewhere (Figure V-2b). Lower diversity (H') and higher dominance (C) tend to occur for the same localities (Figure V-2), suggesting that they are interdependent. Lower diversity (fewer

A.



B.

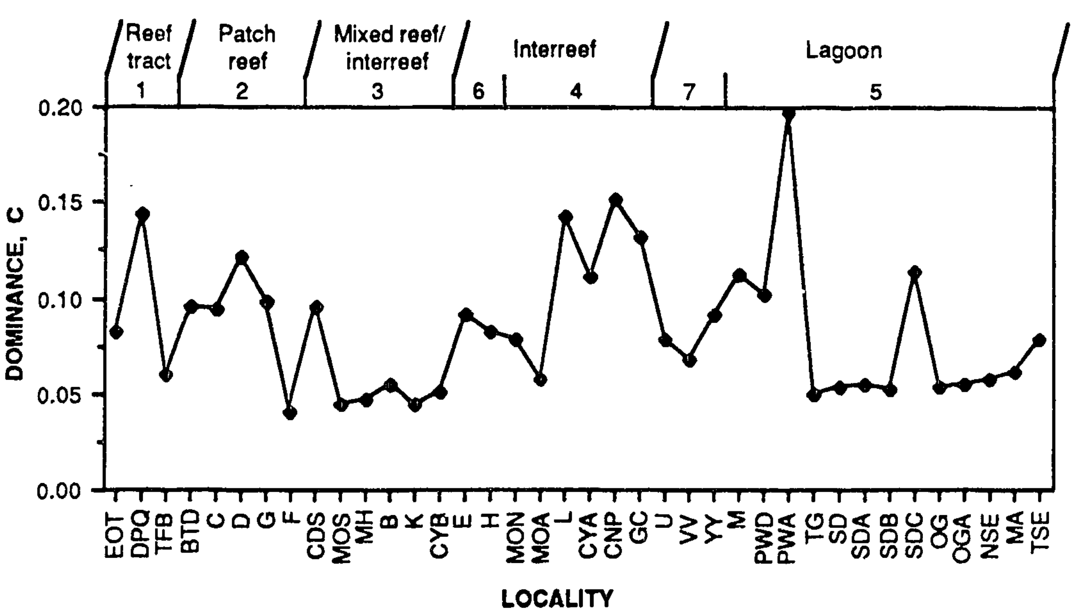


Figure V-2. Measurement of diversity and dominance for localities in the Ironshore Formation. A. Diversity, measured by the Shannon-Wiener index, H'. B. Dominance, measured by Simpson's index, C. Localities are ordered west to east by locality groupings (table IV-3).

species) ensures that each species is likely to be more abundant, which increases the index of dominance.

Dominance is low where the fauna contains a relatively high number of equally abundant species. Low even dominance at the eastern localities in locality grouping 5 reflects a fauna containing many dominant species (associations I, III, and IV), evenly distributed throughout most of their respective ranges. Low dominance in locality grouping 3 reflects the presence of three species associations (I, IV, V) two of which contribute many dominant species (I and V).

Intermediate levels of dominance occur in locality groupings 6 and 7 because there are an intermediate number of dominant species at these localities (Table IV-2).

High dominance throughout locality groupings 1 and 2 reflects a fauna with small numbers of dominant species, mostly arcids and chamids (association V) in locality grouping 2, and gastropods (association VI) in locality grouping 1. Localities in locality grouping 4 and the western localities in locality grouping 5 also have high dominance, due to high local abundances of individual species. For example, localities CNP, GC, and PWA are dominated by the bivalve *Crassinella martinicensis* (35.6%, 30.3%, and 41.9% of the samples respectively). The gastropod *Cerithium litteratum* forms 29.8% of the sample at locality SDC, whereas the bivalve *Chione cancellata* constitutes 32.9% of the sample at locality L. Similarly, the high percentage of the small bivalve *Americardia guppyi* (27.8%) is responsible for the high index of dominance at locality CYA. These high abundances suggest that conditions were optimum for those species at those localities. Environments in this part of the Ironshore Lagoon may have been variable. These species may have been highly opportunistic, rapidly increasing in abundance whenever and wherever conditions warranted. High numbers of juveniles relative to the number of adults in a population, characteristic of opportunistic r-selected species, allow a large increase in the population should the environment become more favourable (Levinton, 1970). Opportunistic species tend to be smaller in size (Pianka, 1970), as *Crassinella martinicensis* is. These species may also have been highly gregarious, occurring in clumped distribution patterns, which are common in nature (Hairston, 1959; Warme, 1969), and typical of opportunistic species (Levinton, 1970).

Trophic structure

Trophic structure is a measure of the energy flow and feeding types present in a community (Scott, 1978). Fossil associations contain only part of the original communities, because 40 to 70% or more of a typical benthic community will not be preserved (Lawrence, 1968; Cummins *et al.*, 1986). The trophic structure preserved in an association does not necessarily represent the original trophic structure present in a community, but may approximate that structure if it can be shown that it is related to the environment (Stanton and Dodd, 1976; Scott, 1978). The trophic structure of fossil associations is commonly described by measuring the relative abundances of organisms with different feeding types, and relating this to the physical environment (Walker, 1972; Scott, 1974; Thayer, 1974; Walker and Bambach, 1974b; Stanton and Dodd, 1976; Scott, 1978).

Organisms of the same feeding type may reduce competition by exploiting different subenvironments within an environment, for example suspension feeders may feed at different levels or tiers above or below the substrate surface (Walker and Bambach, 1974; Scott, 1978; Ausich, 1980;

Ausich and Bottjer, 1985; Bottjer and Ausich, 1986). Niche differentiation of this type allows increased diversity in a community of similar organisms.

Feeding types were determined by comparison with modern shells (Table V-1). Mollusc species were classified as grazing herbivore, grazing carnivore/predator, grazing omnivore, suspension feeder, deposit feeder, or parasite, after Taylor and Reid (1984). Suspension feeders and deposit feeders were divided into epifaunal, shallow infaunal/semiinfaunal, and deep infaunal tiers. Shallow infaunal species are those which typically borrow to a depth less than two to three cm below the substrate surface; deep species to a depth greater than two or three cm below the surface (Stanley, 1970). Suspension feeders were divided into three tiers: epifaunal suspension feeders, shallow infaunal/semiinfaunal suspension feeders (all bivalves), and deep infaunal suspension feeders (all bivalves). Deposit feeders were divided into two tiers: epifaunal deposit feeders (all gastropods) and infaunal deposit feeders (all bivalves). Infaunal deposit feeders were not divided into shallow and deep tiers because all but one individual (*Nucula aegeensis*?) of the infaunal deposit feeders are deep infaunal bivalves. Boring species (all bivalves) are included in the epifaunal tier because they bore into rocks or corals above the substrate surface. The one nestling species in the fauna (a bivalve) is included with boring species because it nestles in empty borings. Grazing herbivores, carnivores and omnivores (all gastropods) are usually epifaunal. Parasites (all gastropods) live in other organisms, and so do not compete with any of these other feeding groups.

Interpretation of tiers in the fossil record may be inhibited by inadequate sampling of all deposits of the same age at different levels (Bottjer and Ausich, 1982). All tiers are equally well represented in the Ironshore Formation samples because of vertical mixing during excavation.

In the Ironshore Formation, epifaunal feeding groups dominate at localities in locality groupings 1 and 2, whereas infaunal feeders dominate in locality groupings 4, 5, 6 and 7 (Figure V-3). The fauna in locality grouping 3 is equally divided between the two types. Parasitic species are rare in the Ironshore Formation.

The high abundances of epifaunal omnivorous and carnivorous gastropods at localities in locality grouping 1 and at BTD in locality grouping 2 reflect the abundance of epifaunal niches present in the reef tract environment (Figure V-3). These feeding groups are less important throughout the rest of the Ironshore Formation. Grazing herbivores are more abundant in locality grouping 1, but occur in significant numbers in locality groupings 2 (patch reefs), and 6 and 7 (interreef and lagoon in close proximity to the reef tract).

Taylor and Reid (1984) found abundant deposit feeding gastropods on reef tops and sheltered edges of reefs in Sudanese Red Sea reefs. Epifaunal deposit feeding gastropods are significant in locality grouping 1 (Figure V-3), suggesting that the top and leeward parts of the reef tract were sampled. This same feeding group is also significant in locality groupings 4, 5, 6 and 7 (Figure V-3), in the sheltered interreef and lagoon environments.

Epifaunal suspension feeding mollusc dominate localities in locality grouping 2 (except for localities BTD and F), reflecting abundant epifaunal niches in an environment optimum for bivalves, with little soft substrate available for infaunal species (Figure V-3). Locality F resembles localities in locality grouping 3 in trophic structure, indicating its transitional nature.

Equal numbers of epifaunal and infaunal suspension feeders dominate localities in locality grouping 3 (Figure V-3). They are localities where reef and interreef environments were mixed, and epifaunal and infaunal niches were equally available. Localities in locality groupings 4, 5 and 7 are dominated by

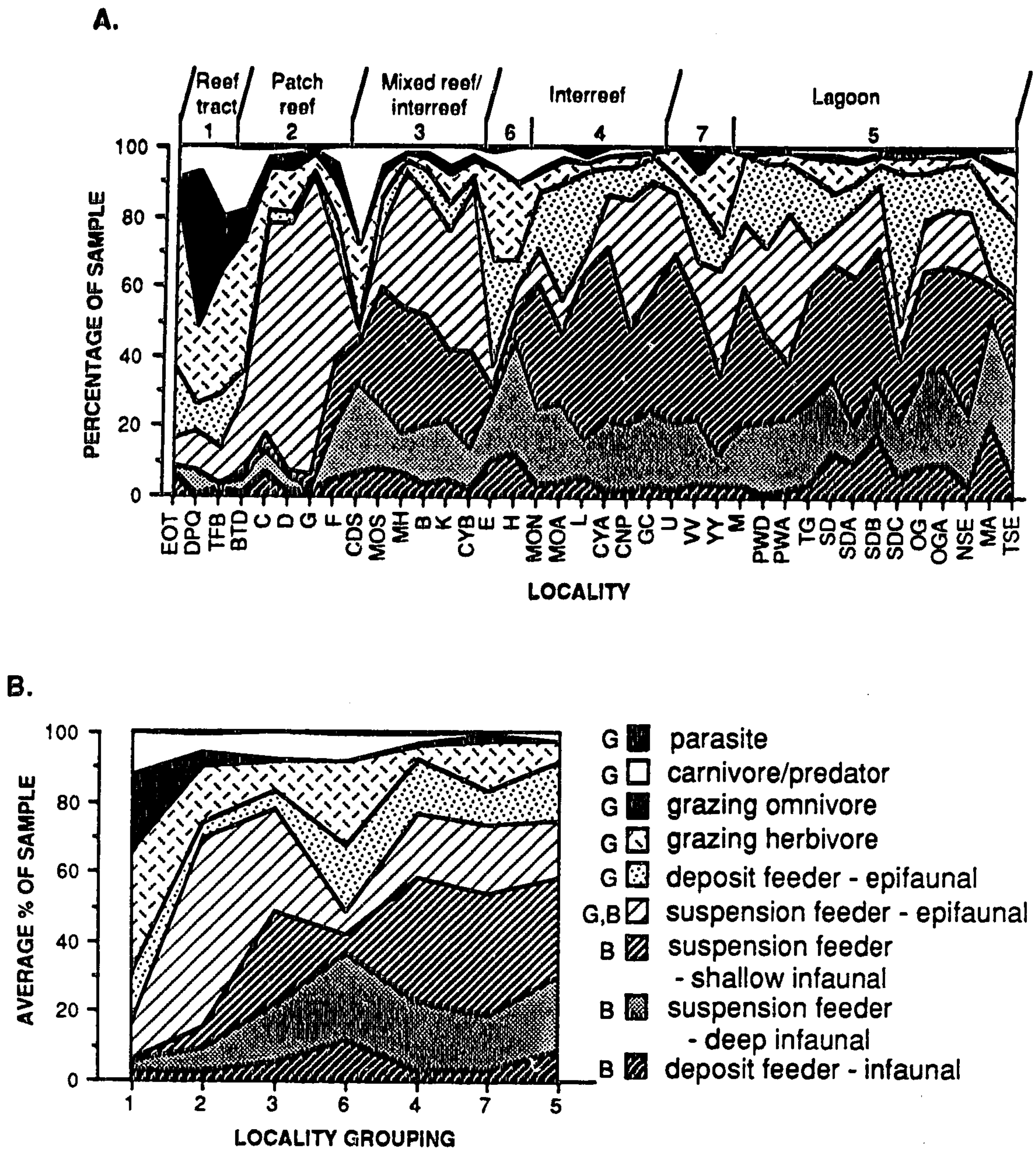


Figure V-3. Feeding types for molluscs in the Ironshore Formation: A. by locality (ordered west to east, by locality groupings from table IV-3), B. by locality grouping (average percentage). G = gastropods; B = bivalves.

infaunal suspension feeders, reflecting the reduced availability of epifaunal niches relative to infaunal niches in the interreef and lagoon environments. Shallow infaunal suspension feeders are the most abundant group, with epifaunal and deep infaunal suspension feeders equally but less abundant.

Infaunal deposit feeders are rare throughout the Ironshore Formation, although slightly more common in locality groupings 5 and 6 (lagoon and interreef, Figure V-3). The abundance of infaunal deposit feeders may be deceptive, as deposit feeding nuculids, tellinids and semelids are opportunistic, becoming suspension feeders when warranted by the availability of food (Cadée, 1984; Russell-Hunter and Tashiro, 1985). Infaunal deposit feeders are generally associated with fine grained organic-rich sediments in low energy environments (Sanders, 1968; Driscoll and Brandon, 1973), although they can thrive in high energy sandy environments as well if they are sufficiently mobile (Yonge and Thompson, 1976). However, in low energy organic-rich sediments deposit feeders are typically dominant (Sanders, 1968; Rhoads and Young, 1970). The abundance of infaunal deposit feeders, almost all of which are deep infaunal bivalves, increases with the abundance of deep infaunal suspension feeders (Figure V-3). This, and the opportunistic feeding style of bivalve deposit feeders, suggests that the principle control on the abundance of infaunal deposit feeders is the availability of deep infaunal niches, not the availability of organic rich sediments.

Life habits of molluscs

Another potentially useful way of describing the structure of a community is by the life modes of the organisms present. Because most molluscs are benthic animals, their life habits reflect the nature of the physical environment. Description of associations by means of organism life habits may facilitate comparisons between groups of associations containing faunas that are different but with similar types of organisms (e.g. mollusc associations in different time periods or in different parts of the globe).

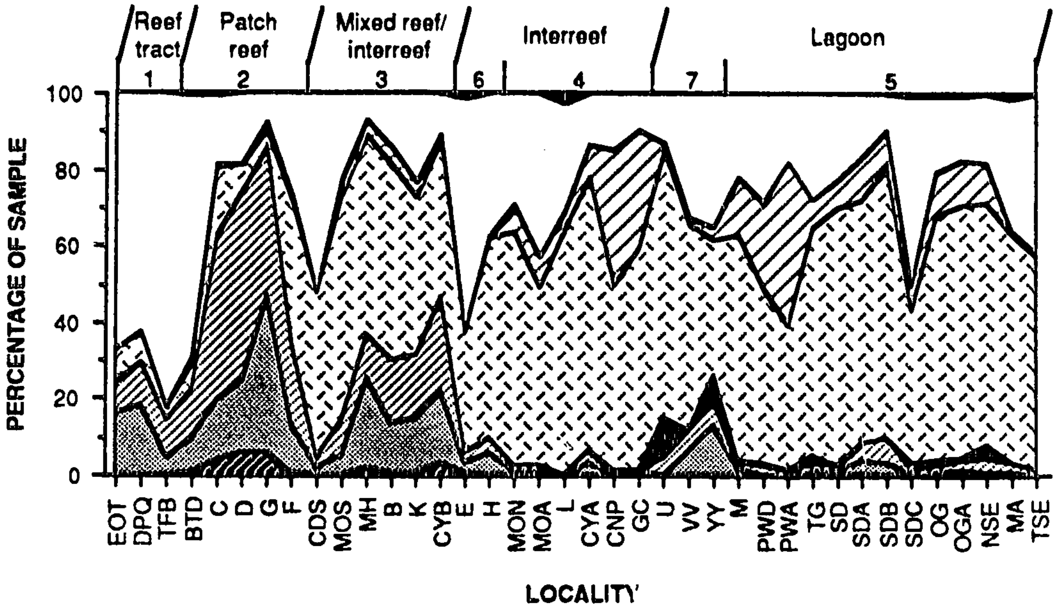
The life modes of bivalves are well known from studies of modern species (e.g. Allen, 1958; Ansell, 1961; Nicol, 1983; Seilacher, 1984; Stanley, 1970, 1972, 1977, 1981; Tevesz, 1975; Thayer, 1972; Yonge, 1949, 1962, 1967, 1969). Bivalves are primarily sedentary benthic animals. Infaunal modes of life include burrowing and boring, whereas epifaunal modes include reclining, cementing, nestling, and epibyssate life habits. Some bivalves can swim, although their primary mode of life is usually reclining or living attached by a byssus. Most bivalves are burrowers (Stanley, 1970; Yonge and Thompson, 1976). Included with burrowers are bivalves which burrow but stabilize their shells with a byssus (endobyssate, e.g. *Anadara*; Stanley, 1970).

The life mode of the bivalves depends on the nature of the substrate. Burrowers require soft substrates whereas borers require hard substrates. Cementers and nestlers also require hard substrates to attach themselves to or to find crevices for nestling. Byssate bivalves may attach themselves to either hard or soft substrates. Reclining bivalves simply rest on the surface, and prefer soft substrates (Stanley, 1970). Most gastropods are free living, but a few cement themselves to the substrate (e.g. *Hipponix*, Yonge and Thompson, 1976) or live symbiotically within a host (e.g. *Epitonium*, Robertson, 1980).

Molluscs from the Ironshore Formation exhibit all of the above life habits (Table V-1). In addition, one species (*Crassinella martinicensis*, Crassitellidae) crawled along the substrate surface whereas another (*Dendostrea frons*, Ostreidae) attached itself to the stalks of gorgonians (Abbott, 1974).

Molluscs in locality grouping 1 (associations V and VI) are predominantly free-living gastropods (Figure V-4). Cementing and byssate molluscs are also

A.



B.

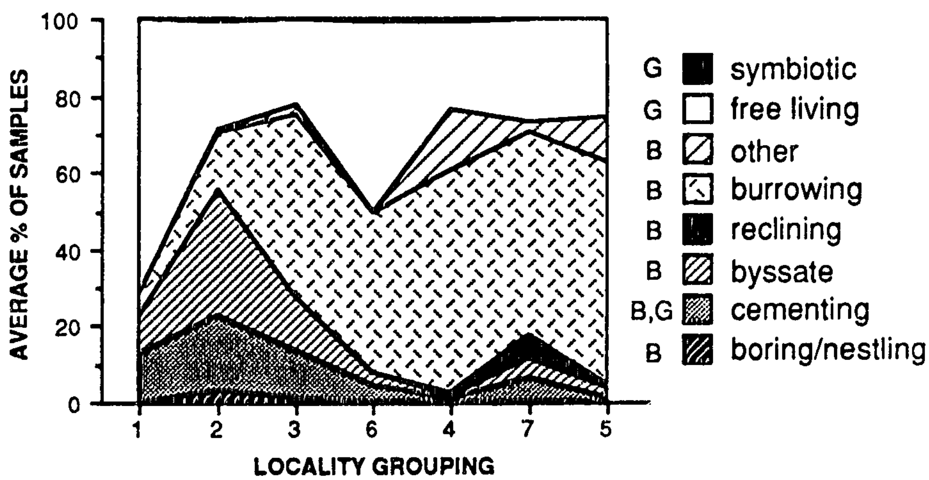


Figure V-4. Life habits of bivalves in the Ironshore Formation. A. by locality (ordered west to east, by locality groupings from table IV-3). B. by locality grouping (average percentage). G = gastropods; B = bivalves.

abundant (up to 30% combined), reflecting the abundance of hard substrates. Boring molluscs are absent. Burrowing molluscs are much less important than elsewhere, indicating the paucity of soft sediment substrates in the reef tract.

Molluscs in locality grouping 2 (associations V and VII) are primarily byssate (10 to 40%) and cementing (10 to 50%) in nature (Figure V-4). Boring and nestling bivalves are more common here than elsewhere, forming up to 5.8% (at locality D) of the total collected mollusc fauna. Only one boring bivalve was found at locality BTD (reef tract) and none were found at the reef tract localities in locality grouping 1. Jones and Pemberton (1988, Jones, pers. comm.) found boring bivalves to be common in the patch reefs, but notably absent from the reef tract. Burrowing bivalves are present but unimportant (highest value is 12.9% at locality C).

Molluscs in locality grouping 3 (associations I, IV, and V) reflect the presence of species from both major species groups, with up to about 20% each of byssate and cementing molluscs, and lesser numbers (0 to 3%) of nestling and boring species (Figure V-4). Burrowing bivalves form about half of the fauna. This association is clearly a mix of reef and lagoonal species.

Locality groupings 4, 5, 6, and 7 (associations I, II, III, and IV) are dominated by burrowing bivalves (40 to 70%), with lesser numbers (0 to 10%) of cementing and byssate species (Figure V-4). These associations are also characterized by numerous specimens of the crawling bivalve *Crassinella martinicensis*. Reclining species form up to 10.9% of the fauna (locality U) in locality grouping 7.

Free living gastropods are present in locality groupings 2 to 7, but generally less important than other life habit groups (Figure V-4). Symbiotic gastropods are rare everywhere.

Synopsis

1. Most localities are characterized by a fauna with more bivalve than gastropod species. However, localities in locality grouping 1, plus one locality in each of locality groupings 2 and 3, have more gastropod than bivalve species. These localities are all from facies E, the reef tract.
2. Localities in locality groupings 1 and 2 are characterized by a fauna with variable richness; generally high dominance; high numbers of deposit feeders and epifaunal suspension feeders relative to infaunal suspension feeders; and a bivalve fauna dominated by cementing and epibyssate species, with some nestlers, borers and burrowers. Locality grouping 1 is characterized by high numbers of grazing herbivorous and omnivorous gastropods.
3. Localities in locality grouping 4 are characterized by a fauna with variable richness and dominance; low numbers of deposit feeders relative to suspension feeders; abundant suspension feeders at all three tiers; and a fauna dominated by burrowing bivalves.
4. Locality grouping 6 is characterized by intermediate dominance and richness; a high percentage of gastropods; and a bivalve fauna dominated by burrowing species. Deposit feeders and deep infaunal suspension feeders are the dominant infaunal feeding groups.
5. Locality grouping 3 is characterized by species from both major species groups (reef and lagoonal). This is reflected by high richness, low dominance, and significant numbers of both burrowers and cementing and epibyssate bivalves. Epifaunal suspension feeders are equal in abundance to infaunal suspension feeders. There are few deposit feeders relative to the number of suspension feeders.

6. Localities in locality grouping 5 are characterized by a fauna with high richness and low dominance, even throughout most of its distribution. The fauna is dominated by burrowing bivalves. The dominant feeding types are epifaunal deposit feeders, deep infaunal suspension feeders, shallow infaunal suspension feeders, and epifaunal suspension feeders.
7. The faunas of the three western localities in locality grouping 5 (associations I, III, and IV) resemble the fauna in locality grouping 4 (association I) in richness and dominance. Locality BTD (locality grouping 2) is intermediate in structure to localities in locality groupings 1 and 2. Locality CDS (locality grouping 3) is intermediate in structure between locality groupings 1 and 3. Similarly, locality F is intermediate between locality groupings 2 and 3. The faunas at these localities emphasize the transitional nature of locality grouping boundaries.

VI. DISCUSSION

Factors controlling distribution of fauna

The distribution of the mollusc fauna in the Ironshore Formation appears to be primarily controlled by the nature of the substrate. There is a strong correlation between physical environment, substrate type, and the composition of the fauna (Table IV-2, Figure VI-1).

The distribution of hard and soft substrates in the Ironshore Lagoon appears to be the single most important controlling factor in the distribution of species. Most of the Ironshore Lagoon was floored by carbonate sand, suitable for infaunal organisms, whereas coral reefs in the outer parts of the Lagoon provided a hard substrate with many epifaunal niches. The two species groups, 1 (associations I, II, III, and IV), and 2 (associations V, VI, and VII), are associated with soft and hard substrates respectively. Among the bivalves, most of those in group 1 were adapted to burrowing in soft substrates, whereas most species in group 2 are epifaunal (epibyssate or cementing) or infaunal in hard substrates (nestling or boring). Gastropods (many of which are epifaunal grazers or predators, Purchon, 1977) were most common in the reef tract (group 2).

