MARINE FAUNA USE IN CERAMIC AGE ANTIGUA

PATTERNS OF MARINE FAUNA USE IN CERAMIC AGE ANTIGUA, WEST INDIES

By

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ABSTRACT

Detailed analysis of marine faunal remains was conducted at an early Saladoid (Ceramic Age) coastal site, located on the island of Antigua, West Indies. Previous subsistence models in the Caribbean are closely linked to theories of migration and culture change. I discuss the economic importance of marine fauna at PA-15 (Doig's) in order to understand the factors underlying variation in the faunal assemblage. The results of the faunal analysis indicate that subsistence strategies of Ceramic Age Antiguans are complex, and that subsistence models are currently too simplistic to be used to describe broad historical trends.

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CHAPTER 1

INTRODUCTION AND BACKGROUND

1.1 Rationale

My research is concerned with the variation in the use of marine fauna at the site of Doig's (*pronounced dew-eggs*), an Early Ceramic age site on Antigua, West Indies (Figure 1.1). A previous inspection of fauna from Doig's (PA-15), a stratified site located approximately 400 m from the present day coastline, suggested a strong focus on the use of marine fauna and land crabs (deMille and Turney 2002).

Using zooarchaeological analysis, I examine variation in fish, shellfish and crab remains found at PA-15. Within the Caribbean, studies often detail what fauna are present in an archaeological assemblage; however, few studies look at the variability of assemblages to determine local patterns of use. This thesis will provide a detailed examination of the utilization of identified marine taxa, assessing both vertical and horizontal distributions in order to understand variability in the presence, and presumably use of resources.

Results of this analysis will improve the understanding of resource production on Antigua and contribute to the literature of Caribbean island subsistence. As discussed below, variations in resource use, particularly the relative emphasis on shellfish and crab have played key roles in past interpretations of the history of migration and transformation of Caribbean cultures.

Figure 1.1. The Eastern Caribbean with the island of Antigua highlighted in black. Created and used with the kind permission of M.J. Turney.

1.2. Physical Setting

The islands in the West Indies, in the Caribbean Sea form island chains which are divided into three groups of islands. These are the Greater Antilles, the Lesser Antilles, and the Bahamas. Greater Antillean islands are large and mountainous, and are of sedimentary origin. Cuba, Hispaniola, Puerto Rico and Jamaica are part of this island group. The Bahamian archipelago consists of tiny coral islands north of Cuba, which includes the Bahamas and Turks and Caicos. The Lesser Antilles consists of two island chains in the Eastern part of the Caribbean Sea (Figure 1.1). Twenty major islands form this archipelago from Puerto Rico in the north to Trinidad in the south (Martin-Kaye 1969:173; Rouse 1992:2-3).

The two island chains (arcs) of the Lesser Antilles form the Leeward Islands, or a northern, inner arc; and the Windward Islands, which form a southern, outer arc. All islands are of volcanic origin; however the Leeward Islands are older, having formed in the early Tertiary (65-55 m.y.a), while the Windward Islands were formed in the Miocene (24-5 m.y.a) and Pliocene (5-2 m.y.a). Some younger Windward Islands still experience volcanic activity today. The island of Antigua is located in the southern Leeward Islands of the Lesser Antilles. The island is no longer volcanically active (Horwith et al 1991:1; Martin-Kaye 1969:172; Towle et al 1991:3).

1.3. Cultural Chronology

Human occupation in the Caribbean is often divided into a series of migrations. The first migration takes place ca. 4000 to 2000 BC, these earliest populations are known archaeologically as the Lithic Age or Casimiroid Culture. A second migration into the Antilles defines the beginning of the Archaic age (Ortoiroid Culture) which dates from ca. 2000 to 400 BC. The mainland origin of preceramic peoples is not as well known as those in the ceramic age, however, a Central or South American migration is most likely (Allaire 1997; Rouse 1992).

The Archaic Age represents the earliest sites in the Leeward and Virgin islands, and is differentiated from the Lithic Age in terms of technological advances including tools of shell and bone, as well as ground stone axes and pestles (Allaire 1997:21; Rouse 1992). Archaic groups were nomadic foragers who relied on the procurement of shallow marine fauna (particularly shellfish) as a central dietary element and this reliance on marine resources was often a controlling factor in the settlement locations of these groups (Davis 1998, 1982; Murphy 1999).