Variations in the grain size of the soft-bottom sediments was probably also a factor in the distribution of molluscs. Molluscs in locality groupings 4 and 6 (species associations I and II) are associated with the coarser sands in the interreef environment whereas those in locality groupings 5 and 7 (associations I, III, and IV) occurred in the finer grained sands of the main lagoon. Species association I occured in both environments, whereas association III was limited to the lagoon. Coarser grained sediments in the interreef environment may

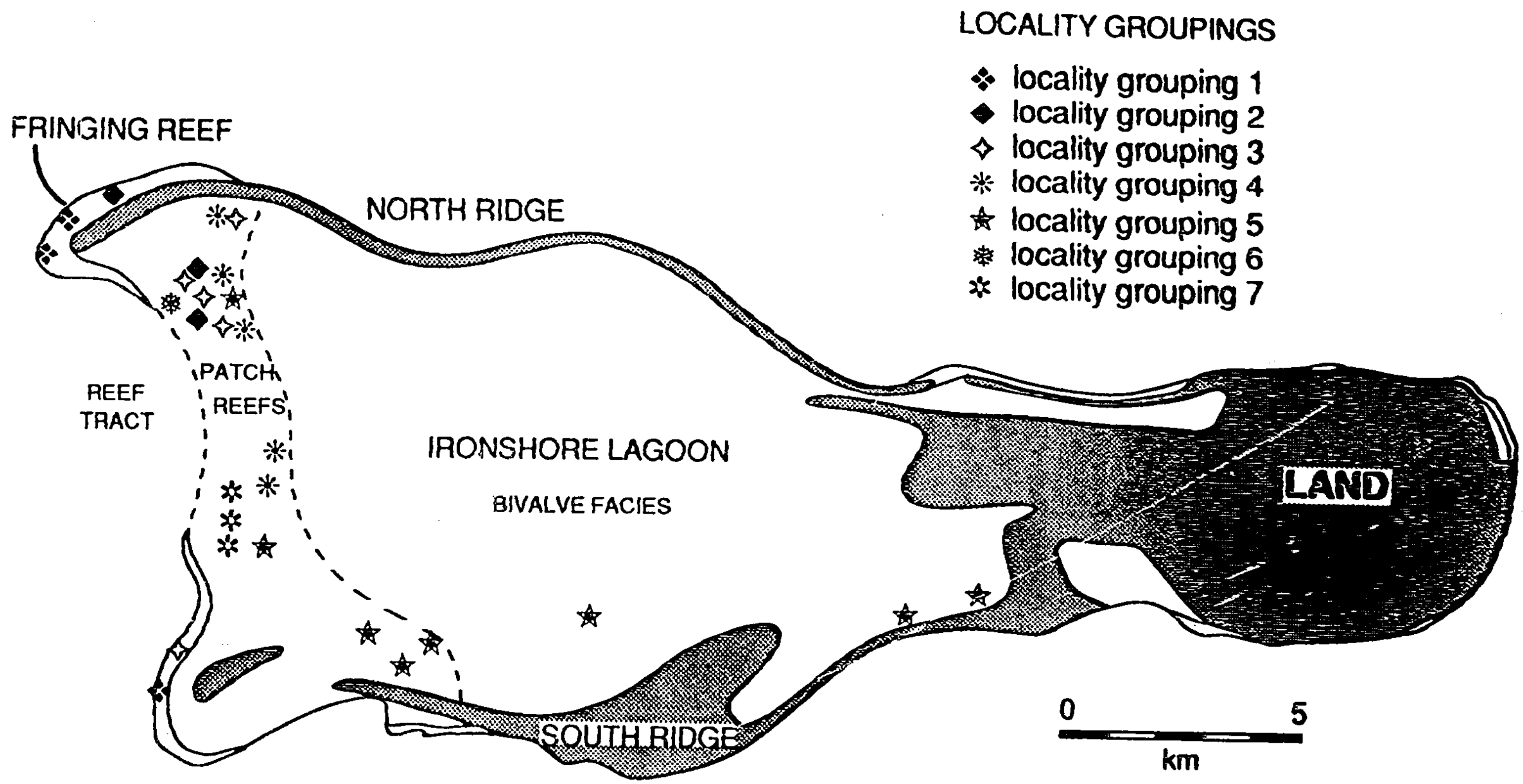


Figure VI-1. Distribution of locality groupings (Table IV-3) in relation to the paleogeography of the Ironshore Lagoon. Base map after unpublished map by I. G. Hunter.

have been responsible for low numbers of species from association III in that environment.

The difference in distribution of associations I and III may also be due to water circulation in the Ironshore Lagoon. Poorer circulation in the interior of the Ironshore Lagoon may have been preferred by species in association III. Decreased circulation may decrease the amount of nutrients available in the water column, and increase the amount of detritus available on the substrate surface. However, circulation would still have been good at most of the localities in the interior of the lagoon, as indicated by the presence of corals (Hunter, pers. comm.).

Salinity appears to have been normal marine at the localities PWD, OG, SD, SDA, SDB, SDC, NSE, and TSE in the eastern part of the Ironshore Lagoon, as indicated by the presence of salinity-sensitive corals (Hunter, pers. comm.). Salinity may have been high, low, or variable in other parts of the lagoon, as it is today in North Sound (Rigby and Roberts, 1976), or it may have been normal.

Boundaries between the associations appear to be gradational. Many species are present in low numbers throughout the lagoon, but only common in one or two locality groupings. The mixing between patch reef and interreef environments is considerable, as there are many locations with the distinctive species of both environments. This is probably due to both mixing of deposits during excavations, and collection of samples over areas containing both environments. Even when mixed deposits are not collected, compositional differences will probably not be absolute, because pockets of soft sediment are always possible in hard substrate environments, as are small hard substrates in soft-bottom areas.

Comparison with the modern fauna of Grand Cayman

The fauna of the Ironshore Lagoon is similar in composition to the modern fauna described by Abbott (1958). Most of the species present in the Pleistocene are still present today. There are a few notable exceptions. Species not yet recorded from the modern fauna of Grand Cayman include *Chione paphia, Dendostrea frons, Leporimetis intastriata* and most of the Chamacea.

Abbott (1958) listed 293 species from the modern fauna of Grand Cayman. He divided these into eleven groups (Table VI-1) based on their physical environments, which differ in substrate type, energy levels, salinity (e.g. normal for circuminsular, low for North Sound) and vegetation (e.g. presence of mangroves). Abbott's reef fauna corresponds well to associations V, VI, and VII of the Ironshore Formation fauna (Table VI-1). The modern circuminsular fauna corresponds somewhat to associations I and II of the Pleistocene fauna. Abbott's ubiquitous and North Sound species groups are both similar to association III of the Pleistocene fauna. There is no direct correlation between the modern North Sound fauna and the Pleistocene lagoon fauna (association IV), as might be expected, because species now exclusive to North Sound occurred throughout the Pleistocene Ironshore Lagoon, not just in the bivalve facies, as did species in the modern circuminsular group. The conditions in North Sound today do not appear to duplicate the conditions in the interior of the Ironshore Lagoon. Where molluscs were sampled in the Ironshore Lagoon, sediments were primarily sand-sized, and salinities were commonly normal marine (indicated by the presence of corals: Hunter, pers. comm.). Much of North Sound, on the other hand, has muddy substrates (Roberts, 1971) and variable salinity, because waters are shallow and susceptible to evaporation and flooding by rain water (Rigby and Roberts, 1976).

Table VI-1. Comparison of Pleistocene mollusc associations in this study with associations of modern molluscs of Grand Cayman, as described by Abbott (1958).

THIS STUDY DOMINANT SPECIES	ABBOTT'S (1958) STUDY ECOLOGICAL DISTRIBUTION	ABBOTT'S (1958) STUDY COMMONEST MOLLUSCS
Association I ***Americardia guppyi*** ***Cerithium eburneum*** ***Cerithium litteratum*** ***Chione cancellata*** ***Chione paphia*** ***Codakia costata*** ***Crassinella martinicensis*** ***Linga pensylvanica*** ***Pitar fulminatus*** *Cerithium lutosum* *Ervilia concentrica* *Tricolia thalassicola*	Circum-insular soft-bottom fauna: (everywhere but North Sound) *Acmaea pustulata* *Alaba incerta* *Americardia guppyi* *Atys caribaea* *Barbatia cancellaria* *Chione pygmaea* *Conus jaspideus* *Divaricella quadrisulcata* *Ervilia concentrica* *Hyalina tenuilabra* *Lucina pensylvanica* *Mangelia bartletti* *Mangelia biconica* *Mangelia quadrilineata* *Mitrella fenestrata* *Natica livida* *Prunum guttatum* *Psarostola monilifera* *Pyramidella dolobrata* *Retusa canaliculata* *Rissoina cancellata* *Seila adamsi* *Smaragdia viridis* *Strigilla mirabilis* *Synaptocochlea picta* *Tellina candeana* *Tellina cuneata* *Tellina listeri* *Tellina radiata* *Tellina similis* *Terebra hastata* *Transennella gerrardi* *Turbo castanea*	Ocean-Facing Lagoons: *Bulla occidentalis* *Cerithium eburneum* *Cerithium litteratum* *Chione cancellata* *Columbella mercatoria* *Conus jaspideus* *Divaricella quadrisulcata* *Nassarius albus* *Olivella dealbata* *Rissoina bryerea* *Tellina candeana* *Tellina listeri* *Tellina similis*
Association II ***Bulla striata*** ***Leporimetis intastriata*** *Olivella sp. A* *Polinices lacteus* *Tellina radiata* *Tellina similis*		
Association IV *Atys sp.* *Nassarius albus*		
Association III ***Anodontia alba*** ***Cerithium eburnem algicola*** ***Codakia orbicularis*** ***Codakia pectinella*** ***Gouldia cerina*** ***Laevicardium laevigatum*** ***Tellina sybaritica*** *Americardia media* *Anadara floridana* *Argopecten nucleus* *Codakia orbiculata* *Divaricella quadrisulcata* *Modulus modulus* *Periglypta listeri* *Semele proficua* *Strigilla mirabilis* *Tellina candeana* *Zebina browniana*	Exclusively North Sound Species *Anadara notabilis* *Anodontia alba* *Aquipecten gibbus nucleus* *Astraea phoebia* *Bittium varium* *Crassispira leucocyma* *Haminoea petiti* *Lyropecten antillarum* *Modiolus americanus* *Musculus lateralis* *Pitar fulminata* *Prunum apicinum* *Pusia hanleyi* *Tellina guadeloupensis*	North Sound: *Astraea phoebia* *Bulla occidentalis* *Carithium eburneum* *Codakia costata* *Codakia orbiculata* *Columbella mercatoria* *Lyropecten antillarum* *Modulus modulus* *Nassarius albus* *Olivella dealbata* *Pitar fulminata* *Rissoina bryerea*

Table VI-1 (cont'd.). Comparison of Pleistocene mollusc associations in this study with associations of modern molluscs of Grand Cayman, as described by Abbott (1958).

<table>
<tr><th>THIS STUDY
DOMINANT SPECIES</th><th>ABBOTT'S (1958) STUDY
ECOLOGICAL DISTRIBUTION</th><th>ABBOTT'S (1958) STUDY
COMMONEST MOLLUSCS</th></tr>
<tr><td>Association V
Arca imbricata
Barbatia cancellaria
Barbatia domingensis
Chama macerophylla
Anachis hotessieriana?
Chama congregata
Chama sp.
Dendostrea frons
Diodora listeri
Diplodonta punctata
Gregariella coralliophaga
Hipponix antiquatus
Pseudochama radians variegata
Transennella gerrardi</td><td rowspan="2">Reef Fauna:
Acmaea jamaicensis
Astraea caelata
Astraea tecta cubana
Barbatia cancellaria
Barbatia domingensis
Bursa cubaniana
Cantharus auritulus
Chlamys ornata
Conus mus
Conus regius
Coralliophila abbreviata
Cyphoma gibbosum
Cypraea cinerea
Diodora listeri
Diodora minuta
Drupa nodulosa
Engina turbinella
Hemitoma octoradiata
Hipponix antiquatus
Hyalina avena
Leucozonia leucozonalis
Lima lima
Lucapina suffusa
Mitra barbadensis
Mitra nodulosa
Pisania pusio
Prunum guttatum
Tegula lividomaculata</td><td rowspan="3">Reef Flats:
Acmaea jamaicensis
Astraea caelata
Barbatia cancellaria
Barbatia domingensis
Chlamys ornata
Conus mus
Diodora listeri
Drupa nodulosa
Hemitoma octoradiata
Hipponix antiquatus
Leucozonia nassa leucozonalis</td></tr>
<tr><td>Association VI
Columbella mercatoria
Leucozonia nassa leucozonalis
Lithopoma tectum
Patelloida pustulata
Cymatium pileare
Cyphoma gibbosum
Cypraea sp. B
Latirus carinifer
Lucapina suffusa</td></tr>
<tr><td>Association VII
Barbatia candida
Cumingia coarctata
Diodora minuta</td><td></td></tr>
</table>

Table VI-1 (cont'd.). Comparison of Pleistocene mollusc associations in this study with associations of modern molluscs of Grand Cayman, as described by Abbott (1958).

ABBOTT'S (1958) STUDY ECOLOGICAL DISTRIBUTION	ABBOTT'S (1958) STUDY ECOLOGICAL DISTRIBUTION	ABBOTT'S (1958) STUDY ECOLOGICAL DISTRIBUTION
Ubiquitous: *Acmaea pustulata* *Anachis hotessieriana* *Arcopsis adamsi* *Bulla occidentalis* *Cerithium litteratum* *Chione cancellata* *Codakia costata* *Codakia orbicularis* *Codakia orbiculata* *Columbella mercatoria* *Cumingia coarctata* *Diplodonta punctata* *Diplodonta semiaspera* *Glycymeris pectinata* *Gouldia cerina* *Laevicardium laevigatum* *Modulus modulus* *Nassarius albus* *Olivella dealbata* *Pinctada radiata* *Prunum pruniosum* *Rissoina bryerea* *Tegula fasciata* *Tricolia thalassicola* *Zebina browniana*	Offshore West End Fauna: *Americardia guppyi* *Atys caribaea* *Atys riiseana* *Conus jaspideus (smooth form)* *Divaricella quadrisulcata* *Laevicardium lavigatum* *Nassarius albus* *Natica livida* *Olivella dealbata* *Polinices lacteus* *Prunum pruniosum* *Sigatica semisulcata* *Strigilla mirabilis* *Tellina cuneata* *Tellina listeri* *Tellina radiata* North Sound and Frank Sound : *Crassinella guadeloupensis* *Diodora dysoni* Mangrove Fauna: *Batillaria minima* *Cerithidea costata* *Cerithium variabile* *Isognomon alatus* *Littorina angulifera* *Neritina virginea* Pelagic Fauna: *Janthina exigua* *Janthina janthina* *Litiopa melanostoma* *Spirula spirula* *Styliola subulata*	Upper Zone of Coastline: (above high tide; within reach of spray) Gastropods: *Puperita pupa* *Littorina mespillum* *Tectarius muricatus* *Echininus nodulosus* Middle Zone of Coastline: (upper intertidal) Gastropods: *Nerita peloronta* *Nerita versicolor* *Littorina ziczac* *Nodolittorina tuberculata* Lower Zone of Coastline: (always wet) Gastropods: *Fissurella barbadensis* *Fissurella angusta* *Nerita tessellata* *Livona pica* *Planaxis lineatus* *Purpura patula* *Thais rustica* *Thais deltoidea*

Comparison with other areas

Thorson (1957) introduced the concept of parallel communities after finding parallels between modern benthic associations from different areas in cold and temperate waters, where distribution of organisms are controlled by the physical environment and sediments are terrigenous. These "communities" are typically defined on the basis of a few dominant macrobenthic species, with different species of the same genus occurring in associations that parallel each other in composition. McNulty *et al.* (1962) described modern associations paralleling those described by Thorson (1957) for a temperate fauna off the coast of Florida. Boucot (1975) introduced the term Benthic Assemblage to describe a series of parallel associations of marine organisms occurring in the same positions relative to shoreline in Paleozoic deposits. The parallel community concept is useful for correlating similar associations in similar environments in different areas and of different ages. However, tropical faunas are considerably more diverse than temperate ones, and do not readily fit within the parallel community scheme (Newell *et al.*, 1959). The associations described in this study do not correspond to the associations described by Thorson (1957) and McNulty *et al.* (1962). The dominant genera are generally different, and there are many more dominant species in the associations in this study than in the parallel communities. The environments examined by Thorson (1957) and McNulty *et al.* (1962) were limited to soft level bottoms, whereas the physical environments in this study include reefs. It should also be noted that these studies examined the entire macrofauna present, whereas the present study examined only bivalve and gastropod molluscs, because most other organisms were not preserved.

Other studies (Hoskins, 1964; Turney and Perkins, 1972) described modern tropical faunas where the distribution of species is controlled by changes in salinity and sediment type over the area of a restricted body of water. The physical environment in both Florida Bay (Turney and Perkins, 1972) and the Gulf of Batabano, Cuba (Hoskins, 1964) varies from good water circulation, sandy sediments, and normal marine salinity in the open parts of the bays, to restricted circulation, muddy sediments and variable salinities above or below normal marine levels in the interior. The range in composition of associations present at both localities reflects the wide range in physical conditions, because significantly different faunas occur in the different environments. The Ironshore Lagoon was also an enclosed body of water, but does not exhibit the same wide range in physical conditions like Florida Bay and the Gulf of Batabano. Consequently, the soft bottom fauna does not vary to the extent that it does in these other environments. Turney and Perkins' (1972) Atlantic subenvironment fauna is similar to that of locality grouping 5 of this study. Hoskins' (1964) *Tellina candeana - Ervilia nitens* subassemblage (high energy environment with shifting sands) resembles assemblage I of this study. In both cases, physical environments are similar in the two settings (sandy sediment, good water circulation). None of the other assemblages in either study correlate with assemblages in this study. One difference between Florida Bay and the Gulf of Batabano and the Ironshore Lagoon is the absence of muddy sediments in the Ironshore lagoon. Another difference is the absence of a reef fauna in the two modern studies. There are no reefs in Florida Bay (Turney and Perkins, 1972), and the reefs in the Gulf of Batabano were not sampled in Hoskins' (1964) study.

Newell *et al.* (1959) found a strong correlation between the distributions of modern bottom facies and organism associations on Great Bahama Bank. Bottom types include hard substrates and a variety of soft substrates, from mud to stable sand to unstable sand and oolites. Benthic associations were strongly controlled by the nature of the substrate. The distribution of both bottom facies and organism associations was controlled by waves and currents. The organism associations of Newell *et al.* (1959) included the entire benthic macrofauna, but it is still possible to see resemblances between some of their associations and the associations present in the Ironshore lagoon. The rock bottom associations of Newell *et al.* (1959), particularly the *Millepora* community, resemble this study's associations V and VI, while their *Strombus costatus* and *Strombus samba* associations (stable and unstable sands respectively) resemble this study's associations I and III together. It appears that the limiting factors in the distribution of molluscs in both studies are essentially the same: the nature of the substrate, which is controlled by wave and current energy.

VII. CONCLUSIONS

1. Eighty-three marine bivalve and 90 marine gastropod species are present in the Ironshore Formation.
2. The mollusc fauna was not significantly affected by post-mortem transportation. However, the collected fauna is time-averaged, and large species are probably overrepresented.
3. The mollusc fauna occurs in seven species associations in two species groups. Seven locality groupings are defined on the basis of the associations they contain. Species group 1 (associations I, II, III, and IV) consists of lagoonal species, whereas species group 2 (associations V, VI, and VII) consists of reef species. Association I, dominated by the species *Americardia guppyi*, *Cerithium spp.*, *Chione spp.*, *Codakia costata*, *Crassinella martinicensis*, *Linga pensylvanica*, and *Pitar fulminatus*, occurred in the interreef environment (facies D, locality grouping 4), as did association II, characterized by *Bulla striata* and *Leporimetis intastriata* (facies C/D, D, locality grouping 6). Association III, characterized by *Anodontia alba*, *Cerithium spp.*, *Chione spp.*, *Codakia spp.*, *Gouldia cerina*, *Laevicardium laevigatum*, and *Tellina sybaritica,* occurred in the lagoon environment (facies A and B, locality grouping 5) together with associations I and IV (*Atys sp.* and *Nassarius albus*). Locality grouping 7 included species from associations I, III, and IV. Association V, consisting of epifaunal bivalves (primarily arcids and chamids), occurred with association VII (*Barbatia candida*, *Cumingia coarctata*, and *Diodora minuta*) in reef environments (facies C and E, locality grouping 2), and with association I in mixed reef/interreef deposits (facies C/D, locality grouping 3). Association VI, with

large numbers of gastropod species, occurred with association V in reef tract localities (facies E, locality grouping 1).

4. Distribution of the mollusc fauna was controlled primarily by the nature of the substrate. Substrate types included hard substrate, and medium and coarse grained carbonate sand substrates. Species group 1 occurred on soft sediment substrates, whereas species group 2 lived in hard substrate environments.
5. Gastropod carnivores, omnivores and herbivores dominate the reef tract fauna. Epifaunal suspension feeders, most of which are bivalves, dominate the patch reefs. Interreef and lagoonal localities are dominated by shallow and deep infaunal suspension feeders, with lesser amounts of epifaunal suspension feeders. Epifaunal gastropod deposit feeders are abundant in the reef tract, suggesting that samples were from sheltered parts of the reefs, and at interreef and lagoonal localities. Infaunal bivalve deposit feeders occur with deep infaunal suspension feeders. Parasitic gastropods are rare.
6. Life habits of the bivalve molluscs reflect the nature of the substrate. Cementing, epibyssate, boring and nestling species are more common on hard substrates. Conversely, burrowing and reclining species are more common on sandy substrates. Gastropods, most of which are free living, are most abundant in and near the reef tract.

VIII. PLATES

Plates I to IV include single views of all species included in cluster analysis, and multiple views of all Chamacea from the Ironshore Formation.

"coated" refers to shells coated with aluminum chloride.

UA = University of Alberta collection index number.

PLATE I

BIVALVIA

Superfamily Arcacea

1. *Anadara floridana*, right valve, locality SDC, UA 7952, X1, coated.
2. *Arca imbricata*, right valve, locality OG, UA 7953, X1, coated.
3. *Barbatia candida*, right valve, locality F, UA 7954, X1, coated.
4. *Barbatia cancellaria*, right valve, locality B, UA 7955, X1, coated.
5. *Barbatia domingensis*, right valve, locality B, UA 7956, X1.5, coated

Superfamily Mytilacea

6. *Gregariella coralliophaga*, left valve, locality C, UA 7957, X3, coated.

Superfamily Crassatellacea

7. *Crassinella martinicensis*, left valve, locality NSE, UA 7958, X4, coated.

Superfamily Ostracea

8. *Dendostrea frons*, ventral view of both valves, locality SDB, UA7959, X1, uncoated.

Superfamily Pectinacea

9. *Argopecten nucleus*, left valve, locality SDC, UA 7960, X1, coated.

Superfamily Lucinacea

10. *Codakia orbicularis*, right valve, locality PWA, UA 7961, X1, coated.
11. *Codakia orbiculata*, right valve, locality MOA, UA 7962, X1.5, coated
12. *Linga pensylvanica*, right valve, locality SD, UA 7963, X1, coated.
13. *Diplodonta punctata*, left valve, locality TG, UA 7964, X1.5, coated.
14. *Divaricella quadrisulcata*, left valve, locality MA, UA 7965, X3, coated.
15. *Codakia costata*, left valve, locality CNP, UA 7966, X1.5, coated.
16. *Codakia pectinella*, left valve, locality SDA, UA 7967, X4, coated.
17. *Anodontia alba*, right valve, locality CNP, UA 7968, X1, coated.

Superfamily Chamacea

18. *Chama congregata*, left valve exterior, locality G, UA 7969, X1, coated.
19. *Chama congregata*, left valve interior, locality G, UA 7970, X1, uncoated.
20. *Chama congregata*, right valve interior, locality MH, UA 7971, X1, uncoated.
21. *Chama congregata*, right valve exterior, locality MH, UA 7971, X1, uncoated.
22. *Chama congregata*, right valve exterior, locality G, UA 7972, X1, coated.
23. *Chama macerophylla*, right valve exterior, locality K, UA 7973, X1, uncoated.
24. *Chama macerophylla*, right valve interior, locality K, UA 7973, X1, uncoated.

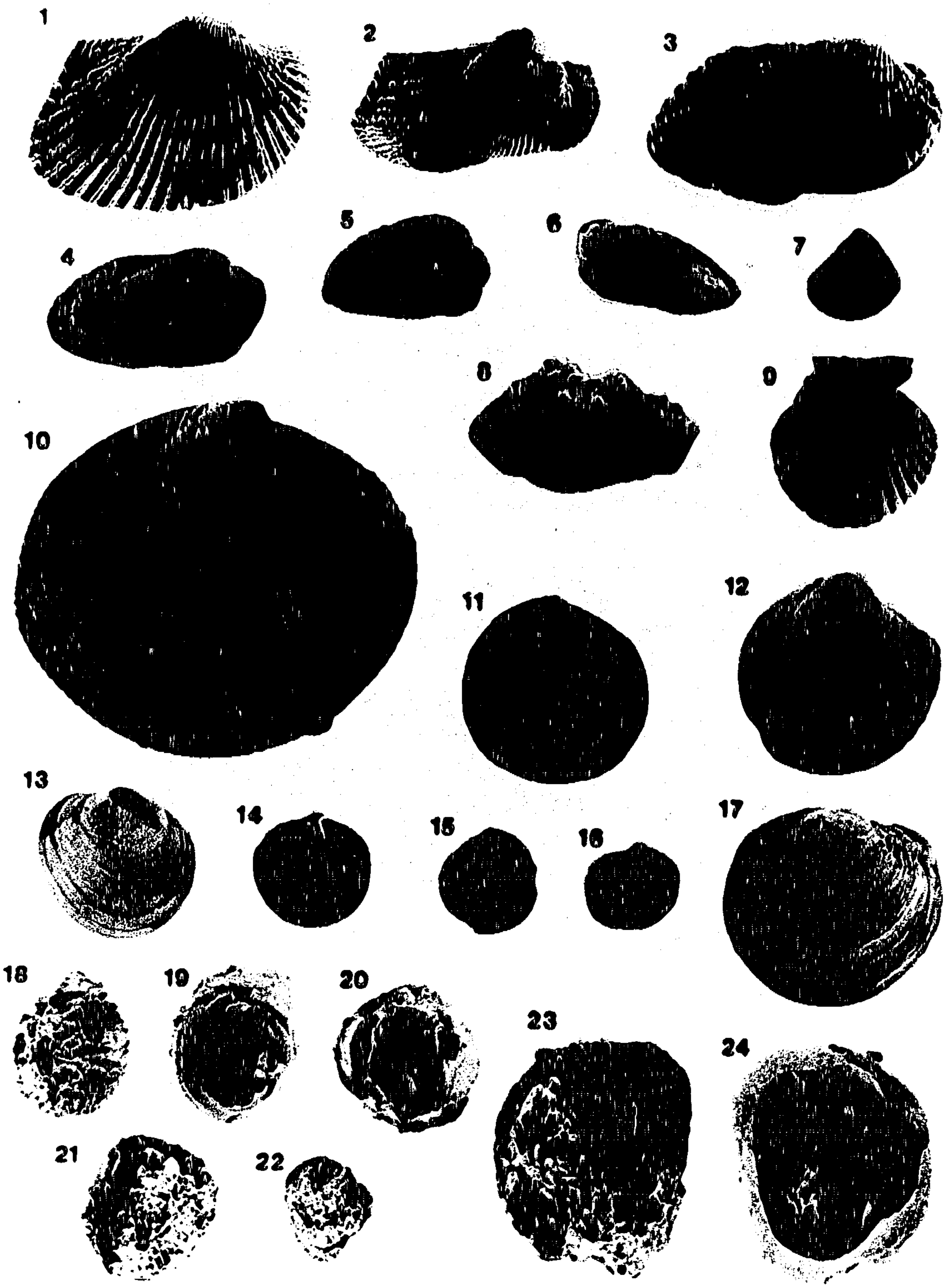


PLATE II

BIVALVIA

Superfamily Chamacea

1. *Chama macerophylla*, left valve interior, locality K, UA 7974, X1, uncoated.
2. *Chama macerophylla*, right valve interior, locality K, UA 7975, X1, uncoated.
3. *Chama macerophylla*, right valve exterior, locality K, UA 7975, X1, uncoated.
4. *Chama sinuosa*, right valve interior, locality B, UA 7976, X1, uncoated.
5. *Chama sinuosa*, right valve exterior, locality B, UA 7976, X1, uncoated.
6. *Chama sinuosa*, left valve interior, locality B, UA 7977, X1, uncoated.
7. *Pseudochama radians*, right valve exterior, locality OG, UA 7978, X1, uncoated.
8. *Pseudochama radians*, right valve interior, locality F, UA 7979, X1, uncoated.

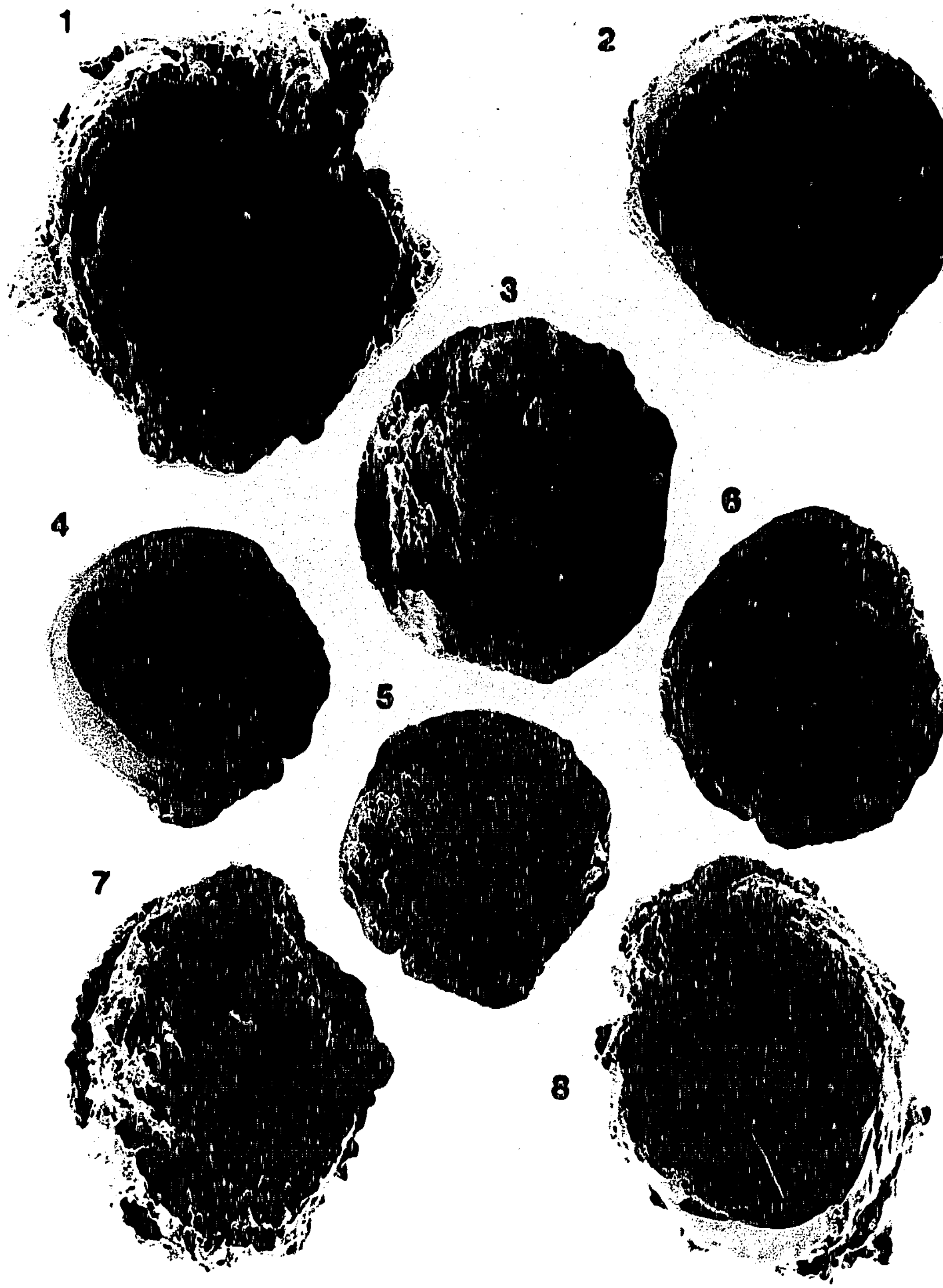

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PLATE III

BIVALVIA

Superfamily Chamacea

1. *Pseudochama radians variegata*, left valve interior, locality K, UA 7980, X1, uncoated.
2. *Pseudochama radians variegata*, left valve exterior, locality K, UA 7981, X1, coated.
3. *Pseudochama radians variegata*, left valve exterior, locality K, UA 7982, X1, coated.
4. *Pseudochama radians variegata*, right valve interior, locality K, UA 7983, X1, uncoated.
5. *Pseudochama radians variegata*, right valve exterior, locality K, UA 7984, X1, coated.

Superfamily Cardiacea

6. *Laevicardium laevigatum*, right valve, locality SD, UA 7985, X1, coated.
7. *Americardia media*, right valve, locality PWD, UA 7986, X1, coated.
8. *Americardia guppyi*, right valve, locality [illegible]G, UA 7987, X1.5, coated.

Superfamily Veneracea

9. *Periglypta listeri*, left valve, locality PWD, UA 7988, X1, coated.
10. *Chione cancellata*, right valve, locality CNP, UA 7989, X1, coated.
11. *Chione paphia*, left valve, locality SD, UA 7990, X1, coated.
12. *Transennella gerrardi*, right valve, locality MH, UA 7991, X3, coated.
13. *Pitar fulminatus*, right valve, locality OGA, UA 7992, X3, coated.
14. *Gouldia cerina*, left valve, locality NSE, UA 7993, X3, coated.

Superfamily Tellinacea

15. *Leporimetis intastriata*, right valve, locality TSE, UA 7994, X1, coated.
16. *Tellina similis*, right valve, locality MOS, UA 7995, X1.5, coated.
17. *Semele proficua,* right valve, locality SDB, UA 7996, X1, coated.
18. *Tellina sybaritica*, left valve, locality MOA, UA 7997, X3, coated.
19. *Tellina radiata*, right valve, locality MOS, UA 7998, X1, coated.
20. *Strigilla mirabilis*, right valve, locality MA, UA 7999, X3, coated.
21. *Cumingia coarctata*, right valve, locality K, UA 8000, X3, coated.
22. *Tellina candeana*, left valve, locality MOA, UA 8001, X3, coated.

Superfamily Mactracea

23. *Ervilia concentrica*, left valve, locality MOS, UA 8002, X4, coated.

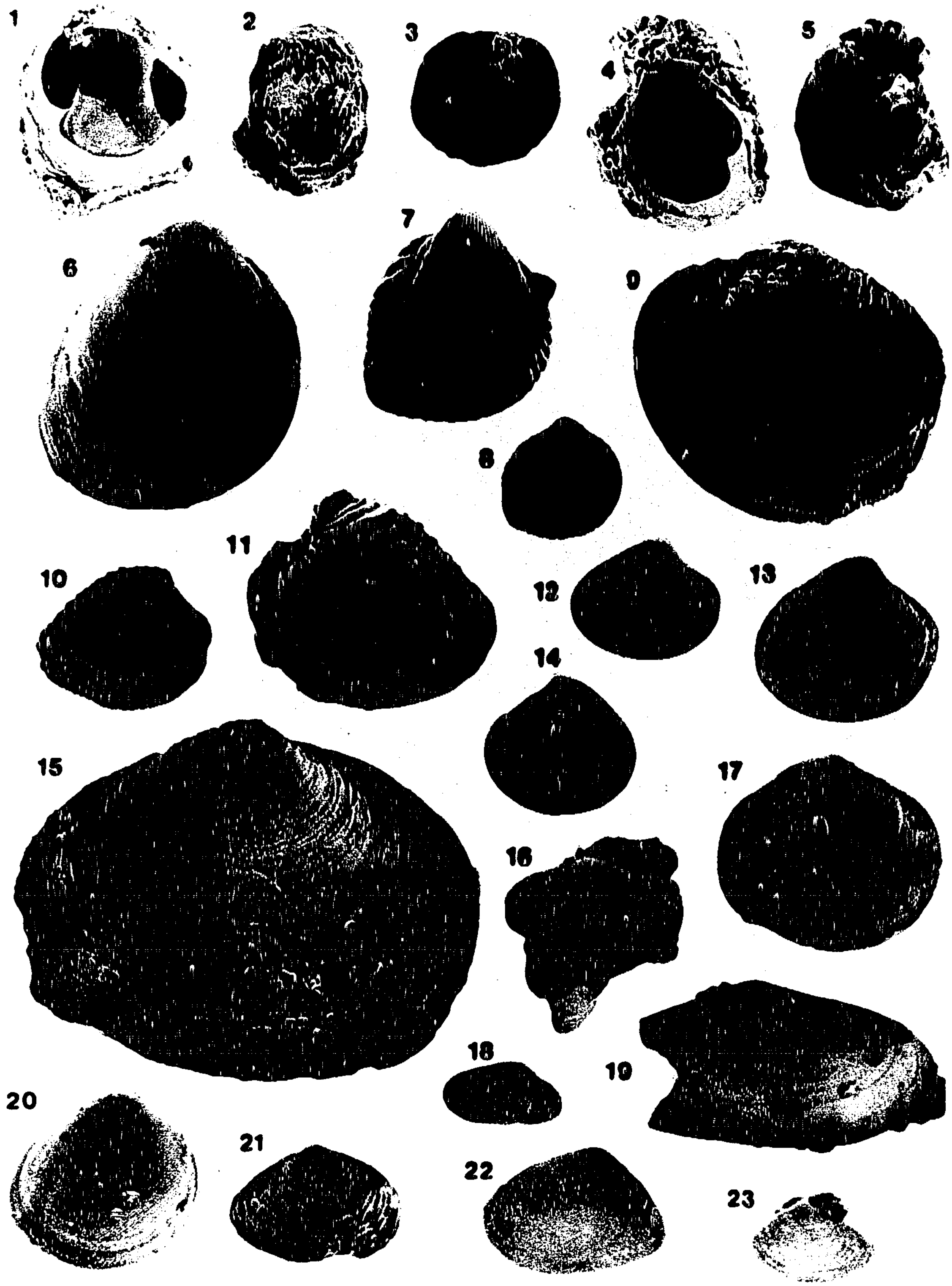
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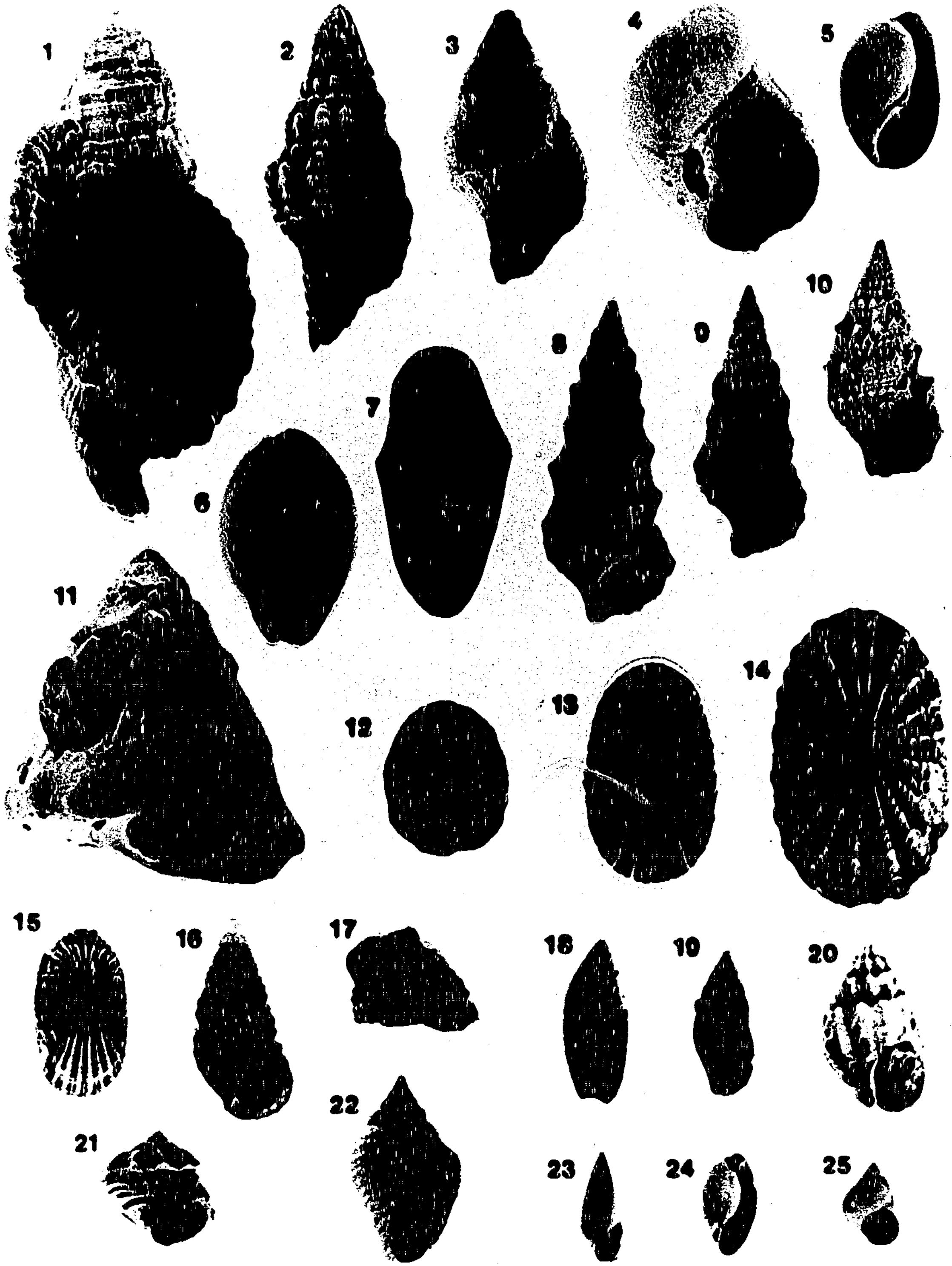
PLATE IV

GASTROPODA

1. *Cymatium pileare*, locality F, UA 8003, X1.5, uncoated.
2. *Latirus carinifer*, locality TFB, UA 8004, X1.5, coated.
3. *Leucozonia nassa leucozonalis*, locality TFB, UA 8005, X1.5, coated.
4. *Polinices lacteus*, locality SD, UA 8006, X1.5, coated.
5. *Bulla striata*, locality TSE, UA 8007, X1.5, coated.
6. *Cypraea sp. B*, locality TFB, UA 8008, X1.5, coated.
7. *Cyphoma gibbosum*, locality TFB, UA 8009, X1.5, coated.
8. *Cerithium eburneum algicola*, locality TSE, UA 8010, X1.5, coated.
9. *Cerithium eburneum*, locality TSE, UA 8011, X1.5, coated.
10. *Cerithium litteratum*, locality TSE, UA 8012, X1.5, coated.
11. *Lithopoma tectum*, locality C, UA 8013, X1.5, coated.
12. *Patelloida pustulata*, locality TFB, UA 8014, X1.5, coated.
13. *Lucapina suffusa*, locality C, UA 8015, X1.5, coated.
14. *Diodora listeri*, locality TFB, UA 8016, X1.5, coated.
15. *Diodora minuta*, locality C, UA 8017, X3, coated.
16. *Cerithium lutosum*, locality L, UA 8018, X3, uncoated.
17. *Hipponix antiquatus*, locality DPQ, UA 8019, X3, coated.
18. *Olivella sp. A*, locality TSE, UA 8020, X3, coated.
19. *Anachis hotessieriana?*, locality BTD, UA 8021, X3, coated.
20. *Nassarius albus*, locality BTD, UA 8022, X3, coated.
21. *Modulus modulus*, locality PWD, UA 8023, X2, coated.
22. *Columbella mercatoria*, locality TFB, UA 8024, X2, coated.
23. *Zebina browniana*, locality TG, UA 8025, X4, coated.
24. *Atys sp.*, locality SDB, UA 8026, X4, coated.
25. *Tricolia thalassicola*, locality SDA, UA 8027, X4, coated.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X. APPENDICES

Appendix I.

Localities sampled for molluscs on Grand Cayman, with locality name and exact location. UTM = Universal Transverse Mercator grid.

CODE	NAME	UTM - N	UTM - E
ABB	West Bay Coast	2141780	457110
ACB	West Bay Coast	2141800	456800
ACH	West Bay Coast	2141890	456100
B		2141040	459820
BTD	Birch Tree - D	2143960	457560
BTH	Birch Tree Hill	2143790	457210
C		2140550	459550
CDS	Cayman Diving School	2132680	459030
CNP	Canal Point	2137550	461450
CYA	Cayman Yacht Club - A	2140690	460210
CYB	Cayman Yacht Club - B	2140690	460620
D		2140450	459550
DPQ	Dolphin Point Quarry	2142040	455850
E		2141180	459020
EOT	Esso Oil Tanks	2132020	458720
F		2141560	459300
G		2141400	459830
GC	Golf Course	2136900	461070
H		2140780	459420
K		2140960	459720
L		2140600	460050
M		2141270	460150
MA	Midland Acres	2133560	476690
MH	Morgan's Harbour	2141920	459620
MOA	Middle of Anywhere	2143020	460040
MON	Middle of Nowhere	2143090	460240
MOS	Middle of Somewhere	2143430	460050
N		2141150	460200
NSE	North Sound Estates	2133330	469340
OG	Omega Gardens	2132860	465330
OGA	Omega Gardens - A	2132840	465260
PMP	Palmetto Point	2143450	461450
PWA	Public Works - A	2135380	461280
PWD	Public Works Department	2134920	461680
SD	Selkirk Drive	2132510	464360
SDA	Selkirk Drive - A	2132560	464350
SDB	Selkirk Drive - B	2132520	464520
SDC	Selkirk Drive - C	2132600	464720
TFB	Turtle Farm - B	2143300	456300
TG	Tropical Gardens	2133050	463600
TSE	Tarpon Springs Estates	2134320	478660
U		2136570	460380
VV		2135900	460180
YY		2135180	460140

Appendix II.

List of sample numbers for mollusc samples collected from the Ironshore Formation.

LOCALITY	SAMPLE	SEDIMENT SAMPLES
ABB	3494	
ACB	3493	
ACH	3492	
B	1907	3499
BTD	1904	
BTH	3491	
C	1908	3500
CDS	1929	
CNP	1923	3514
CYA	1921	3512
CYB	1922	3513
D	1909	3501, 3502
DPQ	1906	
E	1910	3503, 3504
EOT	3495	
F	1911	3505, 3506
G	1912	3507
GC	3490	3528
H	1913	3508
K	1916	3509
L	1917	
M	1918	3510
MA	1938	3526
MH	1920	3511
MOA	1902	3497
MON	1901	3496
MOS	1903	3498
N	1919	
NSE	1937	3525
OG	1935	3523
OGA	1936	3524
PMP	1900	
PWA	1928	3517
PWD	1927	3516
SD	1931	3519
SDA	1932	3520
SDB	1933	3521
SDC	1934	3522
TFB	1905	
TG	1930	3518
TSE	1939	3489, 3527
U	1924	
VV	1925	3515
YY	1926	

Appendix III.