The third migration into the Lesser Antilles, including Antigua, during the middle of the first millennium BC, has been defined as the Saladoid series, named after the Saladero site in Venezuela (Wilson 1997:5). The populations characterizing the initial wave of this third migration have been defined as the Cedrosan Saladoid, who were primarily ceramic-producing horticulturalists who moved into the Caribbean islands from the Orinoco region of South America (Rouse 1992:71). Authors often use the term "Saladoid" to refer to the initial Cedrosan population in addition to the archaeological series.

Eventually a shift is seen within this archaeological culture, defined by changes in pottery manufacturing, population growth, as well as changes in subsistence strategies to a more marine-dominant economy and change in settlement pattern showing increased movement to coasts (Wilson 1997:6). These populations are defined as Post-Saladoid (see Table 1.1). At this time, settlements become more numerous in the Lesser Antilles (Murphy 1999).

Table 1.1. Major prehistoric cultural periods and associated dates in the Lesser Antilles (Revised from Keegan 2000; Murphy 1999; Rouse 1992).

Phase	**Associated Dates**
Casimiroid (Lithic)	4000-2000 BC
Ortoiroid (Archaic)	2000-200 BC
(Cedrosan) Saladoid (Ceramic)	500 BC-AD 600
Post-Saladoid/Ostionoid (Late Ceramic)	AD 600-1500
Taino/Island-Carib (Historic post 1492)	AD 1200-1576

In the Greater Antilles, Saladoid sites were also initially located on the coast, and expanded inland, where large settlements were established with ceremonial plazas and ball courts. The smaller islands of the Lesser Antilles seem to have only been marginally occupied, as the inland environments of these islands were not fully exploited. Some (e.g Rouse 1989; Wilson 1989) see this as an indication that these smaller islands were "stepping stones" to the larger islands. However, as Murphy (1999:264) points out, this conclusion may be based on the lack of research on Lesser Antillean Islands.

The Saladoid were egalitarian forager/farmers and their material culture is characterized by bell-shaped ceramic vessels, with three main types of decorations: white-on-red painted ware (WOR), zoned-incised crosshatched ware (ZIC), and polychrome (Allaire 1997:22; Keegan 2000:143; Rouse 1992:81). The pottery technology of these populations is particularly well advanced and Allaire notes that the "artistic qualities of ceramic decoration and expression of skills rivals artisans of some South American chiefdom-level societies" (1997:24).

Other material culture associated with the Saladoid are clay griddles for baking cassava bread, beads made of stone and shell, stone celts and adzes, coral polishing and rubbing tools, ceremonial objects such as incense burners, zemis (three-pointed stone objects representing personal spirits), as well as pendants (often depicting frogs.) Artistic representations of fauna are often depicted in pottery through zoomorphic figurines and adornos, as well as the lapidary industry, and the carving of semiprecious stones (Allaire 1997:24; Righter 1997:74; Rouse 1992:84).

Pole and thatch houses characterized the living arrangements in Saladoid villages, and though few villages have been excavated extensively, these houses tended to surround a central plaza with substantial middens (Rodríguez 1997:82; Wilson 1997:6). These central plazas also served as planned cemeteries. The structure of Saladoid sites suggests that they were an egalitarian society (Keegan 2000:144).

With the advent of the Post-Saladoid (Ostionoid) period, several lines of evidence indicate changes in the economic and social development of populations in the Lesser Antilles. The finely made ZIC and WOR ceramic styles were gradually replaced by cruder ceramics with linear bands of red (redware). Ceramic styles were also less homogeneous across the islands (Rouse 1992:92-93). This period is marked by population growth. To date, there are eight known Saladoid sites on Antigua, while there are fifty-two known Post-Saladoid sites.

The Formative Age in the Caribbean (ca. AD 800-1500) marks the end of Saladoid culture groups in the Bahamas and Greater Antilles. This was a local development, marked by dramatic changes in social structure, and the first appearance of public monuments. The term Ostionoid is applied to groups who underwent these dramatic changes. These transformations do not occur in the Lesser Antilles at this time, and groups are still termed "Ceramic". Significant cultural change occurs in the Lesser Antilles around AD1500, when further cultural transformations occur again in the Bahamas, and in the Greater and Lesser Antilles (Rouse 1992).

Further changes to the social structure of island groups include the formation of complex tribes or simple chiefdoms (Keegan et al. 1998:229; Rouse 1992; Stokes 1998:64). At this time in the Lesser Antilles, distinct culture groups formed, known as the *Island Carib*, who occupied the Windward Islands, and the *Eastern Tainos,* who occupied the Leeward Islands. Tainos are sometimes referred to as *Island Arawaks,* after the Arawak natives of northeastern South America. Outside of the Lesser Antilles, the *Classic Taino* occupied Puerto Rico and Hispaniola, the *Western Taino* occupied most of Cuba, Jamaica and the Bahamas, and a separate culture group, named the *Guanahatabey* occupied the northwestern portion of Cuba (Rouse 1992).

These distinctions can be arduous, as some groups had names they preferred to call themselves, while others did not. For example, certain "Taino" groups are known enthnographically by other names, such as the *Lucayan* Indians of the Bahamas. To add further confusion, the *Arawakan* language refers to closely related groups in the eastern half of the Caribbean, the Amazon Basin, the Guianas and the Orinoco Valley of Venezuela. However, the Island-Caribs, Tainos, and the Guanahatabey were neighbours, and certainly by Columbus' time, shared more closely related cultural, linguistic and biological traits. The Taino called themselves "noble", and preferred to distinguish themselves from the Island-Carib, who are believed to have been cannibals (Rouse 1992). After Columbus' second voyage, drastic declines in native populations from disease, abuse and warfare resulted in the extinction of these peoples by 1576 (Keegan 1996:268).

1.3. Caribbean Subsistence Models

Typical zooarchaeological assemblages in the Lesser Antilles include small animals, such as rodents and reptiles, iguana and sea turtle. In addition, there are many species of fish, as well as shellfish and crab (Wilson 1997:5). Subsistence strategies varied between the islands, particularly between the Greater and Lesser Antilles. Crocodile, huita and agouti (large rodents), are found in greater abundance on Greater Antillean islands; while the native rice rat, now extinct, was a major source of food in the Lesser Antilles (Boomert 2000:79, 125; deFrance 1988:11; Petersen 1997:121; Wing and Reitz 1982: 23).

Domestic dog, agouti and guinea pig were introduced from South America into the Lesser Antilles during the Ceramic Age. Guinea pig is found on some Greater Antillean islands, but has only been found on Antigua in the Lesser Antilles. Their representation in Ceramic Age sites suggests that they were not principal food resources; their presence and distribution still remains largely unexplained. Dogs were likely not utilized as a food resource, as Saladoid peoples seem to have revered them as particularly significant animals. Newsom and Wing (2004:107) note that "dog remains are found more often in burials and are relatively rare among midden remains, which suggest an intimate association with human groups and a cultural significance over and above a food resource".

Domestic plants, including manioc and tobacco, were also transported from the migrants' mainland home (Wilson 1997:6). Saladoid subsistence strategies combined these plants with native resources available on each island (Petersen 1997:119). Native fruits were adopted as a food resource, and certain woods, in particular lignum-vitae (*Zygophyllaceae guaiacum*) and strongbark (*Boraginaceae bourreria*), were used for fuel. Native medicinal plants were utilized as well, including silk cotton (*Bombacaceae ceiba*), calabash (*Bignoniaceae cresentia*) and sandbox (*Euphorbiaceae hura*) (Newsom and Wing 2004:106-108).

Subsistence of preceramic populations was based on fishing and the collecting of shellfish, supplemented at times with terrestrial reptiles and amphibians, and to a lesser degree birds (Boomert 2000:78-79; Davis 2000; Rouse 1992). The collecting of wild vegetable foods and utilitarian plants is also known from Late Archaic sites (Boomert 2000:78-79). Archaeological evidence of preceramic subsistence also includes simple stone flakes or blades, possibly used to butcher small land mammals, to clean fish, and to open shells (Davis 1982). Various ground stone implements, such as manos, and celts are also found in the Archaic, signifying the presence of wild vegetable foods in the diet (Boomert 2000:80).