Faunal Counts

L = the number of left valves

R = the number of right valves

P = the number of articulated pairs

#I = the total number of individuals

	ABB - 3494				ACB - 3493				ACH - 3492				BTD - 1904			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum																
Americardia guppyi													1			1
Americardia media																
Anadara floridana																
Anadara notabilis																
Anadara sp.																
Anodontia alba																
Anomia simplex																
Arca imbricata													4	6	2	8
Arca sp.																
Arca zebra																
Arcopsis adamsi					1			1		1		1		1		1
Argopecten nucleus																
Barbatia cancellaria										1		1	12	12	1	13
Barbatia candida																
Barbatia domingensis					1	1		1					2	7		7
Basterotia quadrata																
Botula fusca																
Brachidontes modiolus?													1			1
Bractechlamys antillarum																
Chama congregata														4		4
Chama macerophylla														5		5
Chama sinuosa																
Chama sp.					2			2								
Chione cancellata										1		1	1			1
Chione paphia																
Codakia costata									1			1	1			1
Codakia orbicularis													1		2	3
Codakia orbiculata													1			1
Codakia pectinella																
Coralliophaga coralliophaga															1	1
Crassinella martinicensis														1		1
Cumingia coarctata																
Dendostrea frons													2	2		2
Diplodonta punctata																
Diplodonta semiaspera																
Diplodonta sp.																
Divaricella dentata																
Divaricella quadrisulcata													1	1		1
Divaricella sp.									1	1		1				
Ervilia concentrica													2			2
Gastrochaena hians																
Glycymeris pectinata																
Gouldia cerina																
Gregariella coralliophaga																
Laevicardium laevigatum																
Leporimetis intastriata															1	1
Lima lima																
Lima lima?																
Lima scabra													1			1
Linga pensylvanica													1		1	2
Lithophaga antillarum															1	1
Lithophaga nigra																
Lithophaga sp.																
Musculus lateralis																
Nucula aegeensis?																
Pectinid fragments																
Periglypta listeri						1		1					1			1
Petricola lapicida																
Pinctada imbricata																
Pitar fulminatus																
Plicatula gibbosa																
?Poromya sp.																
Pseudochama radians																
Pseudochama radians variegata													6	4	2	8

	ABB - 3494				ACB - 3493				ACH - 3492				BTD - 1904			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments																
Semele bellastriata																
Semele proficua																
Spondylus americanus																
Strigilla mirabilis																
Tagelus divisus																
Tellina aequistriata																
Tellina candeana																
Tellina fausta						1		1							1	1
Tellina gouldii																
Tellina listeri																
Tellina mera																
Tellina radiata	1			1												
Tellina similis																
Tellina sp.																
Tellina sybaritica																
Transennella gerrardi																
unidentified Chamidae	3			3												
GASTROPODS:																
Acmaea sp.																1
Acteocina sp.																
Anachis hotessieriana?																10
Arene cruentata																
Astralium phoebium																
Atys sp.																
Bailya parva																
Bittium varium																
Brachycythara biconica																
Bulla striata								2				3				66
Cerithiopsis emersonii																
Cerithium eburneum																
Cerithium eburneum algicola																2
Cerithium litteratum																17
Cerithium lutosum																1
Cerithium sp.																
Cheilea equestris																
Chicoreus florifer																
Columbella mercatoria																4
Conus jaspideus																
Conus jaspideus verrucosus																
Conus mus																2
Conus sp.																
Coralliophila abbreviata																1
Crassispira fuscescens																
Crepidula aculeata																
Cymatium pileare																7
Cyphoma gibbosum																8
Cypraea sp. A																2
Cypraea sp. B																3
?Dermomurex paupercula																
Diodora dysoni																
Diodora jaumei																
Diodora listeri																11
Diodora minuta																3
Diodora sp.																
Emarginula pumila																
Epitoneum sp. A																
Epitoneum sp. B																
Fasciolaria tulipa																1
Fissurella barbadensis																1
Hemitoma emarginata																
Hipponix antiquatus																5
Ithycythara sp.																
Latirus carinifer																
Leucozonia nassa leucozonalis																10

	ABB - 3494				ACB - 3493				ACH - 3492				BTD - 1904			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum																1
Lithopoma tuber																2
Lucapina suffusa																
Mangelia lastica?																
Marginella apicina?																
Marginella guttata?																1
Marginella pruniosum?																
Marginella sp.																
Melanella sp.																
Mitra barbadensis																1
Mitrella sp.																
Modulus modulus																
Nassarius albus																4
Natica canrena																
Natica livida																
Natica sp.																
Odostomia laevigata																
Oliva reticularis																
Olivella sp. A								1								2
Patelloida pustulata																
Phyllonotus pomum																
Pisania auritula																1
Polinices lacteus																4
Puncturella pauper?																
Pyramidella dolabrata																
Pyrgocythara candidissima																
Rissoina cancellata																
Schwartziella bryerea																3
Seila adamsi																
Sinum perspectivum																
Smaragdia viridis																
Strombus gigas																
Strombus gigas samba?																
Strombus sp.																
Thais deltoidea																
Tricolia thalassicola																
Triphora melanura?																
Triphora turristhomae																
Triptychus niveus																1
Trivia pediculus?																
Trivia quadripunctata?																1
Turbonilla sp.																
Volvarina avena																
Zebina browniana																

	B-1907				B-3499				B-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	51	45	1	52	29	33		33	80	78	1	81
Americardia media												
Anadara floridana												
Anadara notabilis												
Anadara sp.												
Anodontia alba	1	1		1					1	1		1
Anomia simplex												
Arca imbricata	24	25	12	38	2	1		2	26	27	12	39
Arca sp.		1		1						1		1
Arca zebra	1	1		1					1	1		1
Arcopsis adamsi					1	2		2	1	2		2
Argopecten nucleus												
Barbatia cancellaria	17	21	3	24	2	3		3	19	24	3	27
Barbatia candida	1			1					1			1
Barbatia domingensis	11	8	1	12	3	3	1	4	14	11	2	16
Basterotia quadrata		2		2						2		2
Botula fusca												
Brachidontes modiolus?	2	4		4					2	4		4
Bractechlamys antillarum												
Chama congregata	1	8		8					1	8		8
Chama macerophylla	17	43	2	45					17	43	2	45
Chama sinuosa	1	11		11					1	11		11
Chama sp.												
Chione cancellata	12	7		12	5	3	1	6	17	10	1	18
Chione paphia	14	14	2	16	4	2		4	18	16	2	20
Codakia costata	6	2		6	7	3		7	13	5		13
Codakia orbicularis	9	14	5	19					9	14	5	19
Codakia orbiculata	3			3					3			3
Codakia pectinella	2	1		2	2	1		2	4	2		4
Coralliophaga coralliophaga												
Crassinella martinicensis	3	3		3	13	22	1	23	16	25	1	26
Cumingia coarctata	1	2		2		1		1	1	3		3
Dendostrea frons		1		1						1		1
Diplodonta punctata	1		1	2			1	1	1		2	3
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata		2		2						2		2
Divaricella sp.						1		1		1		1
Ervilia concentrica	6	6		6	10	11	3	14	16	17	3	20
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina		1		1	2	1		2	2	2		2
Gregariella coralliophaga												
Laevicardium laevigatum												
Leporimetis intastriata			3	3							3	3
Lima lima												
Lima lima?												
Lima scabra		1		1						1		1
Linga pensylvanica	33	31	14	47	2	3		3	35	34	14	49
Lithophaga antillarum	1	1	1	2					1	1	1	2
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis					1			1	1			1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri												
Petricola lapicida		1		1						1		1
Pinctada imbricata			1	1							1	1
Pitar fulminatus	5	5		5	12	18	1	19	17	23	1	24
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata	7	5		7					7	5		7

	B - 1907				B - 3499				B - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments												
Semele bellastriata												
Semele proficua												
Spondylus americanus	1			1					1			1
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana					1	1	1	2	1	1	1	2
Tellina fausta	1			1					1			1
Tellina gouldii												
Tellina listeri	4	2		4					4	2		4
Tellina mera		1		1						1		1
Tellina radiata												
Tellina similis		1		1		1		1		2		2
Tellina sp.												
Tellina sybaritica	3	3		3					3	3		3
Transennella gerrardi	1	1		1	3	6		6	4	7		7
unidentified Chamidae					1	1		1	1	1		1
GASTROPODS:												
Acmaea sp.												
Acteocina sp.								2				2
Anachis hotessieriana?				2				4				6
Arene cruentata												
Astralium phoebium												
Atys sp.								1				1
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				1				2				3
Cerithiopsis emersonii												
Cerithium eburneum												
Cerithium eburneum algicola								6				6
Cerithium litteratum				11				15				26
Cerithium lutosum				3				2				5
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare								1				1
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex paupercula												
Diodora dysoni												
Diodora jaumei												
Diodora listeri				6								6
Diodora minuta				2								2
Diodora sp.												
Emarginula pumila								1				1
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	B-1907				B-3499				B-TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum				1								1
Lithopoma tuber												
Lucapina suffusa				1								1
Mangelia lastica?												
Marginella apicina?								2				2
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				1				1				2
Nassarius albus								2				2
Natica canrena												
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A								5				5
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				1								1
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				1				4				[illegible]
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?								1				1
Turbonilla sp.												
Volvarina avena								1				1
Zebina browniana				1								1

	BTH - 3491				CDS - 1929				DPQ - 1906				EOT - 3495			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum																
Americardia guppyi						1		1								
Americardia media																
Anadara floridana																
Anadara notabilis																
Anadara sp.																
Anodontia alba																
Anomia simplex																
Arca imbricata		1	1	2	1	1		1					1			1
Arca sp.																
Arca zebra																
Arcopsis adamsi																
Argopecten nucleus																
Barbatia cancellaria									3	2		3	3	1	2	5
Barbatia candida																
Barbatia domingensis																
Basterotia quadrata																
Botula fusca																
Brachidontes modiolus?																
Bractechlamys antillarum																
Chama congregata																
Chama macerophylla	1	1		1												
Chama sinuosa	1			1												
Chama sp.		1		1												
Chione cancellata					4			4								
Chione paphia																
Codakia costata																
Codakia orbicularis					1	2	1	3	1		1	2				
Codakia orbiculata													1			1
Codakia pectinella																
Coralliophaga coralliophaga																
Crassinella martinicensis																
Cumingia coarctata																
Dendostrea frons																
Diplodonta punctata																
Diplodonta semiaspera																
Diplodonta sp.																
Divaricella dentata																
Divaricella quadrisulcata					1	1		1								
Divaricella sp.																
Ervilia concentrica																
Gastrochaena hians																
Glycymeris pectinata																
Gouldia cerina																
Gregariella coralliophaga																
Laevicardium laevigatum																
Leporimetis intastriata																
Lima lima																
Lima lima?																
Lima scabra																
Linga pensylvanica					4	2	4	8								
Lithophaga antillarum																
Lithophaga nigra																
Lithophaga sp.																
Musculus lateralis																
Nucula aegeensis?																
Pectinid fragments																
Periglypta listeri																
Petricola lapicida																
Pinctada imbricata																
Pitar fulminatus																
Plicatula gibbosa																
?Poromya sp.																
Pseudochama radians																
Pseudochama radians variegata																

	BTH - 3491				CDS - 1929				DPQ - 1906				EOT - 3495			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments																
Semele bellastriata																
Semele proficua																
Spondylus americanus																
Strigilla mirabilis														1		1
Tagelus divisus																
Tellina aequistriata																
Tellina candeana																
Tellina fausta													1	2	2	4
Tellina gouldii																
Tellina listeri					1	1	1	2								
Tellina mera																
Tellina radiata					1			1								
Tellina similis																
Tellina sp.																
Tellina sybaritica																
Transennella gerrardi																
unidentified Chamidae																
GASTROPODS:																
Acmaea sp.																
Acteocina sp.																
Anachis hotessieriana?												3				1
Arene cruentata																
Astralium phoebium																
Atys sp.																
Bailya parva																
Bittium varium																
Brachycythara biconica																
Bulla striata				1				3								2
Cerithiopsis emersonii																
Cerithium eburneum																
Cerithium eburneum algicola												1				6
Cerithium litteratum								1				1				7
Cerithium lutosum																
Cerithium sp.																
Cheilea equestris																
Chicoreus florifer																
Columbella mercatoria												7				
Conus jaspideus								1								
Conus jaspideus verrucosus																
Conus mus												1				
Conus sp.																1
Coralliophila abbreviata																
Crassispira fuscescens																
Crepidula aculeata								1								
Cymatium pileare																1
Cyphoma gibbosum																1
Cypraea sp. A																1
Cypraea sp. B												2				2
?Dermomurex paupercula																
Diodora dysoni																
Diodora jaumei																
Diodora listeri								4								5
Diodora minuta																
Diodora sp.												1				
Emarginula pumila																
Epitoneum sp. A																
Epitoneum sp. B																
Fasciolaria tulipa																
Fissurella barbadensis																2
Hemitoma emarginata																
Hipponix antiquatus												5				12
Ithycythara sp.																
Latirus carinifer																
Leucozonia nassa leucozonalis								2				1				1

	BTH - 3491				CDS - 1929				DPQ - 1906				EOT - 3495			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum								2								10
Lithopoma tuber																
Lucapina suffusa																
Mangelia lastica?																
Marginella apicina?																
Marginella guttata?																
Marginella pruniosum?																
Marginella sp.																
Melanella sp.																
Mitra barbadensis																
Mitrella sp.																
Modulus modulus																2
Nassarius albus																1
Natica canrena																
Natica livida																
Natica sp.																
Odostomia laevigata																
Oliva reticularis																
Olivella sp. A								2								
Patelloida pustulata								1								5
Phyllonotus pomum																
Pisania auritula																
Polinices lacteus								8								
Puncturella pauper?																
Pyramidella dolabrata																
Pyrgocythara candidissima																
Rissoina cancellata																
Schwartziella bryerea																
Seila adamsi																
Sinum perspectivum																
Smaragdia viridis																
Strombus gigas																
Strombus gigas samba?																
Strombus sp.																
Thais deltoidea																2
Tricolia thalassicola																
Triphora melanura?																
Triphora turristhomae																
Triptychus niveus																
Trivia pediculus?																
Trivia quadripunctata?																
Turbonilla sp.																
Volvarina avena																
Zebina browniana																

	C-1908				C-3500				C-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	4	2		4	7	6		7	11	8		11
Americardia media												
Anadara floridana												
Anadara notabilis												
Anadara sp.												
Anodontia alba												
Anomia simplex		1		1						1		1
Arca imbricata	34	41	7	48	7	4	2	9	41	45	9	54
Arca sp.												
Arca zebra	1	1		1					1	1		1
Arcopsis adamsi	1	2		2	7	6	1	8	8	8	1	9
Argopecten nucleus	1			1	1			1	2			2
Barbatia cancellaria	105	87	2	107	27	21		27	132	108	2	134
Barbatia candida		1		1						1		1
Barbatia domingensis	8	7		8	4	5		5	12	12		12
Basterotia quadrata												
Botula fusca	1	1	4	5					1	1	4	5
Brachidontes modiolus?												
Bractechlamys antillarum	1			1	1			1	2			2
Chama congregata	2	9		9		4		4	2	13		13
Chama macerophylla	8	31		31	1			1	9	31		31
Chama sinuosa												
Chama sp.												
Chione cancellata						1		1		1		1
Chione paphia												
Codakia costata	2	3		3	1	4		4	3	7		7
Codakia orbicularis	3			3	2	1		2	5	1		5
Codakia orbiculata	3	3		3		2		2	3	5		5
Codakia pectinella	1			1		2		2	1	2		2
Coralliophaga coralliophaga	2	1		2					2	1		2
Crassinella martinicensis						1		1		1		1
Cumingia coarctata	7	6		7	7	11	6	17	14	17	6	23
Dendostrea frons		1		1						1		1
Diplodonta punctata												
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica			1	1	1			1	1		1	2
Gastrochaena hians		1		1						1		1
Glycymeris pectinata												
Gouldia cerina					1	1		1	1	1		1
Gregariella coralliophaga			1	1							1	1
Laevicardium laevigatum	2			2	1			1	3			3
Leporimetis intastriata												
Lima lima												
Lima lima?		1		1						1		1
Lima scabra		1		1						1		1
Linga pensylvanica	7	4	3	10	1	1		1	8	5	3	11
Lithophaga antillarum	1	1	1	2		1		1	1	2	1	3
Lithophaga nigra						2	4	6		2	4	6
Lithophaga sp.												
Musculus lateralis					1			1	1			1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri		1	1	2						1	1	2
Petricola lapicida	2	1	1	3					2	1	1	3
Pinctada imbricata												
Pitar fulminatus	1	1		1	1	2		2	2	3		3
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata	20	10		20					20	10		20

	C-1908				C-3500				C-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments						1		1		1		1
Semele bellastriata												
Semele proficua	1			1					1			1
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana												
Tellina fausta												
Tellina gouldii												
Tellina listeri	1			1					1			1
Tellina mera	1	3		3	2	1		2	3	4		4
Tellina radiata												
Tellina similis						2		2		2		2
Tellina sp.												
Tellina sybaritica					3	1		3	3	1		3
Transennella gerrardi	1			1	1			1	2			2
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?								9				9
Arene cruentata												
Astralium phoebium								1				1
Atys sp.								8				8
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				1				2				3
Cerithiopsis emersonii												
Cerithium eburneum				1				5				6
Cerithium eburneum algicola												
Cerithium litteratum				4				6				10
Cerithium lutosum				1				3				4
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria				1				1				2
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens								1				1
Crepidula aculeata												
Cymatium pileare				2								2
Cyphoma gibbosum												
Cypraea sp. A				1								1
Cypraea sp. B												
?Dermomurex paupercula												
Diodora dysoni												
Diodora jaumei								1				1
Diodora listeri				7								7
Diodora minuta				3				6				9
Diodora sp.												
Emarginula pumila				1				4				5
Epitoneum sp. A												
Epitoneum sp. B								1				1
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus				3				13				16
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis				5								5

	C - 1908				C - 3500				C - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum				2								2
Lithopoma tuber												
Lucapina suffusa				6								6
Mangelia lastica?												
Marginella pruniosum?								1				1
Marginella apicina?												
Marginella guttata?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus								1				1
Nassarius albus												
Natica canrena												
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A												
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				2								2
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea				1				2				3
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola								2				2
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus								2				2
Trivia pediculus?												
Trivia quadripunctata?				3								3
Turbonilla sp.												
Volvarina avena												
Zebina browniana								1				1

	CNP - 1923				CNP - 3514				CNP - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	19	14	1	20	8	7		8	27	21	1	28
Americardia media	3	5		5	1	1		1	4	6		6
Anadara floridana	6	1		6					6	1		6
Anadara notabilis		1		1						1		1
Anadara sp.												
Anodontia alba	13	10		13					13	10		13
Anomia simplex												
Arca imbricata												
Arca sp.												
Arca zebra												
Arcopsis adamsi						1		1		1		1
Argopecten nucleus	1			1					1			1
Barbatia cancellaria	2			2					2			2
Barbatia candida												
Barbatia domingensis												
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata												
Chama macerophylla	1	2		2					1	2		2
Chama sinuosa		1		1						1		1
Chama sp.												
Chione cancellata	40	53	4	57	10	6		10	50	59	4	63
Chione paphia	52	60	16	76	2	6		6	54	66	16	82
Codakia costata	20	24	1	25	21	15	1	22	41	39	2	43
Codakia orbicularis	25	23	21	46	1	1		1	26	24	21	47
Codakia orbiculata	4	10	3	13	3	3		3	7	13	3	16
Codakia pectinella	2	7		7	2	3	1	4	4	10	1	11
Coralliophaga coralliophaga												
Crassinella martinicensis	106	84	20	126	184	160	56	240	290	244	76	366
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata	8	11	23	34	6	10	4	14	14	21	27	48
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica					1	1	1	2	1	1	1	2
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	12	13		13	21	21	1	22	33	34	1	35
Gregariella coralliophaga												
Laevicardium laevigatum	4	7	3	10					4	7	3	10
Leporimetis intastriata												
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	7	3	6	13					7	3	6	13
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis												
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri	2	3		3	1		1	2	3	3	1	4
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	10	11	4	15	30	35	1	36	40	46	5	51
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata	1			1					1			1

	CNP - 1923				CNP - 3514				CNP - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments						1		1		1		1
Semele bellastriata												
Semele proficua		1	9	10						1	9	10
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana												
Tellina fausta												
Tellina gouldii												
Tellina listeri			4	4							4	4
Tellina mera		1		1						1		1
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica		1		1	3	2	1	4	3	3	1	4
Transennella gerrardi												
unidentified Chamidae	1	1		1					1	1		1
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?				4				1				5
Arene cruentata												
Astralium phoebium				3								3
Atys sp.								3				3
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				14				4				18
Cerithiopsis emersonii												
Cerithium eburneum				20				7				27
Cerithium eburneum algicola								22				22
Cerithium litteratum				9				17				26
Cerithium lutosum								1				1
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria				1								1
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex paupercula												
Diodora dysoni				1								1
Diodora jaumei												
Diodora listeri												
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer								1				1
Leucozonia nassa leucozonalis												

	CNP - 1923				CNP - 3514				CNP - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?				1				4				5
Marginella guttata?				1								1
Marginella pruniosum?								1				1
Marginella sp.												
Melanella sp.				1								1
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				7				7				14
Nassarius albus												
Natica canrena				4								4
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A				2				2				4
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				2				1				3
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata				1				1				2
Schwartziella bryerea								10				10
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola								1				1
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana												

	CYA - 1921				CYA - 3512				CYA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	216	201	1	217	101	126		126	317	327	1	328
Americardia media	2			2					2			2
Anadara floridana												
Anadara notabilis												
Anadara sp.		2		2						2		2
Anodontia alba												
Anomia simplex												
Arca imbricata	8	10	2	12	3	2		3	11	12	2	14
Arca sp.												
Arca zebra	3			3					3			3
Arcopsis adamsi					1	1		1	1	1		1
Argopecten nucleus		2		2						2		2
Barbatia cancellaria	8	7		8	2	1		2	10	8		10
Barbatia candida												
Barbatia domingensis	5	7		7	1			1	6	7		7
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?					1			1	1			1
Bractechlamys antillarum												
Chama congregata		9		9	1	2		2	1	11		11
Chama macerophylla	4	21		21					4	21		21
Chama sinuosa												
Chama sp.												
Chione cancellata	54	54	5	59	16	14		16	70	68	5	75
Chione paphia	59	77	15	92	6	5		6	65	82	15	97
Codakia costata	33	25	2	35	21	27		27	54	52	2	56
Codakia orbicularis	7	10	26	36	2			2	9	10	26	36
Codakia orbiculata	4	4		4	2	4	1	5	6	8	1	9
Codakia pectinella	1			1	1	3		3	2	3		3
Coralliophaga coralliophaga												
Crassinella martinicensis	22	18	4	26	57	46	22	79	79	64	26	105
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata	10	5	17	27	6	11	4	15	16	16	21	37
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata	1			1	2	1		2	3	1		3
Divaricella sp.												
Ervilia concentrica	2	1	1	3	8	7	4	12	10	8	5	15
Gastrochaena hians												
Glycymeris pectinata		1		1						1		1
Gouldia cerina	3	3		3	13	12	2	15	16	15	2	18
Gregariella coralliophaga												
Laevicardium laevigatum	5	4		5	1	1		1	6	5		6
Leporimetis intastriata												
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	42	54	39	93	2	1		2	44	55	39	94
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis		1		1	1			1	1	1		1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri	1		1	2					1		1	2
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	3	6	1	7	17	23	1	24	20	29	2	31
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians	1			1					1			1
Pseudochama radians variegata	5	2		5					5	2		5

	CYA - 1921				CYA - 3512				CYA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments	1			1					1			1
Semele bellastriata												
Semele proficua	2	1		2					2	1		2
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana	1	1		1	1	4		4	2	5		5
Tellina fausta												
Tellina gouldii						1		1		1		1
Tellina listeri	2	1	2	4					2	1	2	4
Tellina mera						1		1		1		1
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica		2		2	2	5		5	2	7		7
Transennella gerrardi												
unidentified Chamidae	2			2					2			2
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?								1				1
Arene cruentata												
Astralium phoebium												
Atys sp.								4				4
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				15				7				22
Cerithiopsis emersonii												
Cerithium eburneum								2				2
Cerithium eburneum algicola				11				7				18
Cerithium litteratum				21				29				50
Cerithium lutosum												
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria								1				1
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni				3								3
Diodora jaumei												
Diodora listeri				1								1
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	CYA - 1921				CYA - 3512				CYA - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa				1								1
Mangelia lastica?												
Marginella apicina?								4				4
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				6				10				16
Nassarius albus				1				4				5
Natica canrena				2				4				6
Natica livida												
Natica sp.				2								2
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A				1				10				11
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				3								3
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas								1				1
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				8								8
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana												

	CYB - 1922				CYB - 3513				CYB - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	57	52		57	1	1		1	58	53		58
Americardia media		1		1						1		1
Anadara floridana	9	2	1	10					9	2	1	10
Anadara notabilis	5	5		5		1		1	5	6		6
Anadara sp.												
Anodontia alba			2	2							2	2
Anomia simplex												
Arca imbricata	29	28	4	33	7	5		7	36	33	4	40
Arca sp.												
Arca zebra	5			5		1		1	5	1		5
Arcopsis adamsi		1		1	2	3		3	2	4		4
Argopecten nucleus												
Barbatia cancellaria	15	19		19	2	4		4	17	23		23
Barbatia candida	2	3		3					2	3		3
Barbatia domingensis	20	35	1	36	5	7		7	25	42	1	43
Basterotia quadrata												
Botula fusca			1	1							1	1
Brachidontes modiolus?		1		1						1		1
Bractechlamys antillarum												
Chama congregata	4	31	1	32		4		4	4	35	1	36
Chama macerophylla	5	42		42		2		2	5	44		44
Chama sinuosa		4		4						4		4
Chama sp.					1	2		2	1	2		2
Chione cancellata	11	17	1	18					11	17	1	18
Chione paphia	12	10	5	17					12	10	5	17
Codakia costata	8	13		13					8	13		13
Codakia orbicularis	1	1	1	2					1	1	1	2
Codakia orbiculata	3	2	1	4					3	2	1	4
Codakia pectinella	1			1					1			1
Coralliophaga coralliophaga			2	2							2	2
Crassinella martinicensis	3	3	1	4					3	3	1	4
Cumingia coarctata					1		2	3	1		2	3
Dendostrea frons	1	1		1	1	1		1	2	2		2
Diplodonta punctata	3	8	12	20	1			1	4	8	12	20
Diplodonta semiaspera			1	1							1	1
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica					1	2		2	1	2		2
Gastrochaena hians												
Glycymeris pectinata		2		2						2		2
Gouldia cerina	2	3		3	1	1		1	3	4		4
Gregariella coralliophaga						1	6	7		1	6	7
Laevicardium laevigatum		1		1						1		1
Leporimetis intastriata												
Lima lima					1			1	1			1
Lima lima?												
Lima scabra												
Linga pensylvanica	13	8	9	22					13	8	9	22
Lithophaga antillarum												
Lithophaga nigra					1		3	4	1		3	4
Lithophaga sp.	1			1					1			1
Musculus lateralis					1			1	1			1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri												
Petricola lapicida		1	1	2						1	1	2
Pinctada imbricata												
Pitar fulminatus	9	8	2	11	1	1		1	10	9	2	12
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians	1	2		2		1		1	1	3		3
Pseudochama radians variegata	1	7		7					1	7		7

	CYB - 1922				CYB - 3513				CYB - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments												
Semele bellastriata												
Semele proficua			3	3							3	3
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana												
Tellina fausta												
Tellina gouldii												
Tellina listeri		1	2	3						1	2	3
Tellina mera												
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica												
Transennella gerrardi	2	1		2		1		1	2	2		2
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.				1								1
Anachis hotessieriana?				3				2				5
Arene cruentata												
Astralium phoebium				2								2
Atys sp.												
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				2								2
Cerithiopsis emersonii												
Cerithium eburneum				4								4
Cerithium eburneum algicola				1								1
Cerithium litteratum				7				1				8
Cerithium lutosum												
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus				2								2
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare				1								1
Cyphoma gibbosum				2								2
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus				1								1
Diodora dysoni												
Diodora jaumei												
Diodora listeri				6								6
Diodora minuta								4				4
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis				1								1
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	CYB - 1922				CYB - 3513				CYB - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum				3								3
Lithopoma tuber								1				1
Lucapina suffusa				2								2
Mangelia lastica?												
Marginella apicina?				1				1				2
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				1								1
Nassarius albus												
Natica canrena												
Natica livida												
Natica sp.				1								1
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A								1				1
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				1								1
Puncturella pauper?								4				4
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola												
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?				1								1
Turbonilla sp.												
Volvarina avena								1				1
Zebina browniana												