Although Lithic and Archaic Phase populations were not agriculturalists, the role of plants was still important. These populations were likely incipient horticulturalists, who managed or manipulated native plants. This is evidenced by paleobotanical remains of charred plants such as the wild fig (*Ficus citirfolia*), mangrove, mastic bully (*Sapotaceae sideroxylon*), and sapodilla (Petersen 1997: 119, 122). More recent paleobotanical studies show that plants played a much bigger role in preceramic subsistence than previously thought (e.g. Newsom and Wing 2004).

Saladoid populations were horticulturalists/agriculturalists who concentrated mainly on root plants such as cassava, arrowroot, and sweet potato; but also focused on sweetsop, soursop, hogplum, guava, and pineapple. Eventually, maize was also included in the diet (Boomert 2000:93; Davis 1988:179; deFrance 1988: 11). Faunal remains similar to those present at Preceramic sites are found at Saladoid sites, only in differing quantities (Wing and Scudder 1980:239).

Other archaeological evidence pertaining to Ceramic Period subsistence includes cassava griddles, suggesting manioc bread was processed; and small stone chips, possibly used as the teeth for cassava graters. Hunting tools such as arrows, spears, and possibly harpoons have been found on some Greater Antillean islands, along with wooden paddles, possibly used with canoes for off-shore fishing (Boomert 2000:314-335).

From the remains found at Saladoid sites, it appears that these migrants combined farming and hunting with the utilization of maritime resources. The earliest Saladoid sites typically have dense layers of terrestrial crab claws, which do not normally appear in Post-Saladoid assemblages (Allaire 1997:23; Petersen 1997:120-129; Wilson 1997:5).

Conversely, dense shell middens normally appear within Post-Saladoid sites or deposits. This pattern seems to prevail on Antigua, as Terminal, or Post-Saladoid sites, such as Mill Reef, Nonsuch Bay, Coconut Hull and Blackman's Point, contain substantial shellfish middens (Murphy 1999:274-275). Preceramic sites are also delineated by great amounts of shellfish (Petersen 1997:120-129). Preceramic and Late Ceramic (Post-Saladoid) peoples are often cited as relying on marine resources, while Early Ceramic (Saladoid) migrants (those associated with PA-15) are described as having a wider subsistence base, depending on both terrestrial (particularly land crab) and marine resources (Murphy 1999:77).

Rainey (1940) first documented these resource shifts on Puerto Rico, attributing the change from the collection of terrestrial land crab to the collection of shellfish to different cultural groups. This change in emphasis from land crabs in the Saladoid phase to shellfish in the Post-Saladoid phase has since been termed the Crab-Shell Dichotomy (Davis 1988:182; Keegan 1989). Rouse (1986:136) and deFrance (1988:15) have since proposed that this change was more gradual than implied by Rainey, and that it often occurred *within* the Early Saladoid period.

Saladoid populations migrated from mainland South America, where the subsistence strategies were based on a tropical forest environment (Petersen 1997:123-124). Movement into the Caribbean islands meant shifting established food-getting strategies. The way in which the Saladoid populations dealt with this shift has been the subject of some debate. This debate has mainly centered on the probability of whether or not migrants would attempt to recreate the subsistence strategies of their homelands, or would initially attempt to take on a different subsistence base dependent on each island environment.

Some researchers have interpreted the Saladoid as having an unspecialized and flexible subsistence strategy, with a pattern of making use of as many ecological zones as possible depending on local environment (Boomert 2000:309; Haviser 1997). Others believe that initially the Saladoid peoples most likely tried to reconstruct their South American diets in the Caribbean, leading to a strong emphasis on a terrestrial diet (deFrance 1988: 3,13). Boomert (2000) points out that the Saladoid expansion was a rapid one, and that as they moved further and further from their homeland, and as time passed, these populations would become better adapted at dealing with the different environments of the islands. This results in the interpretation of the Cedrosan Saladoid (or terrestrial) subsistence base as a reflection of the South American tradition, and the later Post-Saladoid marine subsistence base as an adaptation to island living (deMille and Turney 2002:10; Murphy 1999:6).