	D-1909				D-3501				D-3502				D-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum																
Americardia guppyi									1			1	1			1
Americardia media																
Anadara floridana																
Anadara notabilis																
Anadara sp.																
Anodontia alba																
Anomia simplex																
Arca imbricata	11	18	2	20	1			1	1			1	13	18	2	20
Arca sp.																
Arca zebra		2		2										2		2
Arcopsis adamsi					1	1		1					1	1		1
Argopecten nucleus																
Barbatia cancellaria	46	45		46	5	2		5		1		1	51	48		51
Barbatia candida	1	4		4									1	4		4
Barbatia domingensis	5	4		5		1		1	1			1	6	5		6
Basterotia quadrata																
Botula fusca			1	1											1	1
Brachidontes modiolus?																
Bractechlamys antillarum																
Chama congregata	2	11		11									2	11		11
Chama macerophylla	9	16		16									9	16		16
Chama sinuosa																
Chama sp.																
Chione cancellata																
Chione paphia																
Codakia costata	1			1									1			1
Codakia orbicularis	2			2						1		1	2	1		2
Codakia orbiculata																
Codakia pectinella																
Coralliophaga coralliophaga																
Crassinella martinicensis																
Cumingia coarctata																
Dendostrea frons																
Diplodonta punctata																
Diplodonta semiaspera																
Diplodonta sp.																
Divaricella dentata																
Divaricella quadrisulcata																
Divaricella sp.																
Ervilia concentrica																
Gastrochaena hians																
Glycymeris pectinata																
Gouldia cerina										1		1		1		1
Gregariella coralliophaga																
Laevicardium laevigatum																
Leporimetis intastriata																
Lima lima																
Lima lima?																
Lima scabra		1		1	1			1					1	1		1
Linga pensylvanica	2	4		4	1			1					3	4		4
Lithophaga antillarum			1	1											1	1
Lithophaga nigra			1	1			2	2							3	3
Lithophaga sp.			2	2											2	2
Musculus lateralis																
Nucula aegeensis?																
Pectinid fragments																
Periglypta listeri	1			1									1			1
Petricola lapicida	2	1	1	3									2	1	1	3
Pinctada imbricata																
Pitar fulminatus																
Plicatula gibbosa																
?Poromya sp.																
Pseudochama radians																
Pseudochama radians variegata	1	1		1									1	1		1

	D-1909				D-3501				D-3502				D-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments																
Semele bellastriata																
Semele proficua																
Spondylus americanus																
Strigilla mirabilis																
Tagelus divisus																
Tellina aequistriata																
Tellina candeana																
Tellina fausta																
Tellina gouldii																
Tellina listeri	1			1									1			1
Tellina mera																
Tellina radiata																
Tellina similis																
Tellina sp.			1	1											1	1
Tellina sybaritica																
Transennella gerrardi																
unidentified Chamidae																
GASTROPODS:																
Acmaea sp.																
Acteocina sp.																
Anachis hotessieriana?				1				3								4
Arene cruentata																
Astralium phoebium																
Atys sp.																
Bailya parva																
Bittium varium																
Brachycythara biconica																
Bulla striata																
Cerithiopsis emersonii																
Cerithium eburneum																
Cerithium eburneum algicola																
Cerithium litteratum				1				3								4
Cerithium lutosum												1				1
Cerithium sp.																
Cheilea equestris																
Chicoreus florifer																
Columbella mercatoria				3												3
Conus jaspideus																
Conus jaspideus verrucosus																
Conus mus																
Conus sp.																
Coralliophila abbreviata																
Crassispira fuscescens								1								1
Crepidula aculeata																
Cymatium pileare				1												1
Cyphoma gibbosum																
Cypraea sp. A																
Cypraea sp. B																
?Dermomurex paupercula																
Diodora dysoni				1												1
Diodora jaumei																
Diodora listeri				7				1				1				9
Diodora minuta								1								1
Diodora sp.																
Emarginula pumila				1				1								2
Epitoneum sp. A																
Epitoneum sp. B																
Fasciolaria tulipa																
Fissurella barbadensis																
Hemitoma emarginata																
Hipponix antiquatus				2								3				5
Ithycythara sp.																
Latirus carinifer																
Leucozonia nassa leucozonalis																

	D-1909				D-3501				D-3502				D-TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum																
Lithopoma tuber																
Lucapina suffusa				2				1								3
Mangelia lastica?																
Marginella apicina?																
Marginella guttata?																
Marginella pruniosum?																
Marginella sp.																
Melanella sp.																
Mitra barbadensis																
Mitrella sp.																
Modulus modulus																
Nassarius albus																
Natica canrena																
Natica livida																
Natica sp.																
Odostomia laevigata																
Oliva reticularis																
Olivella sp. A				1												1
Patelloida pustulata																
Phyllonotus pomum																
Pisania auritula																
Polinices lacteus																
Puncturella pauper?																
Pyramidella dolabrata																
Pyrgocythara candidissima																
Rissoina cancellata																
Schwartziella bryerea																
Seila adamsi																
Sinum perspectivum																
Smaragdia viridis																
Strombus gigas				1												1
Strombus gigas samba?																
Strombus sp.																
Thais deltoidea																
Tricolia thalassicola																
Triphora melanura?																
Triphora turristhomae																
Triptychus niveus																
Trivia pediculus?																
Trivia quadripunctata?				1												1
Turbonilla sp.																
Volvarina avena																
Zebina browniana																

	E-1910				E-3503				E-3504				E-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum																
Americardia guppyi	5	3		5									5	3		5
Americardia media																
Anadara floridana																
Anadara notabilis																
Anadara sp.																
Anodontia alba	5	6	21	27		2		2					5	8	21	29
Anomia simplex																
Arca imbricata	2	2		2									2	2		2
Arca sp.																
Arca zebra																
Arcopsis adamsi																
Argopecten nucleus																
Barbatia cancellaria	4	6		6					1	1		1	5	7		7
Barbatia candida																
Barbatia domingensis																
Basterotia quadrata																
Botula fusca																
Brachidontes modiolus?																
Bractechlamys antillarum																
Chama congregata		2	1	3										2	1	3
Chama macerophylla	1	1		1									1	1		1
Chama sinuosa																
Chama sp.																
Chione cancellata		1		1										1		1
Chione paphia																
Codakia costata	6	4		6	2	2		2	4	1		4	12	7		12
Codakia orbicularis																
Codakia orbiculata	1			1									1			1
Codakia pectinella						2		2	2			2	2	2		2
Coralliophaga coralliophaga																
Crassinella martinicensis					1			1					1			1
Cumingia coarctata																
Dendostrea frons	1	1		1									1	1		1
Diplodonta punctata																
Diplodonta semiaspera																
Diplodonta sp.																
Divaricella dentata																
Divaricella quadrisulcata																
Divaricella sp.																
Ervilia concentrica									1			1	1			1
Gastrochaena hians																
Glycymeris pectinata																
Gouldia cerina																
Gregariella coralliophaga																
Laevicardium laevigatum																
Leporimetis intastriata		2	12	14										2	12	14
Lima lima																
Lima lima?																
Lima scabra																
Linga pensylvanica	10	9	2	12					1			1	11	9	2	13
Lithophaga antillarum	2	2		2									2	2		2
Lithophaga nigra																
Lithophaga sp.																
Musculus lateralis																
Nucula aegeensis?																
Pectinid fragments																
Periglypta listeri																
Petricola lapicida																
Pinctada imbricata																
Pitar fulminatus					2	1		2	1	2		2	3	3		3
Plicatula gibbosa																
?Poromya sp.																
Pseudochama radians		1		1										1		1
Pseudochama radians variegata	2	1		2									2	1		2

	E-1910				E-3503				E-3504				E-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments																
Semele bellastriata																
Semele proficua																
Spondylus americanus																
Strigilla mirabilis																
Tagelus divisus																
Tellina aequistriata																
Tellina candeana									6	4		6	6	4		6
Tellina fausta	1			1									1			1
Tellina gouldii																
Tellina listeri		1		1										1		1
Tellina mera																
Tellina radiata																
Tellina similis	1	2		2	6	5		6	2	5		5	9	12		12
Tellina sp.																
Tellina sybaritica									1			1	1			1
Transennella gerrardi																
unidentified Chamidae	1			1									1			1
GASTROPODS:																
Acmaea sp.																
Acteocina sp.																
Anachis hotessieriana?																
Arene cruentata																
Astralium phoebium																
Atys sp.								2				2				4
Bailya parva																
Bittium varium																
Brachycythara biconica																
Bulla striata				58				5				6				69
Cerithiopsis emersonii																
Cerithium eburneum				1				15				32				48
Cerithium eburneum algicola								6								6
Cerithium litteratum				9				6				9				24
Cerithium lutosum				4				13								17
Cerithium sp.																
Cheilea equestris																
Chicoreus florifer																
Columbella mercatoria																
Conus jaspideus																
Conus jaspideus verrucosus																
Conus mus																
Conus sp.																
Coralliophila abbreviata																
Crassispira fuscescens																
Crepidula aculeata																
Cymatium pileare																
Cyphoma gibbosum																
Cypraea sp. A																
Cypraea sp. B																
?Dermomurex paupercula																
Diodora dysoni				1												1
Diodora jaumei																
Diodora listeri												2				2
Diodora minuta												1				1
Diodora sp.																
Emarginula pumila				1								1				2
Epitoneum sp. A																
Epitoneum sp. B																
Fasciolaria tulipa																
Fissurella barbadensis																
Hemitoma emarginata																
Hipponix antiquatus												1				1
Ithycythara sp.																
Latirus carinifer																
Leucozonia nassa leucozonalis																

	E-1910				E-3503				E-3504				E-TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum																
Lithopoma tuber																
Lucapina suffusa																
Mangelia lastica?																
Marginella apicina?																
Marginella guttata?																
Marginella pruniosum?												1				1
Marginella sp.																
Melanella sp.																
Mitra barbadensis																
Mitrella sp.																
Modulus modulus								1				1				2
Nassarius albus				1				1				2				4
Natica canrena				5												5
Natica livida																
Natica sp.																
Odostomia laevigata																
Oliva reticularis																
Olivella sp. A												2				2
Patelloida pustulata																
Phyllonotus pomum																
Pisania auritula																
Polinices lacteus				4												4
Puncturella pauper?																
Pyramidella dolabrata				2				1				1				4
Pyrgocythara candidissima																
Rissoina cancellata																
Schwartziella bryorea																
Seila adamsi																
Sinum perspectivum																
Smaragdia viridis																
Strombus gigas																
Strombus gigas samba?																
Strombus sp.																
Thais deltoidea																
Tricolia thalassicola								3				3				6
Triphora melanura?																
Triphora turristhomae																
Triptychus niveus																
Trivia pediculus?																
Trivia quadripunctata?																
Turbonilla sp.																
Volvarina avena																
Zebina browniana												2				2

	F-1911				F-3505				F-3506				F-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum																
Americardia guppyi	24	36	1	37	38	37		38	34	32		34	96	105	1	106
Americardia media																
Anadara floridana																
Anadara notabilis																
Anadara sp.																
Anodontia alba			4	4	2			2		1		1	2	1	4	6
Anomia simplex																
Arca imbricata	40	28	12	52	2	4	4	8	18	25	1	26	60	57	17	77
Arca sp.	3	1		3									3	1		3
Arca zebra	3	2		3					10	5		10	13	7		13
Arcopsis adamsi	1			1	4	3		4	5	8		8	10	11		11
Argopecten nucleus																
Barbatia cancellaria	31	33	1	34	23	25		25	24	19	1	25	78	77	2	80
Barbatia candida		2		2										2		2
Barbatia domingensis	8	8		8	18	9		18	13	14	2	16	39	31	2	41
Basterotia quadrata																
Botula fusca			1	1											1	1
Brachidontes modiolus?	4			4	2	3		3	2			2	8	3		8
Bractechlamys antillarum																
Chama congregata		12		12		1		1		8		8		21		21
Chama macerophylla	14	73	2	75						1		1	14	74	2	76
Chama sinuosa																
Chama sp.																
Chione cancellata	9	8		9	4	3		4	2	2		2	15	13		15
Chione paphia	3	3		3	2			2	1			1	6	3		6
Codakia costata	6	6		6	13	11		13	1	6		6	20	23		23
Codakia orbicularis	6	6	5	11	2			2		2		2	8	8	5	13
Codakia orbiculata	1		1	2	5	1		5	2	3		3	8	4	1	9
Codakia pectinella		1	1	2	1	5		5		3		3	1	9	1	10
Coralliophaga coralliophaga											1	1			1	1
Crassinella martinicensis	3	2	2	5	8	9	1	10	2	2		2	13	13	3	16
Cumingia coarctata	1			1	5	5		5	5	2	1	6	11	7	1	12
Dendostrea frons										1		1		1		1
Diplodonta punctata	2		3	5	2	4		4	9	5		9	13	9	3	16
Diplodonta semiaspera																
Diplodonta sp.																
Divaricella dentata																
Divaricella quadrisulcata					1	1		1		1		1	1	2		2
Divaricella sp.																
Ervilia concentrica	5	1		5	10	9	1	11	2	2		2	17	12	1	18
Gastrochaena hians																
Glycymeris pectinata																
Gouldia cerina	2	4		4	1	5		5	2	2		2	5	11		11
Gregariella coralliophaga																
Laevicardium laevigatum	3	2		3	2	1		2					5	3		5
Leporimetis intastriata			2	2											2	2
Lima lima										1		1		1		1
Lima lima?																
Lima scabra	1	1		1									1	1		1
Linga pensylvanica	46	56	33	89	4	2		4	3	1		3	53	59	33	92
Lithophaga antillarum																
Lithophaga nigra																
Lithophaga sp.	1			1									1			1
Musculus lateralis						1		1						1		1
Nucula aegeensis?		1		1					1			1	1	1		1
Pectinid fragments																
Periglypta listeri																
Petricola lapicida			2	2											2	2
Pinctada imbricata																
Pitar fulminatus	1	5	1	6	19	20		20	12	10		12	32	35	1	36
Plicatula gibbosa																
?Poromya sp.	2			2									2			2
Pseudochama radians	5	7		7									5	7		7
Pseudochama radians variegata	3	1		3					1			1	4	1		4

	F-1911				F-3505				F-3506				F-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments						1		1	2			2	2	1		2
Semele bellastriata		1		1										1		1
Semele proficua		1		1										1		1
Spondylus americanus																
Strigilla mirabilis																
Tagelus divisus		1		1										1		1
Tellina aequistriata						1		1						1		1
Tellina candeana	1			1	2	3		3					3	3		3
Tellina fausta		1		1										1		1
Tellina gouldii						1		1						1		1
Tellina listeri		1	3	4										1	3	4
Tellina mera			1	1						1		1		1	1	2
Tellina radiata																
Tellina similis					7	3		7	2	2		2	9	5		9
Tellina sp.																
Tellina sybaritica		1		1	4	6		6	2	8		8	6	15		15
Transennella gerrardi	3			3									3			3
unidentified Chamidae	7	7		7									7	7		7
GASTROPODS:																
Acmaea sp.																
Acteocina sp.																
Anachis hotessieriana?				12				19				28				59
Arene cruentata																
Astralium phoebium																
Atys sp.								8								8
Bailya parva												1				1
Bittium varium																
Brachycythara biconica																
Bulla striata				4				11				2				17
Cerithiopsis emersonii																
Cerithium eburneum				4				21				1				26
Cerithium eburneum algicola				1				9				6				16
Cerithium litteratum				9				20				3				32
Cerithium lutosum				2												2
Cerithium sp.																
Cheilea equestris																
Chicoreus florifer																
Columbella mercatoria												1				1
Conus jaspideus				2				2								4
Conus jaspideus verrucosus																
Conus mus																
Conus sp.												1				1
Coralliophila abbreviata																
Crassispira fuscescens								2								2
Crepidula aculeata																
Cymatium pileare				1				1								2
Cyphoma gibbosum																
Cypraea sp. B																
Cypraea sp.A																
?Dermomurex paupercula																
Diodora dysoni																
Diodora jaumei												1				1
Diodora listeri				3				1				2				6
Diodora minuta								10				18				28
Diodora sp.				1												1
Emarginula pumila								1				1				2
Epitoneum sp. A																
Epitoneum sp. B																
Fasciolaria tulipa				1												1
Fissurella barbadensis												1				1
Hemitoma emarginata																
Hipponix antiquatus				3				12				11				26
Ithycythara sp.																
Latirus carinifer				1								6				7
Leucozonia nassa leucozonalis				2								3				5

	F-1911				F-3505				F-3506				F-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum				5												5
Lithopoma tuber																
Lucapina suffusa								1								1
Mangelia lastica?																
Marginella apicina?																
Marginella guttata?																
Marginella prunicsum?								2								2
Marginella sp.																
Melanella sp.																
Mitra barbadensis																
Mitrella sp.																
Modulus modulus				1				4				6				11
Nassarius albus				3				5				5				13
Natica canrena																
Natica livida																
Natica sp.				1												1
Odostomia laevigata																
Oliva reticularis																
Olivella sp. A				1				7				3				11
Patelloida pustulata																
Phyllonotus pomum																
Pisania auritula																
Polinices lacteus				1												1
Puncturella pauper?								2				6				8
Pyramidella dolabrata																
Pyrgocythara candidissima												2				2
Rissoina cancellata																
Schwartziella bryerea												1				1
Seila adamsi																
Sinum perspectivum																
Smaragdia viridis																
Strombus gigas																
Strombus gigas samba?																
Strombus sp.																
Thais deltoidea																
Tricolia thalassicola				4				10								14
Triphora melanura?																
Triphora turristhomae																
Triptychus niveus								1				2				3
Trivia pediculus?																
Trivia quadripunctata?								1				1				2
Turbonilla sp.																
Volvarina avena				1								1				2
Zebina browniana																

	G-1912				G-3507				G-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	1			1					1			1
Americardia media												
Anadara floridana												
Anadara notabilis												
Anadara sp.												
Anodontia alba												
Anomia simplex												
Arca imbricata	17	21	8	29	4	4		4	21	25	8	33
Arca sp.												
Arca zebra		2		2						2		2
Arcopsis adamsi												
Argopecten nucleus												
Barbatia cancellaria	20	19		20	4	1		4	24	20		24
Barbatia candida												
Barbatia domingensis	31	10	2	33	5	5	1	6	36	15	3	39
Basterotia quadrata					1			1	1			1
Botula fusca												
Brachidontes modiolus?					1	2		2	1	2		2
Bractechlamys antillarum												
Chama congregata	6	48	1	49					6	48	1	49
Chama macerophylla	11	25	3	28					11	25	3	28
Chama sinuosa	1	3		3					1	3		3
Chama sp.						14		14		14		14
Chione cancellata	3	1		3					3	1		3
Chione paphia												
Codakia costata	2	1		2					2	1		2
Codakia orbicularis												
Codakia orbiculata												
Codakia pectinella												
Coralliophaga coralliophaga	1		1	2					1		1	2
Crassinella martinicensis					1	1		1	1	1		1
Cumingia coarctata						1	1	2		1	1	2
Dendostrea frons	3	3		3	1			1	4	3		4
Diplodonta punctata												
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica					1			1	1			1
Gastrochaena hians			1	1							1	1
Glycymeris pectinata												
Gouldia cerina						1		1		1		1
Gregariella coralliophaga							6	6			6	6
Laevicardium laevigatum												
Leporimetis intastriata												
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	1	1		1					1	1		1
Lithophaga antillarum			2	2							2	2
Lithophaga nigra							3	3			3	3
Lithophaga sp.												
Musculus lateralis					1			1	1			1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri												
Petricola lapicida	1			1					1			1
Pinctada imbricata												
Pitar fulminatus												
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata	6	1		6					6	1		6

	G-1912				G-3507				G-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments												
Semele bellastriata												
Semele proficua												
Spondylus americanus	1	1		1	1			1	2	1		2
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana												
Tellina fausta												
Tellina gouldii												
Tellina listeri												
Tellina mera												
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica						1		1		1		1
Transennella gerrardi												
unidentified Chamidae	6	6		6					6	6		6
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?												
Arene cruentata												
Astralium phoebium												
Atys sp.												
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata												
Cerithiopsis emersonii												
Cerithium eburneum				2								2
Cerithium eburneum algicola												
Cerithium litteratum				1				1				2
Cerithium lutosum												
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A				1								1
Cypraea sp. B				1								1
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri				6				1				7
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B				1								1
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus								1				1
Ithycythara sp.												
Latirus carinifer								1				1
Leucozonia nassa leucozonalis												

	G-1912				G-3507				G-TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum				1								1
Lithopoma tuber												
Lucapina suffusa				2								2
Mangelia lastica?												
Marginella apicina?												
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus												
Nassarius albus												
Natica canrena												
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A								1				1
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus												
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.				2								2
Thais deltoidea												
Tricolia thalassicola												
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana												

	GC - 3490				GC - 3528				GC - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	8	7	2	10	12	10		12	20	17	2	22
Americardia media												
Anadara floridana	1	1		1					1	1		1
Anadara notabilis												
Anadara sp.												
Anodontia alba	5	6	5	11					5	6	5	11
Anomia simplex												
Arca imbricata												
Arca sp.												
Arca zebra												
Arcopsis adamsi						1		1		1		1
Argopecten nucleus												
Barbatia cancellaria												
Barbatia candida												
Barbatia domingensis												
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum	1			1					1			1
Chama congregata												
Chama macerophylla		3	1	4						3	1	4
Chama sinuosa												
Chama sp.												
Chione cancellata	32	21	3	35	5	3		5	37	24	3	40
Chione paphia	42	47	11	58	1			1	43	47	11	58
Codakia costata	4	5		5	7	5		7	11	10		11
Codakia orbicularis	15	21	16	37					15	21	16	37
Codakia orbiculata	4	3	1	5	4	2	1	5	8	5	2	10
Codakia pectinella	1	1		1	1			1	2	1		2
Coralliophaga coralliophaga												
Crassinella martinicensis	83	70	12	95	41	26	9	50	124	96	21	145
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata	2	1		2	2	1		2	4	2		4
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica		2		2						2		2
Gastrochaena hians												
Glycymeris pectinata	1			1					1			1
Gouldia cerina	7	5	1	8	9	?	1	10	16	7	2	18
Gregariella coralliophaga												
Laevicardium laevigatum	3	4	4	8					3	4	4	8
Leporimetis intastriata			4	4							4	4
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	19	13	11	30					19	13	11	30
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis												
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri		1		1						1		1
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus		1		1	5	4		5	5	5		5
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata			1	1							1	1

	GC-3490				GC-3528				GC-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments												
Semele bellastriata												
Semele proficua	2	3	1	4					2	3	1	4
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana												
Tellina fausta												
Tellina gouldii												
Tellina listeri	2		3	5					2		3	5
Tellina mera												
Tellina radiata												
Tellina similis												
Tellina sp.	1		1	2					1		1	2
Tellina sybaritica					1			1	1			1
Transennella gerrardi		1		1						1		1
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?				1								1
Arene cruentata												
Astralium phoebium												
Atys sp.												
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata								5				5
Cerithiopsis emersonii												
Cerithium eburneum				12				5				17
Cerithium eburneum algicola				2				6				8
Cerithium litteratum				4				4				8
Cerithium lutosum												
Cerithium sp.												
?Dermomurex pauperculus												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
Diodora dysoni												
Diodora jaumei												
Diodora listeri												
Diodora minuta				1								1
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	GC-3490				GC-3528				GC-TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?								1				1
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus								2				2
Nassarius albus												
Natica canrena				2								2
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A				1				1				2
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus								1				1
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola												
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana												

	H - 1913				H - 3508				H - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi		4		4	2	1		2	2	5		5
Americardia media												
Anadara floridana		1		1						1		1
Anadara notabilis												
Anadara sp.												
Anodontia alba			11	11							11	11
Anomia simplex												
Arca imbricata												
Arca sp.												
Arca zebra												
Arcopsis adamsi												
Argopecton nucleus												
Barbatia cancellaria	4	2		4					4	2		4
Barbatia candida												
Barbatia domingensis					2			2	2			2
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata		1	1	2						1	1	2
Chama macerophylla												
Chama sinuosa												
Chama sp.												
Chione cancellata	1			1					1			1
Chione paphia												
Codakia costata	1	3		3	2	2		2	3	5		5
Codakia orbicularis	1			1					1			1
Codakia orbiculata												
Codakia pectinella												
Coralliophaga coralliophaga												
Crassinella martinicensis												
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata												
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.					1			1	1			1
Ervilia concentrica												
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina												
Gregariella coralliophaga												
Laevicardium laevigatum	1	2		2					1	2		2
Leporimetis intastriata		3	5	8						3	5	8
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	21	14	7	28		1		1	21	15	7	28
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis												
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri												
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus					1	1		1	1	1		1
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians		1	1	2						1	1	2
Pseudochama radians variegata												