> Their [Cedrosan Saladoid] sites are limited to the coastal plains, mostly on the northern and eastern sides of the islands, which had luxuriant forests because of their exposure to the trade winds. Wherever possible, they chose to settle on rivers a short distance back from the shore, where access to the heart of the forest was easier, but in the absence of large streams they lived along the shore on the edge of the forest (Rouse 1992:79, parentheses added).

Initial expansion by the Saladoid appears to have been selective; some islands seem to have been bypassed in favour of others. The islands settled tended to be wetter and more fertile, which is again perhaps an indication that they were selecting islands that had similar resources and ecosystems to that of South America (Murphy 1995:1-2; Rouse

1992:79). Early Saladoid sites were often associated with inland locations, where rivers or streams were nearby, and where forest resources were plentiful (Murphy 1999:63). More recent studies of Saladoid settlement systems show that early Ceramic Age coastal sites in the West Indies are more common. In addition, coastal and inland sites were sometimes used simultaneously (Keegan 2000:141).

Boomert (2000:309) criticizes the assumption that Saladoid populations attempted to recreate their mainland subsistence strategies, and further suggests that 'inland' sites are often assumed, in the absence of evidence, to be Saladoid. He prefers an "opportunistic perspective" (Haviser 1989) which interprets Saladoid populations as quick adapters to their environments (Boomert 2000:311). Boomert further states that Saladoid populations are inappropriately associated with the terrestrial environment through the association of crabs. He points out that the Blue crab dominates most collections, yet it prefers swampy, coastal habitats, and as such is not truly terrestrial (Boomert 2000:310).

For this reason, the definition of what is meant by a maritime economy should be made clear for the purposes of this discussion. Fitzhugh (1975) defines maritime peoples as those obtaining at least fifty percent of their calories or protein from marine resources. Though a primarily *marine economy* will rely on a substantial amount of marine resources, this thesis also addresses the nature of the exploitation of *marine environments* in general. Although crabs are generally described as terrestrial animals in Caribbean archaeological literature, many spend the majority of their lives in coastal environments.

Crab at Doig's likely inhabited the marine environment due to the close proximity of the site to the coast.

From the time of Rainey's (1940) initial interpretation, Caribbean archaeologists have proposed several theories to explain the resource shifts often seen in Saladoid versus Post-Saladoid assemblages. Goodwin (1979:49) and Keegan (1985) argued that subsistence stress caused by population growth led to a focus on marine resources. The availability of abundant resources perhaps promoted sedentism, leading to human population increases. They argue that as terrestrial resources were depleted, populations were forced to broaden their subsistence base to include a greater reliance on marine resources.

Lange (1978) and Jones (1985) proposed that a resource shift was the result of deforestation and over-hunting. Jones, in particular, denied that Saladoid populations were large enough to impact crab populations. Instead, he argued that land crab habitats were destroyed due to clearance of land for agriculture.

Carbone (1980) suggests that there was a dry change in climate, which resulted in the depletion of land crab populations. However, Turney (2000:11) argues against this by pointing out that changes in the utilization of land crabs occur at different times on different islands. Furthermore, Boomert (2000:313) states there was a dry period from AD 600 to 750 that was limited to South America, and likely did not affect the Caribbean islands.

Because changes in resource use occurred at different times on different islands, it is possible that over-harvesting, or resource depression were contributing factors.

DeFrance (1988:17) notes that a lack of terrestrial fauna on most Caribbean islands resulted in a change to marine resources during subsistence intensification. When the resources of one subsistence base were depleted, or environmental conditions in any particular years were unfavourable, a change back to an alternate form of subsistence may have occurred. This may account for the conflicting evidence we sometimes see between islands of the Caribbean, as different islands would have experienced these strains at different times.