	H-1913				H-3508				H-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments												
Semele bellastriata												
Semele proficua												
Spondylus americanus		1		1						1		1
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana												
Tellina fausta					1			1	1			1
Tellina gouldii												
Tellina listeri	1		1	2					1		1	2
Tellina mera		1		1						1		1
Tellina radiata	1		4	5					1		4	5
Tellina similis												
Tellina sp.												
Tellina sybaritica					1	1		1	1	1		1
Transennella gerrardi												
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?												
Arene cruentata												
Astralium phoebium												
Atys sp.								2				2
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				13				7				20
Cerithiopsis emersonii												
Cerithium eburneum								5				5
Cerithium eburneum algicola												
Cerithium litteratum								1				1
Cerithium lutosum								3				3
Cerithium sp.				1								1
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri								2				2
Diodora minuta				1				1				2
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus								3				3
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	H-1913				H-3508				H-TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?								1				1
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus								1				1
Nassarius albus												
Natica canrena												
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A				2				8				10
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				3				1				4
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas				2								2
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola												
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana												

	K-1916				K-3509				K-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	28	31	1	32	10	9		10	38	40	1	41
Americardia media	1			1					1			1
Anadara floridana												
Anadara notabilis												
Anadara sp.												
Anodontia alba	1		1	2					1		1	2
Anomia simplex												
Arca imbricata	22	16	2	24	4	5	1	6	26	21	3	29
Arca sp.												
Arca zebra	4	4		4					4	4		4
Arcopsis adamsi	2	1	1	3					2	1	1	3
Argopecten nucleus												
Barbatia cancellaria	20	9		20	4	7		7	24	16		24
Barbatia candida												
Barbatia domingensis	6	7		7	4	5		5	10	12		12
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?						1		1		1		1
Bractechlamys antillarum												
Chama congregata		4		4						4		4
Chama macerophylla	15	38	1	39	2	3		3	17	41	1	42
Chama sinuosa		2		2						2		2
Chama sp.												
Chione cancellata	2	6		6	6			6	8	6		8
Chione paphia	6	2	1	7		3		3	6	5	1	7
Codakia costata	5	5		5	1	2		2	6	7		7
Codakia orbicularis	3	3	1	4					3	3	1	4
Codakia orbiculata		2		2	1			1	1	2		2
Codakia pectinella	2			2		1		1	2	1		2
Coralliophaga coralliophaga												
Crassinella martinicensis	3	2	1	4	6	2		6	9	4	1	10
Cumingia coarctata	4	2		4	2			2	6	2		6
Dendostrea frons	4	5		5	1	1		1	5	6		6
Diplodonta punctata		1	1	2	1	2		2	1	3	1	4
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata		1		1						1		1
Divaricella sp.		1		1		1		1		2		2
Ervilia concentrica		1		1	8	11	1	12	8	12	1	13
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	1			1					1			1
Gregariella coralliophaga												
Laevicardium laevigatum		1		1		2		2		3		3
Leporimetis intastriata		1	3	4						1	3	4
Lima lima												
Lima lima?		1		1						1		1
Lima scabra	1	3		3					1	3		3
Linga pensylvanica	38	28	13	51	2	2		2	40	30	13	53
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.	1		2	3					1		2	3
Musculus lateralis						1		1		1		1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri			1	1							1	1
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	2	3		3	14	11		14	16	14		16
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata	7	9		9					7	9		9

	K-1916				K-3509				K-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments												
Semele bellastriata												
Semele proficua	1	1	1	2					1	1	1	2
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana												
Tellina fausta												
Tellina gouldii												
Tellina listeri			1	1		1		1		1	1	2
Tellina mera	1		1	2					1		1	2
Tellina radiata	1			1					1			1
Tellina similis					1	1		1	1	1		1
Tellina sp.												
Tellina sybaritica	1			1		4		4	1	4		4
Transennella gerrardi					2	4		4	2	4		4
unidentified Chamidae	8	8		8					8	8		8
GASTROPODS:												
Acmaea sp.												
Acteocina sp.				6								6
Anachis hotessieriana?								6				6
Arene cruentata												
Astralium phoebium								1				1
Atys sp.				2				8				10
Bailya parva												
Bittium varium												
Brachycythara biconica				1								1
Bulla striata				3				3				6
Cerithiopsis emersonii				1								1
Cerithium eburneum												
Cerithium eburneum algicola				9				6				15
Cerithium litteratum				6				12				18
Cerithium lutosum												
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria				1								1
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare				1								1
Cyphoma gibbosum												
Cypraea sp. A				1								1
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni				1								1
Diodora jaumei												
Diodora listeri				5				1				6
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis								1				1
Hemitoma emarginata												
Hipponix antiquatus								2				2
Ithycythara sp.												
Latirus carinifer								1				1
Leucozonia nassa leucozonalis				4				1				5

	K-1916				K-3509				K-TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum				5								5
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?												
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				2				1				3
Nassarius albus				7				3				10
Natica canrena												
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A				2				5				7
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				2								2
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata				1								1
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				1								1
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena				1								1
Zebina browniana								1				1

	L - 1917				N - 1019				PMP - 1900			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	1			1								
Americardia media												
Anadara floridana	2			2								
Anadara notabilis												
Anadara sp.												
Anodontia alba												
Anomia simplex												
Arca imbricata												
Arca sp.												
Arca zebra												
Arcopsis adamsi												
Argopecten nucleus												
Barbatia cancellaria												
Barbatia candida												
Barbatia domingensis												
Bastarotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata												
Chama macerophylla												
Chama sinuosa												
Chama sp.												
Chione cancellata	23	20		23	2	4	2	6				
Chione paphia	3	2		3					1			1
Codakia costata	1	2		2								
Codakia orbicularis												
Codakia orbiculata												
Codakia pectinella												
Coralliophaga coralliophaga												
Crassinella martinicensis	3			3								
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata		1	1	2								
Diplodonta semiaspera												
Diplodonta sp.					1			1				
Divaricella dentata												
Divaricella quadrisulcata	2			2								
Divaricella sp.												
Ervilia concentrica		2		2								
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina												
Gregariella coralliophaga												
Laevicardium laevigatum												
Leporimetis intastriata												
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	1	1		1			2	2				
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis												
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri	1			1								
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	1			1								
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata												

	L - 1917				N - 1919				PMP - 1900			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments												
Semele bellastriata												
Semele proficua												
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana												
Tellina fausta												
Tellina gouldii												
Tellina listeri												
Tellina mera												
Tellina radiata												
Tellina similis		2		2								
Tellina sp.	1	2		2								
Tellina sybaritica												
Transennella gerrardi	1			1								
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?												
Arene cruentata												
Astralium phoebium												
Atys sp.												
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				2								
Cerithiopsis emersonii												
Cerithium eburneum				8								
Cerithium eburneum algicola				1								
Cerithium litteratum				6								
Cerithium lutosum				2								
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri												
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis								1				

	L - 1917				N - 1919				PMP - 1900			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?												
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus												
Nassarius albus				1								
Natica canrena												
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A												
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus												
Puncturella pauper?												
Pyramidella dolabrata				2								
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola												
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana												

	M-1918				M-3510				M-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi		1		1		2		2		3		3
Americardia media						1		1		1		1
Anadara floridana	4	1		4					4	1		4
Anadara notabilis												
Anadara sp.												
Anodontia alba	2		2	4					2		2	4
Anomia simplex												
Arca imbricata												
Arca sp.												
Arca zebra												
Arcopsis adamsi												
Argopecten nucleus		1		1						1		1
Barbatia cancellaria												
Barbatia candida												
Barbatia domingensis												
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata												
Chama macerophylla												
Chama sinuosa												
Chama sp.												
Chione cancellata	37	40	9	49	4	10		10	41	50	9	59
Chione paphia	4	4	2	6					4	4	2	6
Codakia costata	1			1	3	8		8	4	8		8
Codakia orbicularis						1		1		1		1
Codakia orbiculata												
Codakia pectinella		3		3	4	5		5	4	8		8
Coralliophaga coralliophaga												
Crassinella martinicensis	11	7	1	12	23	19	1	24	34	26	2	36
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata			1	1		1		1		1	1	2
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata						1		1		1		1
Divaricella sp.												
Ervilia concentrica					4	1		4	4	1		4
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina		1		1	2	2		2	2	3		3
Gregariella coralliophaga												
Laevicardium laevigatum												
Leporimetis intastriata												
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	16	10	1	17	1			1	17	10	1	18
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis					1	2		2	1	2		2
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri												
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	2			2	7	11		11	9	11		11
Plicatula gibbosa	1	1	2	3					1	1	2	3
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata		2		2						2		2

	M-1918				M-3510				M-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments	1			1		1		1	1	1		1
Semele bellastriata												
Semele proficua												
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata	1			1					1			1
Tellina candeana					3	3		3	3	3		3
Tellina fausta												
Tellina gouldii												
Tellina listeri												
Tellina mera												
Tellina radiata												
Tellina similis												
Tellina sp.			1	1							1	1
Tellina sybaritica					2	3		3	2	3		3
Transennella gerrardi												
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?												
Arene cruentata												
Astralium phoebium												
Atys sp.												
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				1								1
Cerithiopsis emersonii												
Cerithium eburneum				12				13				25
Cerithium eburneum algicola								8				8
Cerithium litteratum				5				6				11
Cerithium lutosum								2				2
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex paupercula												
Diodora dysoni												
Diodora jaumei												
Diodora listeri												
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	M-1918				M-3510				M-TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?								1				1
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus								1				1
Nassarius albus												
Natica canrena				1								1
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis				1								1
Olivella sp. A								1				1
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus												
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola												
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana												

	MA - 1938				MA - 3526				MA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi						2		2		2		2
Americardia media												
Anadara floridana												
Anadara notabilis												
Anadara sp.												
Anodontia alba	3	4	5	9	4	2		4	7	6	5	12
Anomia simplex												
Arca imbricata												
Arca sp.												
Arca zebra												
Arcopsis adamsi	6			6	5	5		5	11	5		11
Argopecten nucleus												
Barbatia cancellaria												
Barbatia candida												
Barbatia domingensis					1	1		1	1	1		1
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?					1	3		3	1	3		3
Bractechlamys antillarum												
Chama congregata						1		1		1		1
Chama macerophylla												
Chama sinuosa												
Chama sp.												
Chione cancellata	4	8		8	7	4		7	11	12		12
Chione paphia	1			1					1			1
Codakia costata	13	8		13	22	30		30	35	38		38
Codakia orbicularis	4	1		4					4	1		4
Codakia orbiculata	8	8		8	13	12		13	21	20		21
Codakia pectinella		1		1	3	3		3	3	4		4
Coralliophaga coralliophaga												
Crassinella martinicensis					2	1		2	2	1		2
Cumingia coarctata					1			1	1			1
Dendostrea frons												
Diplodonta punctata						1		1		1		1
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata	5	3	4	9			1	1	5	3	5	10
Divaricella quadrisulcata	11	17		17	42	45	1	46	53	62	1	63
Divaricella sp.												
Ervilia concentrica					9	7		9	9	7		9
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina												
Gregariella coralliophaga												
Laevicardium laevigatum		1		1						1		1
Leporimetis intastriata												
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	37	36	10	47	1	3		3	38	39	10	49
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis												
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri												
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	3	3		3	9	24		24	12	27		27
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata												

	MA - 1938				MA - 3526				MA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments					2	2		2	2	2		2
Semele bellastriata												
Semele proficua						1		1		1		1
Spondylus americanus												
Strigilla mirabilis		1		1	15	8		15	15	9		15
Tagelus divisus												
Tellina aequistriata						2		2		2		2
Tellina candeana					103	92	1	104	103	92	1	104
Tellina fausta	1			1					1			1
Tellina gouldii												
Tellina listeri						1		1		1		1
Tellina mera					1	2		2	1	2		2
Tellina radiata		1		1		3		3		4		4
Tellina similis	6	6		6		1		1	6	7		7
Tellina sp.												
Tellina sybaritica					4	6		6	4	6		6
Transennella gerrardi												
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.								3				3
Anachis hotessieriana?				2				9				11
Arene cruentata												
Astralium phoebium												
Atys sp.				1				2				3
Bailya parva												
Bittium varium								11				11
Brachycythara biconica								3				3
Bulla striata												
Cerithiopsis emersonii												
Cerithium eburneum				4				15				19
Cerithium eburneum algicola								23				23
Cerithium litteratum								19				19
Cerithium lutosum				10				51				61
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata								2				2
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei								1				1
Diodora listeri												
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa				2				1				3
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus								2				2
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	MA - 1938				MA - 3526				MA - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?												
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus								11				11
Nassarius albus				2				1				3
Natica canrena												
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A				1				7				8
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus												
Puncturella pauper?												
Pyramidella dolabrata								7				7
Pyrgocythara candidissima								2				2
Rissoina cancellata								1				1
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis				1				4				5
Strombus gigas								2				2
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				6				21				27
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana				1				16				17

	MH - 1920				MH - 3511				MH - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#!
?Agriopoma texasianum					1			1	1			1
Americardia guppyi	7	5		7	23	18		23	30	23		30
Americardia media												
Anadara floridana												
Anadara notabilis												
Anadara sp.												
Anodontia alba												
Anomia simplex												
Arca imbricata	5	4	2	7	3	6		6	8	10	2	12
Arca sp.												
Arca zebra												
Arcopsis adamsi	1	2		2		2		2	1	4		4
Argopecten nucleus												
Barbatia cancellaria	4	4		4	2	4		4	6	8		8
Barbatia candida												
Barbatia domingensis	4	2		4	4	6		6	8	8		8
Basterotia quadrata					1			1	1			1
Botula fusca	1	2	1	3			1	1	1	2	2	4
Brachidontes modiolus?		2		2		1		1		3		3
Bractechlamys antillarum												
Chama congregata	1	16		16	1	1		1	2	17		17
Chama macerophylla	2	14		14	1	11		11	3	25		25
Chama sinuosa	1	5		5					1	5		5
Chama sp.												
Chione cancellata	5			5	5	4		5	10	4		10
Chione paphia	2	1	1	3	5	3		5	7	4	1	8
Codakia costata		3		3	1	4		4	1	7		7
Codakia orbicularis		2		2	2	1		2	2	3		3
Codakia orbiculata	1			1	2	3		3	3	3		3
Codakia pectinella	1	1		1	1			1	2	1		2
Coralliophaga coralliophaga												
Crassinella martinicensis	2	2	1	3	1	2		2	3	4	1	5
Cumingia coarctata	2	1	1	3	1			1	3	1	1	4
Dendostrea frons	3	3		3	5	4		5	8	7		8
Diplodonta punctata		3	2	5	3	3	1	4	3	6	3	9
Diplodonta semiaspera						1		1		1		1
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata					2			2	2			2
Divaricella sp.												
Ervilia concentrica	3	4		4	6	4		6	9	8		9
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina					1	2		2	1	2		2
Gregariella coralliophaga												
Laevicardium laevigatum												
Leporimetis intastriata												
Lima lima												
Lima lima?						1		1		1		1
Lima scabra												
Linga pensylvanica	5	4	2	7	4	3		4	9	7	2	11
Lithophaga antillarum		1		1						1		1
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis					1			1	1			1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri	1			1			1	1	1		1	2
Petricola lapicida					1			1	1			1
Pinctada imbricata												
Pitar fulminatus	6	2		6	12	12	1	13	18	14	1	19
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians	1	1		1					1	1		1
Pseudochama radians variegata	1	2		2	2	2		2	3	4		4

	MH - 1920				MH - 3511				MH - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments												
Semele bellastriata					1			1	1			1
Semele proficua												
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana					2	2		2	2	2		2
Tellina fausta												
Tellina gouldii		1		1		1		1		2		2.
Tellina listeri	1			1					1			1
Tellina mera												
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica	5	4		5	6	2		6	11	6		11
Transennella gerrardi	11	7		11	23	18		23	34	25		34
unidentified Chamidae	26	20	1	27					26	20	1	27
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?				1								1
Arene cruentata												
Astralium phoebium												
Atys sp.												
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata								1				1
Cerithiopsis emersonii												
Cerithium eburneum												
Cerithium eburneum algicola				3				1				4
Cerithium litteratum				6				1				7
Cerithium lutosum												
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare				1								1
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. A												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri				1								1
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	MH - 1920				MH - 3511				MH - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa				1				2				3
Mangelia lastica?												
Marginella apicina?												
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus												
Nassarius albus								1				1
Natica canrena				1				1				2
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A								1				1
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus								1				1
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				1								1
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana												

	MOA - 1902				MOA - 3497				MOA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	10	12		12	7	10		10	17	22		22
Americardia media												
Anadara floridana	2	1		2					2	1		2
Anadara notabilis												
Anadara sp.						1		1		1		1
Anodontia alba	7	10	5	15	3	1		3	10	11	5	16
Anomia simplex												
Arca imbricata		1		1		1		1		2		2
Arca sp.		2		2						2		2
Arca zebra		1		1						1		1
Arcopsis adamsi					1			1	1			1
Argopecten nucleus						1		1		1		1
Barbatia cancellaria	1			1					1			1
Barbatia candida												
Barbatia domingensis												
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata												
Chama macerophylla	1	4		4					1	4		4
Chama sinuosa		1		1						1		1
Chama sp.												
Chione cancellata	46	44	3	49	4	8		8	50	52	3	55
Chione paphia	43	40	3	46	4	3	1	5	47	43	4	51
Codakia costata	18	28		28	24	17		24	42	45		45
Codakia orbicularis	6	10	6	16					6	10	6	16
Codakia orbiculata	9	6		9		3		3	9	9		9
Codakia pectinella	10	2		10	8	5	1	9	18	7	1	19
Coralliophaga coralliophaga												
Crassinella martinicensis	34	40	2	42	39	35		39	73	75	2	77
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata		4		4		1		1		5		5
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata					1	1		1	1	1		1
Divaricella quadrisulcata	2			2					2			2
Divaricella sp.												
Ervilia concentrica	10	13		13	3	15	2	17	13	28	2	30
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	9	2		9	2			2	11	2		11
Gregariella coralliophaga												
Laevicardium laevigatum	5	7	1	8		1		1	5	8	1	9
Leporimetis intastriata		1	2	3						1	2	3
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	66	74	42	116	5	7		7	71	81	42	123
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis						3		3		3		3
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri												
Petricola lapicida												
Pinctada imbricata	1			1					1			1
Pitar fulminatus	5	7		7	11	11		11	16	18		18
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata	3			3	1			1	4			4

	MOA - 1902				MOA - 3497				MOA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments					2	2		2	2	2		2
Semele bellastriata												
Semele proficua												
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus		3		3						3		3
Tellina aequistriata	1			1					1			1
Tellina candeana	11	4		11	3	5		5	14	9		14
Tellina fausta												
Tellina gouldii												
Tellina listeri	1	1		1					1	1		1
Tellina mera	5			5			1	1	5		1	6
Tellina radiata												
Tellina similis	2			2	1			1	3			3
Tellina sp.												
Tellina sybaritica	4	5		5	3	3	1	4	7	8	1	9
Transennella gerrardi	1	1		1		2		2	1	3		3
unidentified Chamidae	1	1		1					1	1		1
GASTROPODS:												
Acmaea sp.												
Acteocina sp.								2				2
Anachis hotessieriana?								5				5
Arene cruentata												
Astralium phoebium												
Atys sp.								2				2
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				8				8				16
Cerithiopsis emersonii												
Cerithium eburneum				52				27				79
Cerithium eburneum algicola				12				67				79
Cerithium litteratum				22				40				62
Cerithium lutosum				14				92				106
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri												
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus								1				1
Ithycythara sp.								1				1
Latirus carinifer												
Leucozonia nassa leucozonalis												

	MOA - 1902				MOA - 3497				MOA - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?								4				4
Marginella guttata?												
Marginella pruniosum?				1								1
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				9				6				15
Nassarius albus				1				3				4
Natica canrena				2								2
Natica livida												
Natica sp.												
Odostomia laevigata								1				1
Oliva reticularis												
Olivella sp. A								14				14
Patelloida pustulata								1				1
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				2				1				3
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima				2				1				3
Rissoina cancellata												
Schwartziella bryerea				3				2				5
Seila adamsi				1								1
Sinum perspectivum												
Smaragdia viridis				1				2				3
Strombus gigas												
Strombus gigas samba?				1								1
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				9				16				25
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus								1				1
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana				3				6				9

	MON - 1901				MON - 3496				MON - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	49	41	1	50	43	39	1	44	92	80	2	94
Americardia media												
Anadara floridana												
Anadara notabilis	1	1		1					1	1		1
Anadara sp.												
Anodontia alba		1		1	1			1	1	1		1
Anomia simplex												
Arca imbricata	1	4		4					1	4		4
Arca sp.						1		1		1		1
Arca zebra	1			1					1			1
Arcopsis adamsi												
Argopecten nucleus												
Barbatia cancellaria					1	2		2	1	2		2
Barbatia candida												
Barbatia domingensis						1		1		1		1
Basterotia quadrata												
Botula fusca							1	1			1	1
Brachidontes modiolus?					1			1	1			1
Bractechlamys antillarum												
Chama congregata	1	3		3	1	5		5	2	8		8
Chama macerophylla	2	1		2					2	1		2
Chama sinuosa		3		3						3		3
Chama sp.		1		1						1		1
Chione cancellata	60	53	7	67	18	16		18	78	69	7	85
Chione paphia	102	112	16	128	11	8		11	113	120	16	136
Codakia costata	12	14		14	23	13		23	35	27		35
Codakia orbicularis		3		3						3		3
Codakia orbiculata						1		1		1		1
Codakia pectinella		2		2	2	1		2	2	3		3
Coralliophaga coralliophaga												
Crassinella martinicensis	20	10	2	22	65	59	8	73	85	69	10	95
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata	3		2	5	5	2		5	8	2	2	10
Diplodonta semiaspera			1	1	2			2	2		1	3
Diplodonta sp.												
Divaricella dentata					1	2	1	3	1	2	1	3
Divaricella quadrisulcata												
Divaricella sp.			1	1							1	1
Ervilia concentrica	5	5	1	6	14	15	2	17	19	20	3	23
Gastrochaena hians												
Glycymeris pectinata	1			1					1			1
Gouldia cerina		2		2	1	1		1	1	3		3
Gregariella coralliophaga												
Laevicardium laevigatum	2	3	5	8	3	1		3	5	4	5	10
Leporimetis intastriata			3	3							3	3
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	99	118	80	198	21	17	2	23	120	135	82	217
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis					1			1	1			1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri	1			1		1		1	1	1		1
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	8	13		13	33	36	3	39	41	49	3	52
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata												

	MON - 1901				MON - 3496				MON - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments					1			1	1			1
Semele bellastriata												
Semele proficua			1	1							1	1
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana	3	3		3	2	5		5	5	8		8
Tellina fausta												
Tellina gouldii		1		1						1		1
Tellina listeri		2	1	3	2	2		2	2	4	1	5
Tellina mera						1		1		1		1
Tellina radiata												
Tellina similis		3		3	5	3		5	5	6		6
Tellina sp.												
Tellina sybaritica					13	10	2	15	13	10	2	15
Transennella gerrardi	6	10		10	26	21		26	32	31		32
unidentified Chamidae		2		2	1			1	1	2		2
GASTROPODS:												
Acmaea sp.												
Acteocina sp.								3				3
Anachis hotessieriana?				1				3				4
Arene cruentata												
Astralium phoebium												
Atys sp.				3				16				19
Bailya parva												
Bittium varium												
Brachycythara biconica								1				1
Bulla striata				13				8				21
Cerithiopsis emersonii												
Cerithium eburneum				7				26				33
Cerithium eburneum algicola												
Cerithium litteratum				4				19				23
Cerithium lutosum				7				134				141
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus								2				2
Conus jaspideus verrucosus				2								2
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni				1								1
Diodora jaumei												
Diodora listeri												
Diodora minuta												
Diodora sp.				1				1				2
Emarginula pumila												
Epitoneum sp. A								1				1
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	MON - 1901				MON - 3496				MON - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?				3				3				6
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				1				4				5
Nassarius albus				5				18				23
Natica canrena				1								1
Natica livida												
Natica sp.								5				5
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A				5				27				32
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				8				1				9
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea								1				1
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				4				15				19
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana				1				8				9

	MOS - 1903				MOS - 3498				MOS - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	36	35		36	95	102		102	131	137		137
Americardia media												
Anadara floridana	1			1					1			1
Anadara notabilis												
Anadara sp.												
Anodontia alba		1	1	2						1	1	2
Anomia simplex												
Arca imbricata	21	19		21	20	13		20	41	32		41
Arca sp.												
Arca zebra	2			2					2			2
Arcopsis adamsi		4		4	6	7		7	6	11		11
Argopecten nucleus												
Barbatia cancellaria	6	10		10	25	24		25	31	34		34
Barbatia candida												
Barbatia domingensis	4	6		6	14	21		21	18	27		27
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?		1		1	1	2		2	1	3		3
Bractechlamys antillarum												
Chama congregata	3	18		18		5		5	3	23		23
Chama macerophylla	6	23		23		10		10	6	33		33
Chama sinuosa		3		3						3		3
Chama sp.												
Chione cancellata	19	14	5	24	10	15	1	16	29	29	6	35
Chione paphia	18	17	4	22	3	6		6	21	23	4	27
Codakia costata	16	15		16	37	29		37	53	44		53
Codakia orbicularis	1	3	2	5	2			2	3	3	2	5
Codakia orbiculata	2	2	1	3	1	3	1	4	3	5	2	7
Codakia pectinella	1	3		3	4	7	2	9	5	10	2	12
Coralliophaga coralliophaga												
Crassinella martinicensis	3	7	1	8	26	28	5	33	29	35	6	41
Cumingia coarctata	1			1		3		3	1	3		3
Dendostrea frons	2	3		3					2	3		3
Diplodonta punctata	3	1		3	1	1		1	4	2		4
Diplodonta semiaspera					2			2	2			2
Diplodonta sp.												
Divaricella dentata					1			1	1			1
Divaricella quadrisulcata	5	3	1	6		9		9	5	12	1	13
Divaricella sp.		1		1						1		1
Ervilia concentrica	6	5	1	7	60	52	7	67	66	57	8	74
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina					2	4		4	2	4		4
Gregariella coralliophaga												
Laevicardium laevigatum	4	5	4	9	2	2		2	6	7	4	11
Leporimetis intastriata			5	5							5	5
Lima lima												
Lima lima?												
Lima scabra					1			1	1			1
Linga pensylvanica	80	66	51	131	9	20	3	23	89	86	54	143
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis		1		1	3	2		3	3	3		3
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri												
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	9	13		13	64	72		72	73	85		85
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata		2		2	2	1		2	2	3		3