Jones' (1989:49) interpretation of faunal remains from Indian Creek, Antigua suggests the 'crab/shell transition' is too simplistic. Jones argues that "the simplicity of the concept has obscured and distracted us from subtleties hidden in the animal remains of the middens" (1989:43). He further states that he seeks "to demonstrate that within the crude subdivisions within the faunal record that we already recognise, a greater degree of resolution can be achieved" (1989:43). Therefore, resource shifts on the different islands cannot be explained by Pan-Caribbean models of environmental or cultural causes.

Murphy (1999:76-77) notes that the crab-shell debate was an attempt at understanding the relationship between subsistence and cultural change. He further states that "regardless of its validity, it created an early awareness among Caribbean archaeologists that subsistence studies were essential for defining and interpreting Ceramic Age adaptation within the diversity of islands. Today, the crab-shell model may be interpreted as a gradual expansion in diet breadth and not as a marker for the transition from a terrestrial to a marine oriented diet". In sum, changes in the exploitation of animals in Caribbean archaeological assemblages that were once seen as markers for cultural transition are now interpreted as indicators of a change in subsistence strategies. Whether this expansion of resource use is the result of adaptation to an island environment, or a need to expand due to stresses on exploited fauna is still not clear. This is partly due to the fact that comprehensive subsistence studies within the Caribbean are only beginning to emerge (e.g. Newsom and Wing 2004; Wing 2001). Until recently, published analyses of zooarchaeological remains from Caribbean sites were limited to lists of marine and terrestrial species found.

The dominant discussion within Caribbean archaeology that has appeared to have "given us a sense of common purpose" (Jones 1989:42) is that of the transition from a focus on land crabs to shellfish. More detailed accounts of species variation within Caribbean archaeological sites are needed in order to ask more meaningful questions about animal exploitation. The possibility that diverse populations migrated from different homelands over time to the Caribbean, or that different groups may have used a variety of strategies is often underplayed. Instead, populations of the Caribbean have been described as homogeneous groups who either did or did not concentrate their subsistence efforts on marine or terrestrial fauna. The prehistoric inhabitants of the Caribbean, much like the islands of the Caribbean, were likely very diverse.

CHAPTER 2

SITE AND CONTEXT

2.1. Environmental Setting: Subsistence Economies and the Maritime Environment

In order to determine the relative importance of different marine resources, one must take into consideration the factors that might affect their utilization. Four main factors may influence the choices made in collecting or procuring food resources. These include: 1) what resources are available (depending on the micro or macro environment, specific habitat being occupied, as well as season, etc.) (Monks 1981; Shackleton et al. 1984); 2) technologies known to each group in order to obtain resources (this can include hunting implements, domestication of plants and animals, ceramic technology, as well as knowledge of the local environment, including variations in habitat, animal behaviors, etc.) (Kirch and Yen 1982); 3) the abundance or ease of obtaining resources (i.e. the highest food return in relation to the cost of obtaining any given resource, explained by the Optimal Foraging Theory) (Begossi 1992); and 4) social constraints (such as the extreme case of food taboos demonstrated by the Australian Tasmanians) (Jones 1978:44).

Differing accessibility of certain resources will change in relation to the physical features of a particular environment. In relation to a maritime economy, larger islands, or mainland coastal areas have a much larger land mass and hence more diversity in both flora and fauna. For this reason, these areas would be more likely to have a broader subsistence base, while smaller islands, or isolated areas, would have greater potential for specialization of resources (Boomert 2000: 349; Creamer 1983:395; Petersen 1997:121).

Voorhies (1978) states that "Among coastal peoples, specific ecological niches differ considerably, so it is reasonable to find a variety of ecological patterns manifested in the archaeological record" (1978:12). The maritime environment can include many microenvironments, and differentiating these in terms of subsistence strategy and possible flora and fauna is important for interpretation.

An oceanic environment can include coastal mainland sites, such as on the coast of Peru, or island coasts, such as the Caribbean or Pacific islands. It is important to note these differences, as the surrounding land and resource base will greatly affect which types of resources are more likely to be exploited. Wing and Wing (2001) apply island biogeographic models, which show that, not surprisingly, there is a greater diversity of species on larger islands in the Caribbean. They also show that diversity decreases the farther isolated an island is from the mainland (namely the Bahamas and Turks and Caicos).