	MOS - 1903				MOS - 3408				MOS - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments					1	1		1	1	1		1
Semele bellastriata												
Semele proficua	1	1		1					1	1		1
Spondylus americanus		1		1	1			1	1	1		1
Strigilla mirabilis	2	2		2	2			2	4	2		4
Tagelus divisus												
Tellina aequistriata					1			1	1			1
Tellina candeana	7	10		10	14	12		14	21	22		22
Tellina fausta												
Tellina gouldii					3	1		3	3	1		3
Tellina listeri	2	6	1	7	1	1		1	3	7	1	8
Tellina mera					1	1		1	1	1		1
Tellina radiata	3	4		4	1	2		2	4	6		6
Tellina similis	5	4		5	12	6		12	17	10		17
Tellina sp.												
Tellina sybaritica	3	2		3	24	26		26	27	28		28
Transennella gerrardi	2	10		10	22	40		40	24	50		50
unidentified Chamidae	2	3		3					2	3		3
GASTROPODS:												
Acmaea sp.												
Acteocina sp.								6				6
Anachis hotessieriana?				8				15				23
Arene cruentata												
Astralium phoebium												
Atys sp.				5				20				25
Bailya parva				1				1				2
Bittium varium												
Brachycythara biconica												
Bulla striata				7				3				10
Cerithiopsis emersonii												
Cerithium eburneum				5				29				34
Cerithium eburneum algicola								6				6
Cerithium litteratum				6				33				39
Cerithium lutosum				8				27				35
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria								1				1
Conus jaspideus				1				2				3
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens								1				1
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B				1								1
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri				1				1				2
Diodora minuta				1				1				2
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus				1				2				3
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	MOS - 1903				MOS - 3498				MOS - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum				1								1
Lithopoma tuber												
Lucapi[illegible]a suffusa												
Mang[illegible]a [illegible]stica?												
Marginella apicina?				1				2				3
Marginella guttata?								2				2
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis				1								1
Mitrella sp.												
Modulus modulus				1				1				2
Nassarius albus				4				10				14
Natica canrena				2								2
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A				3				21				24
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				6				7				13
Puncturella pauper?								1				1
Pyramidella dolabrata												
Pyrgocythara candidissima								2				2
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum								1				1
Smaragdia viridis								1				1
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				5				21				26
Triphora melanura?								1				1
Triphora turristhomae								1				1
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?								2				2
Turbonilla sp.								1				1
Volvarina avena								1				1
Zebina browniana				2				11				13

	NSE - 1937				NSE - 3525				NSE - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	5	3		5	1			1	6	3		6
Americardia media	9	11	1	12					9	11	1	12
Anadara floridana	28	34	4	38					28	34	4	38
Anadara notabilis	2	3		3	4	3		4	6	6		6
Anadara sp.	6	2	1	7					6	2	1	7
Anodontia alba												
Anomia simplex												
Arca imbricata												
Arca sp.												
Arca zebra	1	1		1					1	1		1
Arcopsis adamsi	10	4		10					10	4		10
Argopecten nucleus	6	14	1	15	2	5		5	8	19	1	20
Barbatia cancellaria												
Barbatia candida												
Barbatia domingensis												
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?					1			1	1			1
Bractechlamys antillarum	2			2					2			2
Chama congregata		3		3						3		3
Chama macerophylla												
Chama sinuosa												
Chama sp.												
Chione cancellata	41	35	4	45	5	2		5	46	37	4	50
Chione paphia	15	15	6	21	1	1		1	16	16	6	22
Codakia costata	22	14		22	1			1	23	14		23
Codakia orbicularis	13	12	9	22	2			2	15	12	9	24
Codakia orbiculata	46	44	2	48	4	5		5	50	49	2	52
Codakia pectinella	10	19		19	2	1		2	12	20		20
Coralliophaga coralliophaga												
Crassinella martinicensis	42	36	6	48	14	11	4	18	56	47	10	66
Cumingia coarctata						1		1		1		1
Dendostrea frons												
Diplodonta punctata	3	3	3	6	1	3		3	4	6	3	9
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica												
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	59	46		59	13	14		14	72	60		72
Gregariella coralliophaga												
Laevicardium laevigatum	5	8	3	11	1	1		1	6	9	3	12
Leporimetis intastriata			4	4							4	4
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	1			1					1			1
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis	1	2		2	2	2		2	3	4		4
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri	1	1		1					1	1		1
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	7	7		7	5	6		6	12	13		13
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata												

	NSE - 1937				NSE - 3525				NSE - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments		4		4	2	4		4	2	8		8
Semele bellastriata												
Semele proficua	3	3	2	5					3	3	2	5
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana												
Tellina fausta	1	2	2	4					1	2	2	4
Tellina gouldii												
Tellina listeri		3		3						3		3
Tellina mera												
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica	2	3		3	2	2		2	4	5		5
Transennella gerrardi												
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?								1				1
Arene cruentata												
Astralium phoebium				5								5
Atys sp.												
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				4				1				5
Cerithiopsis emersonii												
Cerithium eburneum				17				8				25
Cerithium eburneum algicola				18				16				34
Cerithium litteratum				2				7				9
Cerithium lutosum												
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri												
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa				1								1
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis								1				1

	NSE - 1937				NSE - 3525				NSE - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?												
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.								1				1
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				13				3				16
Nassarius albus												
Natica canrena				2								2
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A												
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				1								1
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea				3								3
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				1				1				2
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana				7								7

	OG - 1935				OG - 3523				OG - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	7	8		8	1	2		2	8	10		10
Americardia media	3	3	1	4					3	3	1	4
Anadara floridana	9	12	4	16	3			3	12	12	4	16
Anadara notabilis	8	3	1	9					8	3	1	9
Anadara sp.												
Anodontia alba	6	7	67	74		2	1	3	6	9	68	77
Anomia simplex												
Arca imbricata		1	1	2						1	1	2
Arca sp.												
Arca zebra		3	2	5						3	2	5
Arcopsis adamsi	3	1		3					3	1		3
Argopecten nucleus	4	8		8					4	8		8
Barbatia cancellaria		1		1						1		1
Barbatia candida												
Barbatia domingensis												
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum					1			1	1			1
Chama congregata		2		2						2		2
Chama macerophylla	1		1	2					1		1	2
Chama sinuosa												
Chama sp.												
Chione cancellata	27	33	10	43	6	7		7	33	40	10	50
Chione paphia	11	26	8	34		1		1	11	27	8	35
Codakia costata	13	17		17	8	6		8	21	23		23
Codakia orbicularis	7	17	25	42					7	17	25	42
Codakia orbiculata	13	14		14	1	2		2	14	16		16
Codakia pectinella	15	18		18	11	12		12	26	30		30
Coralliophaga coralliophaga												
Crassinella martinicensis	53	25	3	56	25	17		25	78	42	3	81
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata												
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica	1	2		2	3	2		3	4	4		4
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	5	7		7	5	8		8	10	15		15
Gregariella coralliophaga												
Laevicardium laevigatum	23	16	13	36	1			1	24	16	13	37
Leporimetis intastriata		2	18	20						2	18	20
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	3	4	4	8	1			1	4	4	4	8
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis	1			1		2		2	1	2		2
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri												
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	15	12		15	6	8		8	21	20		21
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians			1	1							1	1
Pseudochama radians variegata												

	OG - 1935				OG - 3523				OG - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments					1			1	1			1
Semele bellastriata												
Semele proficua	1		1	2					1		1	2
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana	3	3		3	3	2		3	6	5		6
Tellina fausta												
Tellina gouldii												
Tellina listeri	1	1	2	3		1		1	1	2	2	4
Tellina mera												
Tellina radiata												
Tellina similis		3		3						3		3
Tellina sp.												
Tellina sybaritica	7	20		20	2	12		12	9	32		32
Transennella gerrardi												
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.				1								1
Anachis hotessieriana?				1								1
Arene cruentata												
Astralium phoebium												
Atys sp.				1				2				3
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				3								3
Cerithiopsis emersonii												
Cerithium eburneum				27				9				36
Cerithium eburneum algicola				1								1
Cerithium litteratum				26				26				52
Cerithium lutosum												
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri												
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A				1								1
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	OG - 1835				OG - 3523				OG - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?				2				1				3
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				8				4				12
Nassarius albus												
Natica canrena				5								5
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A												
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				1								1
Puncturella pauper?												
Pyramidella dolabrata				3								3
Pyrgocythara candidissima												
Rissoina cancellata								3				3
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas				2								2
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				8				7				15
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena				1								1
Zebina browniana				4				4				8

	OGA - 1936				OGA - 3524				OGA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	4	5		5	6	7		7	10	12		12
Americardia media	2	1		2					2	1		2
Anadara floridana	3	3		3					3	3		3
Anadara notabilis	3			3		1		1	3	1		3
Anadara sp.												
Anodontia alba	10	15	33	48					10	15	33	48
Anomia simplex												
Arca imbricata		1		1						1		1
Arca sp.												
Arca zebra	3	2	2	5					3	2	2	5
Arcopsis adamsi		1		1		2		2		3		3
Argopecten nucleus	4	4	1	5					4	4	1	5
Barbatia cancellaria	2			2					2			2
Barbatia candida												
Barbatia domingensis												
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata		1		1		1		1		2		2
Chama macerophylla	1		2	3					1		2	3
Chama sinuosa												
Chama sp.												
Chione cancellata	19	26	7	33	3	3		3	22	29	7	36
Chione paphia	13	14	6	20	2	2		2	15	16	6	22
Codakia costata	17	19		19	9	9	1	10	26	28	1	29
Codakia orbicularis	4	9	13	22					4	9	13	22
Codakia orbiculata	7	7		7	3	2		3	10	9		10
Codakia pectinella	23	21		23	10	17		17	33	38		38
Coralliophaga coralliophaga												
Crassinella martinicensis	45	50	1	51	18	15		18	63	65	1	66
Cumingia coarctata												
Dendostrea frons		1		1						1		1
Diplodonta punctata					1	2		2	1	2		2
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica	2	1		2		1		1	2	2		2
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	7	5		7	4	6		6	11	11		11
Gregariella coralliophaga												
Laevicardium laevigatum	20	25	15	40	3	2		3	23	27	15	42
Leporimetis intastriata			7	7							7	7
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica		1	3	4						1	3	4
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis		1		1	1			1	1	1		1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri												
Petricola lapicida												
Pinctada imbricata			1	1							1	1
Pitar fulminatus	8	13		13	7	14		14	15	27		27
Plicatula gibbosa		1		1						1		1
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata												

	OGA - 1936				OGA - 3524				OGA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments	2	1		2					2	1		2
Semele bellastriata												
Semele proficua												
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana	2			2	5	1		5	7	1		7
Tellina fausta												
Tellina gouldii												
Tellina listeri	3	1	6	9					3	1	6	9
Tellina mera		1		1						1		1
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica	21	22		22	9	9		9	30	31		31
Transennella gerrardi												
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?												
Arene cruentata												
Astralium phoebium												
Atys sp.				2				3				5
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				1								1
Cerithiopsis emersonii				1								1
Cerithium eburneum				17				4				21
Cerithium eburneum algicola				7				3				10
Cerithium litteratum				18				16				34
Cerithium lutosum												
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni				1								1
Diodora jaumei												
Diodora listeri												
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa				2								2
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	OGA - 1936				OGA - 3524				OGA - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?												
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				2				2				4
Nassarius albus				1								1
Natica canrena				3								3
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A								1				1
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus								1				1
Puncturella pauper?												
Pyramidella dolabrata				1				3				4
Pyrgocythara candidissima				1								1
Rissoina cancellata				2								2
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				3								3
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana				4								4

	PWA - 1928				PWA - 3517				PWA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	2	1		2	1	3		3	3	4		4
Americardia media	5	1		5					5	1		5
Anadara floridana	3	4		4					3	4		4
Anadara notabilis												
Anadara sp.												
Anodontia alba	2	1	6	8	1			1	3	1	6	8
Anomia simplex												
Arca imbricata												
Arca sp.												
Arca zebra		1		1						1		1
Arcopsis adamsi		1		1						1		1
Argopecten nucleus												
Barbatia cancellaria												
Barbatia candida												
Barbatia domingensis												
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata						1		1		1		1
Chama macerophylla												
Chama sinuosa												
Chama sp.												
Chione cancellata	12	16	3	19	6	1		6	18	17	3	21
Chione paphia	1	4	2	6	3			3	4	4	2	6
Codakia costata	22	15		22	17	19		19	39	34		39
Codakia orbicularis	16	19	21	40					16	19	21	40
Codakia orbiculata	4	2	2	6	1			1	5	2	2	7
Codakia pectinella	9	13		13	6	6		6	15	19		19
Coralliophaga coralliophaga												
Crassinella martinicensis	147	111	11	158	87	68	10	97	234	179	21	255
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata			1	1			1	1			2	2
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica												
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	13	16		16	14	13	1	15	27	29	1	30
Gregariella coralliophaga												
Laevicardium laevigatum	2		2	4	1			1	3		2	5
Leporimetis intastriata			2	2							2	2
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	4	3	3	7	1			1	5	3	3	8
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis		1		1						1		1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri	1	2	1	3					1	2	1	3
Petricola lapicida												
Pinctada imbricata	1			1					1			1
Pitar fulminatus	7	7		7	5	10	1	11	12	17	1	18
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata												

	PWA - 1928				PWA - 3517				PWA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments						2		2		2		2
Semele bellastriata												
Semele proficua	1		1	2					1		1	2
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana	1			1					1			1
Tellina fausta												
Tellina gouldii												
Tellina listeri			1	1							1	1
Tellina mera		2		2						2		2
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica					3	4		4	3	4		4
Transennella gerrardi												
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?												
Arene cruentata												
Astralium phoebium												
Atys sp.				1								1
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				1				1				2
Cerithiopsis emersonii												
Cerithium eburneum				25				10				35
Cerithium eburneum algicola								17				17
Cerithium litteratum				12				13				25
Cerithium lutosum				1								1
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri				1								1
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B								1				1
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus				1								1
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	PWA - 1928				PWA - 3517				PWA - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?								1				1
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				5				4				9
Nassarius albus				1								1
Natica canrena				1				1				2
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A												
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				1				1				2
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi				1								1
Sinum perspectivum												
Smaragdia viridis				1								1
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				10				3				13
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana												

	PWD - 1927				PWD - 3516				PWD - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	3	2		3		3		3	3	5		5
Americardia media	6	6	2	8					6	6	2	8
Anadara floridana	22	18	7	29					22	18	7	29
Anadara notabilis	10	6		10	3			3	13	6		13
Anadara sp.	1	3		3					1	3		3
Anodontia alba	4	5	10	15					4	5	10	15
Anomia simplex												
Arca imbricata	1		2	3					1		2	3
Arca sp.												
Arca zebra												
Arcopsis adamsi	3	5		5	1			1	4	5		5
Argopecten nucleus	3	3		3	1			1	4	3		4
Barbatia cancellaria		1		1						1		1
Barbatia candida												
Barbatia domingensis												
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?	2			2					2			2
Bractechlamys antillarum	1			1					1			1
Chama congregata		1		1						1		1
Chama macerophylla		1		1						1		1
Chama sinuosa												
Chama sp.												
Chione cancellata	[illegible]	31	10	44	3	4		4	37	35	10	47
Chione paphia	2	1	1	3					2	1	1	3
Codakia costata	27	29		29	13	13		13	40	42		42
Codakia orbicularis	28	20	37	65					28	20	37	65
Codakia orbiculata	5	9	1	10		1		1	5	10	1	11
Codakia pectinella	43	46		46	12	22	5	27	55	68	5	73
Coralliophaga coralliophaga												
Crassinella martinicensis	149	136	10	159	63	53	3	66	212	189	13	225
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata					1	1		1	1	1		1
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica	1	1		1					1	1		1
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	70	55		70	26	31	2	33	96	86	2	98
Gregariella coralliophaga												
Laevicardium laevigatum	7	3		7					7	3		7
Leporimetis intastriata												
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	1	3	2	5					1	3	2	5
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis	3			3	3	4		4	6	4		6
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri	1			1					1			1
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	8	14	1	15	17	15	1	18	25	29	2	31
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata												

	PWD - 1927				PWD - 3516				PWD - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments	7	7		7	1	1		1	8	8		8
Semele bellastriata												
Semele proficua	1			1					1			1
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus		1		1						1		1
Tellina aequistriata												
Tellina candeana					2			2	2			2
Tellina fausta												
Tellina gouldii												
Tellina listeri												
Tellina mera												
Tellina radiata												
Tellina similis												
Tellina sp.			2	2							2	2
Tellina sybaritica												
Transennella gerrardi												
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?				2				1				3
Arene cruentata												
Astralium phoebium												
Atys sp.												
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata												
Cerithiopsis emersonii				1								1
Cerithium eburneum				140				18				158
Cerithium eburneum algicola				5				31				36
Cerithium litteratum				18				14				32
Cerithium lutosum												
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare								1				1
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri												
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	PWD - 1927				PWD - 3516				PWD - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?				2				1				3
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				17				4				21
Nassarius albus								1				1
Natica canrena												
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A												
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus								1				1
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima				1								1
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				15				3				18
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana				18				1				19

	SD - 1831				SD - 3519				SD - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	3	3		3	7	7		7	10	10		10
Americardia media	1	3		3					1	3		3
Anadara floridana	1	3		3					1	3		3
Anadara notabilis												
Anadara sp.												
Anodontia alba	7	4	39	46	4			4	11	4	39	50
Anomia simplex												
Arca imbricata		2		2						2		2
Arca sp.												
Arca zebra						1		1		1		1
Arcopsis adamsi	3	1		3	1	1		1	4	2		4
Argopecten nucleus												
Barbatia cancellaria	1			1					1			1
Barbatia candida												
Barbatia domingensis	3	1		3					3	1		3
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata		2		2						2		2
Chama macerophylla	1	3		3					1	3		3
Chama sinuosa												
Chama sp.												
Chione cancellata	8	7		8	6	2		6	14	9		14
Chione paphia	19	24	18	42	1	3		3	20	27	18	45
Codakia costata	9	10		10					9	10		10
Codakia orbicularis	4	4	14	18	9	5		9	13	9	14	27
Codakia orbiculata	2	4		4	1	4		4	3	8		8
Codakia pectinella	16	18		18	17	14		17	33	32		33
Coralliophaga coralliophaga												
Crassinella martinicensis	30	20	1	31	15	18	2	20	45	38	3	48
Cumingia coarctata	1			1					1			1
Dendostrea frons												
Diplodonta punctata						2		2		2		2
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica	1			1	2	6		6	3	6		6
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	3	6		6	1	7		7	4	13		13
Gregariella coralliophaga												
Laevicardium laevigatum	49	32	30	79	1	1		1	50	33	30	80
Leporimetis intastriata	2		4	6					2		4	6
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	4	4	4	8					4	4	4	8
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis												
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri												
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	12	17		17	14	12		14	26	29		29
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata												

	SD-1931				SD-3519				SD-TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments												
Semele bellastriata												
Semele proficua												
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus		2		2						2		2
Tellina aequistriata		1		1						1		1
Tellina candeana	1			1	8	8		8	9	8		9
Tellina fausta												
Tellina gouldii												
Tellina listeri	3		4	7			1	1	3		5	8
Tellina mera												
Tellina radiata												
Tellina similis	4	2		4	8	8		8	12	10		12
Tellina sp.												
Tellina sybaritica	18	21		21	19	23		23	37	44		44
Transennella gerrardi												
unidentified Chamidae	1			1					1			1
GASTROPODS:												
Acmaea sp.												
Acteocina sp.								1				1
Anachis hotessieriana?				6				1				7
Arene cruentata												
Astralium phoebium				1								1
Atys sp.								1				1
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				14				8				22
Cerithiopsis emersonii												
Cerithium eburneum				10				9				19
Cerithium eburneum algicola				2								2
Cerithium litteratum				9				27				36
Cerithium lutosum				2				2				4
Cerithium sp.												
Cheilea equestris								1				1
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri				1								1
Diodora minuta				1								1
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	SD - 1931				SD - 3519				SD - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?				1								1
Marginella apicina?								1				1
Marginella guttata?												
Marginella pruniosum?				2								2
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				2								2
Nassarius albus				1				3				4
Natica canrena				1								1
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis				1								1
Olivella sp. A								2				2
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				1				1				2
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata				2								2
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas				2								2
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				11				8				19
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana				5				5				10

	SDA - 1932				SDA - 3520				SDA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	22	27		27	10	12		12	32	39		39
Americardia media					1			1	1			1
Anadara floridana		2		2						2		2
Anadara notabilis	1			1					1			1
Anadara sp.												
Anodontia alba	1	2	3	5	1			1	2	2	3	5
Anomia simplex												
Arca imbricata	2	1		2	4			4	6	1		6
Arca sp.												
Arca zebra		1	1	2	1			1	1	1	1	2
Arcopsis adamsi	1			1	5	5		5	6	5		6
Argopecten nucleus												
Barbatia cancellaria	1	4		4	1	1		1	2	5		5
Barbatia candida	1			1					1			1
Barbatia domingensis	2	6		6	3			3	5	6		6
Basterotia quadrata					2			2	2			2
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata		6		6		3		3		9		9
Chama macerophylla		7		7		3		3		10		10
Chama sinuosa												
Chama sp.												
Chione cancellata	18	21	5	26	3	7		7	21	28	5	33
Chione paphia	51	44	17	68	7	3		7	58	47	17	75
Codakia costata	8	10		10	8	5		8	16	15		16
Codakia orbicularis	5	3	7	12					5	3	7	12
Codakia orbiculata	7	2		7	4	2		4	11	4		11
Codakia pectinella	4	6		6	8	5		8	12	11		12
Coralliophaga coralliophaga												
Crassinella martinicensis	36	28	4	40	30	19	1	31	66	47	5	71
Cumingia coarctata			1	1							1	1
Dendostrea frons												
Diplodonta punctata	1	1		1		1		1	1	2		2
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica	2	1		2	9	8	1	10	11	9	1	12
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	2	4		4	9	3		9	11	7		11
Gregariella coralliophaga							1	1			1	1
Laevicardium laevigatum	14	10	13	27	3	3		3	17	13	13	30
Leporimetis intastriata	1	1	7	8					1	1	7	8
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	2	4	7	11					2	4	7	11
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis						1		1		1		1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri	1			1					1			1
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	13	15	1	16	15	26		26	28	41	1	42
Plicatula gibbosa			1	1							1	1
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata	1	1		1					1	1		1

	SDA - 1932				SDA - 3520				SDA - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments						2		2		2		2
Semele bellastriata												
Semele proficua												
Spondylus americanus					1			1	1			1
Strigilla mirabilis												
Tagelus divisus			1	1							1	1
Tellina aequistriata												
Tellina candeana					2			2	2			2
Tellina fausta												
Tellina gouldii												
Tellina listeri	4	2	5	9					4	2	5	9
Tellina mera												
Tellina radiata												
Tellina similis					5	5		5	5	5		5
Tellina sp.												
Tellina sybaritica	17	16		17	14	20		20	31	36		36
Transennella gerrardi	1			1					1			1
unidentified Chamidae	1			1					1			1
GASTROPODS:												
Acmaea sp.												
Acteocina sp.				1				2				3
Anachis hotessieriana?				1				2				3
Arene cruentata												
Astralium phoebium												
Atys sp.												
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				8				5				13
Cerithiopsis emersonii												
Cerithium eburneum												
Cerithium eburneum algicola				9				6				15
Cerithium litteratum				9				17				26
Cerithium lutosum												
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens								1				1
Crepidula aculeata												
Cymatium pileare				1								1
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri				2								2
Diodora minuta				1								1
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer								1				1
Leucozonia nassa leucozonalis				1								1

	SDA - 1932				SDA - 3520				SDA - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum				2								2
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?				1								1
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus												
Nassarius albus								3				3
Natica canrena				1								1
Natica livida								1				1
Natica sp.								1				1
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A				2								2
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				5								5
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata								3				3
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.								1				1
Thais deltoidea												
Tricolia thalassicola				4				4				8
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus								1				1
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana				4				2				6

	SDB - 1933				SDB - 3521				SDB - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	6	3		6	13	12		13	19	15		19
Americardia media	1			1					1			1
Anadara floridana	1	1		1					1	1		1
Anadara notabilis												
Anadara sp.												
Anodontia alba	5	2	15	20					5	2	15	20
Anomia simplex												
Arca imbricata	4	3		4	4	3		4	8	6		8
Arca sp.												
Arca zebra												
Arcopsis adamsi	1	3	1	4	7	2		7	8	5	1	9
Argopecten nucleus		1		1						1		1
Barbatia cancellaria	4	2		4	5	1		5	9	3		9
Barbatia candida												
Barbatia domingensis	2	4		4	4	4		4	6	8		8
Basterotia quadrata	1			1		1		1	1	1		1
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum					1			1	1			1
Chama congregata	1	6		6	1	7		7	2	13		13
Chama macerophylla	5	3		5					5	3		5
Chama sinuosa		1		1						1		1
Chama sp.												
Chione cancellata	15	21	4	25	4	4		4	19	25	4	29
Chione paphia	31	37	22	59	4	3	1	5	35	40	23	63
Codakia costata	3	9		9	3	8		8	6	17		17
Codakia orbicularis	3	1	5	8					3	1	5	8
Codakia orbiculata	4	4		4	3	2		3	7	6		7
Codakia pectinella	12	14		14	6	8		8	18	22		22
Coralliophaga coralliophaga												
Crassinella martinicensis	32	31	2	34	16	12	1	17	48	43	3	51
Cumingia coarctata	2	1		2	1	3		3	3	4		4
Dendostrea frons	3	4	2	6	1	1		1	4	5	2	7
Diplodonta punctata	1			1	3	2		3	4	2		4
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica	14	26		26	21	17		21	35	43		43
Gastrochaena hians		1		1						1		1
Glycymeris pectinata												
Gouldia cerina	6	4		6	3	4		4	9	8		9
Gregariella coralliophaga												
Laevicardium laevigatum	14	16	9	25	2	2		2	16	18	9	27
Leporimetis intastriata		1	9	10						1	9	10
Lima lima												
Lima lima?												
Lima scabra		1		1						1		1
Linga pensylvanica	4	10	8	18	3			3	7	10	8	18
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis					1			1	1			1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri	1	1	1	2			1	1	1	1	2	3
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	20	19		20	22	22		22	42	41		42
Plicatula gibbosa							1	1			1	1
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata												

	SDB - 1933				SDB - 3521				SDB - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments	1			1	1			1	2			2
Semele bellastriata												
Semele proficua		2		2						2		2
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus					1			1	1			1
Tellina aequistriata						2		2		2		2
Tellina candeana					7	4		7	7	4		7
Tellina fausta												
Tellina gouldii												
Tellina listeri	1	3	6	9	1			1	2	3	6	9
Tellina mera												
Tellina radiata												
Tellina similis	3	1		3	2			2	5	1		5
Tellina sp.	1	2		2					1	2		2
Tellina sybaritica	28	33		33	34	41		41	62	74		74
Transennella gerrardi												
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?				1				2				3
Arene cruentata												
Astralium phoebium												
Atys sp.				1				1				2
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				1								1
Cerithiopsis emersonii				1								1
Cerithium eburneum				8				1				9
Cerithium eburneum algicola								1				1
Cerithium litteratum				12				9				21
Cerithium lutosum				1				1				2
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri				1				1				2
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa				1								1
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus				1								1
Ithycythara sp.				1								1
Latirus carinifer												
Leucozonia nassa leucozonalis												

	SDB - 1933				SDB - 3521				SDB - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?												
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.								1				1
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				1								1
Nassarius albus												
Natica canrena				3								3
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A												
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				1								1
Puncturella pauper?				1				2				3
Pyramidella dolabrata				1								1
Pyrgocythara candidissima												
Rissoina cancellata				1								1
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas				2								2
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				2								2
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina a[illegible]na												
Zebina browniana				3				2				5

	SDC - 1934				SDC - 3522				SDC - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi	3	4		4	4	9		9	7	13		13
Americardia media	3	3	1	4					3	3	1	4
Anadara floridana	13	9	2	15					13	9	2	15
Anadara notabilis	10	3		10	6	4		6	16	7		16
Anadara sp.	1	2		2					1	2		2
Anodontia alba	10	10	27	37		5		5	10	15	27	42
Anomia simplex												
Arca imbricata						2		2		2		2
Arca sp.												
Arca zebra	7	4	2	9	1	2		2	8	6	2	10
Arcopsis adamsi					1	2		2	1	2		2
Argopecten nucleus	4	6		6	3	3		3	7	9		9
Barbatia cancellaria												
Barbatia candida												
Barbatia domingensis												
Basterotia quadrata					1			1	1			1
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata		1		1	1			1	1	1		1
Chama macerophylla												
Chama sinuosa												
Chama sp.												
Chione cancellata	28	28	3	31	15	16		16	43	44	3	47
Chione paphia	3	4	1	5	2	2		2	5	6	1	7
Codakia costata	16	14		16	16	18		18	32	32		32
Codakia orbicularis	6	3	16	22		2		2	6	5	16	22
Codakia orbiculata	6	11	1	12	8	9		9	14	20	1	21
Codakia pectinella	19	17		19	36	45		45	55	62		62
Coralliophaga coralliophaga												
Crassinella martinicensis	32	32		32	50	48		50	82	80		82
Cumingia coarctata		1		1						1		1
Dendostrea frons												
Diplodonta punctata												
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica	2	2		2	6	3		6	8	5		8
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	10	6	1	11	29	31		31	39	37	1	40
Gregariella coralliophaga												
Laevicardium laevigatum	8	3	3	11					8	3	3	11
Leporimetis intastriata												
Lima lima						1		1		1		1
Lima lima?												
Lima scabra												
Linga pensylvanica	1	3	1	4		1		1	1	4	1	5
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis						2		2		2		2
Nucula aegeensis?												
Pectinid fragments	2			2					2			2
Periglypta listeri	1			1	1	1		1	2	1		2
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	17	15		17	34	37		37	51	52		52
Plicatula gibbosa			1	1			1	1			2	2
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata	1			1	1			1	2			2

	SDC - 1934				SDC - 3522				SDC - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments		1		1	5	4		5	5	5		5
Semele bellastriata												
Semele proficua												
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus		1		1						1		1
Tellina aequistriata		1		1	2	3		3	2	4		4
Tellina candeana	2			2	4	2		4	6	2		6
Tellina fausta												
Tellina gouldii					3			3	3			3
Tellina listeri	1	1	3	4	1			1	2	1	3	5
Tellina mera		2	1	3						2	1	3
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica	12	13	1	14	32	47		47	44	60	1	61
Transennella gerrardi	1			1					1			1
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.				1								1
Anachis hotessieriana?				1				7				8
Arene cruentata												
Astralium phoebium												
Atys sp.								2				2
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				3				3				6
Cerithiopsis emersonii								1				1
Cerithium eburneum				47				32				79
Cerithium eburneum algicola				16				41				57
Cerithium litteratum				172				190				362
Cerithium lutosum								8				8
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri												
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa				1								1
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer								2				2
Leucozonia nassa leucozonalis												

	SDC - 1934				SDC - 3522				SDC - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?												
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				4				11				15
Nassarius albus				1				5				6
Natica canrena				5								5
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A								2				2
Patelloida pustulata												
Phyllonotus pomum				1								1
Pisania auritula												
Polinices lacteus				1								1
Puncturella pauper?												
Pyramidella dolabrata								7				7
Pyrgocythara candidissima												
Rissoina cancellata								1				1
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas				4								4
Strombus gigas samba?				1								1
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				9				17				26
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana				4				8				12

	TG - 1930				TG - 3518				TG - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi		1		1	4	2		4	4	3		4
Americardia media	16	16	2	18	2	1		2	18	17	2	20
Anadara floridana	37	36	3	40	1	1		1	38	37	3	41
Anadara notabilis	11	8		11					11	8		11
Anadara sp.												
Anodontia alba	5	12	16	28	1			1	6	12	16	28
Anomia simplex												
Arca imbricata	3	2	1	4					3	2	1	4
Arca sp.												
Arca zebra	2	3		3					2	3		3
Arcopsis adamsi						1		1		1		1
Argopecten nucleus	6	15	1	16					6	15	1	16
Barbatia cancellaria												
Barbatia candida												
Barbatia domingensis		2		2						2		2
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?	2	2		2					2	2		2
Bractechlamys antillarum												
Chama congregata	1			1					1			1
Chama macerophylla	1	4		4					1	4		4
Chama sinuosa												
Chama sp.												
Chione cancellata	39	35	10	49	14	9		14	53	44	10	63
Chione paphia	2	2	1	3					2	2	1	3
Codakia costata	19	23		23	6	10		10	25	33		33
Codakia orbicularis	24	15	23	47	1			1	25	15	23	48
Codakia orhiculata	17	22	4	26	5	6	1	7	22	28	5	33
Codakia pectinella	28	25		28	23	19	3	26	51	44	3	54
Coralliophaga coralliophaga												
Crassinella martinicensis	25	24	1	26	32	22	1	33	57	46	2	59
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata	1			1		1		1	1	1		1
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica					5	6	1	7	5	6	1	7
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	18	30		30	41	35		41	59	65		65
Gregariella coralliophaga												
Laevicardium laevigatum	9	5	7	16					9	5	7	16
Leporimetis intastriata			1	1							1	1
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica	1			1					1			1
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis					1	1		1	1	1		1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri		1		1						1		1
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	9	7		9	12	15	1	16	21	22	1	23
Plicatula gibbosa		1	1	2						1	1	2
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata												

	TG - 1930				TG - 3518				TG - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pterid fragments					3	1		3	3	1		3
Semele bellastriata												
Semele proficua	4	3	1	5					4	3	1	5
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata	1			1					1			1
Tellina candeana	1			1	4	2		4	5	2		5
Tellina fausta												
Tellina gouldii												
Tellina listeri		1		1						1		1
Tellina mera	1	2		2					1	2		2
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica	13	7		13	6	12		12	19	19		19
Transennella gerrardi												
unidentified Chamidae			1	1							1	1
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?				4				1				5
Arene cruentata				1								1
Astralium phoebium				1								1
Atys sp.								3				3
Bailya parva												
Bittium varium												
Brachycythara biconica								1				1
Bulla striata				7				2				9
Cerithiopsis emersonii												
Cerithium eburneum				35				21				56
Cerithium eburneum algicola				4				12				16
Cerithium litteratum				25				46				71
Cerithium lutosum				2								2
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri												
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa				2								2
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis				1								1

	TG - 1930				TG - 3518				TG - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa												
Mangelia lastica?												
Marginella apicina?								1				1
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				8				8				16
Nassarius albus				2				2				4
Natica canrena				7								7
Natica livida												
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A												
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				1								1
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis				2				1				3
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola				8				4				12
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana				11				8				19

	TFB - 1905				U - 1924				YY - 1926			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi					2			2				
Americardia media					2	4	1	5		1		1
Anadara floridana					5	3		5				
Anadara notabilis												
Anadara sp.												
Anodontia alba						1	1	2				
Anomia simplex												
Arca imbricata	1	2		2							1	1
Arca sp.												
Arca zebra												
Arcopsis adamsi												
Argopecten nucleus					5	2		5		2		2
Barbatia cancellaria	7	12		12								
Barbatia candida												
Barbatia domingensis	3	4		4								
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata										1	1	2
Chama macerophylla												
Chama sinuosa												
Chama sp.		1		1								
Chione cancellata					5	6		6	3	1		3
Chione paphia												
Codakia costata					1	1		1				
Codakia orbicularis	1			1	2		1	3	1	1		1
Codakia orbiculata					1			1			1	1
Codakia pectinella					1			1				
Coralliophaga coralliophaga												
Crassinella martinicensis					1			1		1		1
Cumingia coarctata		1		1								
Dendostrea frons												
Diplodonta punctata												
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata		1		1								
Divaricella sp.												
Ervilia concentrica												
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina					1			1				
Gregariella coralliophaga												
Laevicardium laevigatum					3	1		3	1	2		2
Leporimetis intastriata					1			1			1	1
Lima lima						1		1				
Lima lima?		1		1								
Lima scabra		1		1								
Linga pensylvanica										1		1
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis												
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri					1			1				
Petricola lapicida												
Pinctada imbricata						1		1				
Pitar fulminatus									1			1
Plicatula gibbosa									1			1
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata										1		1

	TFB - 1905				U - 1924				YY - 1926			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments									1	1		1
Semele bellastriata												
Semele proficua												
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana												
Tellina fausta	3	3		3								
Tellina gouldii												
Tellina listeri												
Tellina mera												
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica												
Transennella gerrardi												
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?				7								
Arene cruentata												
Astralium phoebium												
Atys sp.												
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				5				4				7
Cerithiopsis emersonii												
Cerithium eburneum								2				
Cerithium eburneum algicola				8								1
Cerithium litteratum				16								
Cerithium lutosum												
Cerithium sp.												2
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria				19								
Conus jaspideus				1								
Conus jaspideus verrucosus				1								
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum				5								
Cypraea sp. A												
Cypraea sp. B				5								
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri				8								
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa				2								
Fissurella barbadensis												
Hemitoma emarginata				3								
Hipponix antiquatus				8								
Ithycythara sp.												
Latirus carinifer				7								
Leucozonia nassa leucozonalis				10								

	TFB - 1905				U - 1924				YY - 1926			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum				30								1
Lithopoma tuber												
Lucapina suffusa				4								
Mangelia lastica?												
Marginella apicina?												
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus				7								
Nassarius albus				3								
Natica canrena												
Natica livida				1								
Natica sp.												
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A				2								
Patelloida pustulata				10								
Phyllonotus pomum												
Pisania auritula				1								
Polinices lacteus				4								
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas				3								
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea				2								
Tricolia thalassicola												
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?				1								
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana												

	TSE - 1939				TSE - 3489				TSE - 3527				TSE - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum																
Americardia guppyi	4	9		9	1			1	8	7		8	13	16		16
Americardia media	4	4		4					3	1		3	7	5		7
Anadara floridana	4	3	2	6			1	1					4	3	3	7
Anadara notabilis	3	4		4									3	4		4
Anadara sp.																
Anodontia alba	10	11	98	109	1	1	2	3	5			5	16	12	100	116
Anomia simplex																
Arca imbricata																
Arca sp.																
Arca zebra																
Arcopsis adamsi	2	2		2		1		1	1	2		2	3	5		5
Argopecten nucleus		2	1	3	1			1					1	2	1	3
Barbatia cancellaria																
Barbatia candida																
Barbatia domingensis									1			1	1			1
Basterotia quadrata																
Botula fusca																
Brachidontes modiolus?	2	3		3					1	1		1	3	4		4
Bractechlamys antillarum		1		1										1		1
Chama congregata																
Chama macerophylla																
Chama sinuosa																
Chama sp.																
Chione cancellata	92	98	18	116	16	12		16	27	28		28	135	138	18	156
Chione paphia	15	9	5	20	2			2					17	9	5	22
Codakia costata	18	22		22	6	10		10	18	6		18	42	38		42
Codakia orbicularis	2	2	5	7	1			1					3	2	5	8
Codakia orbiculata	3	5	1	6	1			1	2	3		3	6	8	1	9
Codakia pectinella	1	3		3					1			1	2	3		3
Coralliophaga coralliophaga																
Crassinella martinicensis	4	2		4	1			1	1	3		3	6	5		6
Cumingia coarctata										1		1		1		1
Dendostrea frons																
Diplodonta punctata																
Diplodonta semiaspera																
Diplodonta sp.																
Divaricella dentata																
Divaricella quadrisulcata	1			1									1			1
Divaricella sp.																
Ervilia concentrica	1	1		1					3	3		3	4	4		4
Gastrochaena hians																
Glycymeris pectinata																
Gouldia cerina									1	1		1	1	1		1
Gregariella coralliophaga																
Laevicardium laevigatum		5	3	8										5	3	8
Leporimetis intastriata		1	13	14										1	13	14
Lima lima																
Lima lima?																
Lima scabra																
Linga pensylvanica	72	85	42	127	3		2	5	2	3		3	77	88	44	132
Lithophaga antillarum																
Lithophaga nigra																
Lithophaga sp.																
Musculus lateralis		1		1					1			1	1	1		1
Nucula aegeensis?																
Pectinid fragments																
Periglypta listeri	1		1	2									1		1	2
Petricola lapicida																
Pinctada imbricata																
Pitar fulminatus	4	4		4	2			2	7	13		13	13	17		17
Plicatula gibbosa																
?Poromya sp.																
Pseudochama radians																
Pseudochama radians variegata																

	TSE - 1939				TSE - 3489				TSE - 3527				TSE - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments		1		1										1		1
Semele bellastriata																
Semele proficua																
Spondylus americanus																
Strigilla mirabilis																
Tagelus divisus									1			1	1			1
Tellina aequistriata									1			1	1			1
Tellina candeana	6	4		6					21	11		21	27	15		27
Tellina fausta																
Tellina gouldii																
Tellina listeri	1	2	1	3									1	2	1	3
Tellina mera									2			2	2			2
Tellina radiata																
Tellina similis	5	5		5		1	1	2	7	2		7	12	8	1	13
Tellina sp.																
Tellina sybaritica	2	2		2	1			1		1		1	3	3		3
Transennella gerrardi																
unidentified Chamidae																
GASTROPODS:																
Acmaea sp.																
Acteocina sp.				6								5				11
Anachis hotessieriana?				1												1
Arene cruentata																
Astralium phoebium																
Atys sp.												8				8
Bailya parva																
Bittium varium																
Brachycythara biconica												3				3
Bulla striata				91				29				15				135
Cerithiopsis emersonii																
Cerithium eburneum				51				11				16				78
Cerithium eburneum algicola				14				11				44				69
Cerithium litteratum				21				4				39				64
Cerithium lutosum												7				7
Cerithium sp.																
Cheilea equestris																
Chicoreus florifer				1												1
Columbella mercatoria																
Conus jaspideus								1								1
Conus jaspideus verrucosus				1												1
Conus mus																
Conus sp.																
Coralliophila abbreviata																
Crassispira fuscescens																
Crepidula aculeata																
Cymatium pileare																
Cyphoma gibbosum																
Cypraea sp. A																
Cypraea sp. B																
?Dermomurex pauperculus																
Diodora dysoni																
Diodora jaumei																
Diodora listeri																
Diodora minuta																
Diodora sp.																
Emarginula pumila																
Epitoneum sp. A																
Epitoneum sp. B																
Fasciolaria tulipa				1								1				2
Fissurella barbadensis																
Hemitoma emarginata																
Hipponix antiquatus																
Ithycythara sp.																
Latirus carinifer																
Leucozonia nassa leucozonalis																

	TSE - 1939				TSE - 3489				TSE - 3527				TSE - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum																
Lithopoma tuber																
Lucapina suffusa																
Mangelia lastica?																
Marginella apicina?				8								11				19
Marginella guttata?																
Marginella pruniosum?																
Marginella sp.																
Melanella sp.																
Mitra barbadensis																
Mitrella sp.												2				2
Modulus modulus				5				2				1				8
Nassarius albus				11				4				24				39
Natica canrena				1												1
Natica livida																
Natica sp.																
Odostomia laevigata																
Oliva reticularis																
Olivella sp. A				2				3				2				7
Patelloida pustulata																
Phyllonotus pomum																
Pisania auritula																
Polinices lacteus																
Puncturella pauper?																
Pyramidella dolabrata																
Pyrgocythara candidissima																
Rissoina cancellata																
Schwartziella bryerea																
Seila adamsi																
Sinum perspectivum																
Smaragdia viridis																
Strombus gigas																
Strombus gigas samba?																
Strombus sp.																
Thais deltoidea																
Tricolia thalassicola				2												2
Triphora melanura?																
Triphora turristhomae																
Triptychus niveus																
Trivia pediculus?																
Trivia quadripunctata?																
Turbonilla sp.																
Volvarina avena																
Zebina browniana												6				6

	W - 1925				W - 3515				W - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
?Agriopoma texasianum												
Americardia guppyi		1		1	1			1	1	1		1
Americardia media		2		2						2		2
Anadara floridana	1	2		2					1	2		2
Anadara notabilis												
Anadara sp.												
Anodontia alba		1	2	3						1	2	3
Anomia simplex												
Arca imbricata												
Arca sp.	1	1		1					1	1		1
Arca zebra												
Arcopsis adamsi	1	1		1					1	1		1
Argopecten nucleus												
Barbatia cancellaria	1			1					1			1
Barbatia candida												
Barbatia domingensis		1		1						1		1
Basterotia quadrata												
Botula fusca												
Brachidontes modiolus?												
Bractechlamys antillarum												
Chama congregata	1	2	1	3					1	2	1	3
Chama macerophylla												
Chama sinuosa												
Chama sp.												
Chione cancellata	5	6		6					5	6		6
Chione paphia												
Codakia costata	2			2	1			1	3			3
Codakia orbicularis	1	2	3	5					1	2	3	5
Codakia orbiculata	2			2					2			2
Codakia pectinella		1		1						1		1
Coralliophaga coralliophaga												
Crassinella martinicensis	1			1					1			1
Cumingia coarctata												
Dendostrea frons												
Diplodonta punctata												
Diplodonta semiaspera												
Diplodonta sp.												
Divaricella dentata												
Divaricella quadrisulcata												
Divaricella sp.												
Ervilia concentrica												
Gastrochaena hians												
Glycymeris pectinata												
Gouldia cerina	1	1		1		1		1	1	2		2
Gregariella coralliophaga												
Laevicardium laevigatum	8	4	7	15	1	1		1	9	5	7	16
Leporimetis intastriata			1	1							1	1
Lima lima												
Lima lima?												
Lima scabra												
Linga pensylvanica												
Lithophaga antillarum												
Lithophaga nigra												
Lithophaga sp.												
Musculus lateralis						1		1		1		1
Nucula aegeensis?												
Pectinid fragments												
Periglypta listeri	1	3	1	4					1	3	1	4
Petricola lapicida												
Pinctada imbricata												
Pitar fulminatus	1	1		1					1	1		1
Plicatula gibbosa												
?Poromya sp.												
Pseudochama radians												
Pseudochama radians variegata	2	1	1	3					2	1	1	3

	W - 1925				W - 3515				W - TOTAL			
BIVALVES:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Pteriid fragments												
Semele bellastriata												
Semele proficua		2		2	1			1	1	2		2
Spondylus americanus												
Strigilla mirabilis												
Tagelus divisus												
Tellina aequistriata												
Tellina candeana												
Tellina fausta												
Tellina gouldii												
Tellina listeri												
Tellina mera	1			1					1			1
Tellina radiata												
Tellina similis												
Tellina sp.												
Tellina sybaritica												
Transonnella gerrardi												
unidentified Chamidae												
GASTROPODS:												
Acmaea sp.												
Acteocina sp.												
Anachis hotessieriana?								5				5
Arene cruentata												
Astralium phoebium												
Atys sp.												
Bailya parva												
Bittium varium												
Brachycythara biconica												
Bulla striata				3				2				5
Cerithiopsis emersonii												
Cerithium eburneum				3								3
Cerithium eburneum algicola												
Cerithium litteratum				11				1				12
Cerithium lutosum				1								1
Cerithium sp.												
Cheilea equestris												
Chicoreus florifer												
Columbella mercatoria												
Conus jaspideus												
Conus jaspideus verrucosus												
Conus mus												
Conus sp.												
Coralliophila abbreviata												
Crassispira fuscescens												
Crepidula aculeata												
Cymatium pileare												
Cyphoma gibbosum												
Cypraea sp. A												
Cypraea sp. B												
?Dermomurex pauperculus												
Diodora dysoni												
Diodora jaumei												
Diodora listeri				2								2
Diodora minuta												
Diodora sp.												
Emarginula pumila												
Epitoneum sp. A												
Epitoneum sp. B												
Fasciolaria tulipa												
Fissurella barbadensis												
Hemitoma emarginata												
Hipponix antiquatus												
Ithycythara sp.												
Latirus carinifer												
Leucozonia nassa leucozonalis												

	W - 1925				W - 3515				W - TOTAL			
GASTROPODS:	L	R	P	#I	L	R	P	#I	L	R	P	#I
Lithopoma tectum												
Lithopoma tuber												
Lucapina suffusa				1								1
Mangelia lastica?												
Marginella apicina?												
Marginella guttata?												
Marginella pruniosum?												
Marginella sp.												
Melanella sp.												
Mitra barbadensis												
Mitrella sp.												
Modulus modulus												
Nassarius albus												
Natica canrena												
Natica livida												
Natica sp.				1								1
Odostomia laevigata												
Oliva reticularis												
Olivella sp. A												
Patelloida pustulata												
Phyllonotus pomum												
Pisania auritula												
Polinices lacteus				1								1
Puncturella pauper?												
Pyramidella dolabrata												
Pyrgocythara candidissima												
Rissoina cancellata												
Schwartziella bryerea												
Seila adamsi												
Sinum perspectivum												
Smaragdia viridis												
Strombus gigas												
Strombus gigas samba?												
Strombus sp.												
Thais deltoidea												
Tricolia thalassicola												
Triphora melanura?												
Triphora turristhomae												
Triptychus niveus												
Trivia pediculus?												
Trivia quadripunctata?												
Turbonilla sp.												
Volvarina avena												
Zebina browniana												