Fitzhugh (1975:344) differentiates between different marine environments by defining five types of maritime societies within the circumpolar zone. These consist of the 1) *Modified Interior*, characterized by a "dual economy with seasonal subsistence on both coast and interior"; 2) *Interior-Maritime*, which is similar to the modified interior, but with more marine technological specializations, indicating a greater reliance on the maritime environment; 3) *Modified Maritime*, where subsistence is restricted to the coast, with technologies indicative of marine hunting and fishing; 4) *Maritime*, which includes "total dependence on marine resources including birds and invertebrates; and 5) *Riverine*, where primary resource use is riverine fishing, with additional interior and coastal resources (Fitzhugh 1975:344). Within the Caribbean, most prehistoric populations would be described as either Modified Interior or Interior-Maritime, perhaps with some fitting into the Modified Maritime type, as there are no known populations that have relied solely on coastal or riverine resources.

Wing and Reitz (1982) provide four habitat subdivisions of the marine environment in the Caribbean. They also specify which species of fauna one can expect to find in each of the four habitats. These four subdivisions include: 1) the *Beach*, in which shore birds, and sea turtles are easily accessed, as this is the area in which turtles lay their eggs; 2) the *Inshore/Estuarine Environment*, where fishes adapted to unstable water conditions (e.g. catfish, mullet, bonefish, and jack) are found; 3) the *Bank and Reef Habitat*, where the deep banks are inhabited by snappers and groupers, and the shallow reefs, which are inhabited by parrotfishes and surgeonfishes; and 4) the *Offshore/Pelagic Environment*, which includes the open ocean habitat, where flying fishes and tunas may be found (Wing and Reitz 1982:15-22).

The Inshore/Estuarine zone can be further subdivided into the *Littoral*, or Intertidal Zone; *Eulittoral* (the zone in between Intertidal and the low tide mark); *Sublittoral* (between low tide mark and the open ocean), and *Supralittoral* (the splash zone above the low tide mark) (Cruz 2001: 21-22; Davis 2000:15; Stokes 1991:47). Cruz (2001) notes that the Inshore/Estuarine Habitat may overlap with the terrestrial zone division, as certain fauna, such as marine turtles and some crabs reside within both the Terrestrial and Aquatic Zones.

Such is the case with many Lesser Antillean sites, particularly with the so called "Blue Land Crabs" already discussed.

The Bank and Reef Habitat consists of coral reefs, which are characterized by clear, shallow, warm water with coral and rocky banks, which contain dead coral and rock ledges (Cruz 2001:22; Murphy 1999:80; Wing 1989:142). Murphy (1999:78) notes that this area is the one most exploited by prehistoric Antiguans, likely because it is an area both very diverse and plentiful in terms of fish resources. Antigua is known for its extensive coral reef system, and indeed has more reefs and shallow near-shore habitats than most neighbouring islands. Antigua's markedly crenulated coastline provides numerous environmental niches for marine organisms including offshore reefs and sand bars, coral reefs, sea grass beds and mangrove environments (Horwith et al.1991).

Lagler et al. (1977) divide the pelagic or offshore habitat into two divisions: the *Neritic* and the *Oceanic* Zones. According to the authors, the Neritic Zone has the most abundance and variety of fishes. It is also characterized by plenty of light, with marked seasonal variations in temperature, nutrients, oxygen, wave action and biota, to name a few. The Oceanic Zone is not as productive, due to reduced detrital matter, although there is a wider range of living conditions. The Oceanic Zone can be further divided by depth into *Epipelagic*, *Mesopelagic*, *Bathypelagic* and the *Abyssopelagic* zones (Lagler *et al.* 1977:424-425).

One of the simplest classifications of fishes, based on their location within the aquatic ecosystem, is described by Lagler et al. (1977:414). These are the *benthic*, or bottom dwellers or ground fishes; the *pelagic* (free swimming fishes); and *planktonic* (those species that depend on currents for their movements). These examples show the importance of describing the type of marine environment under study. Different micro-environments will vary in the types of resources available, and hence so will the patterns one might expect to see in the archaeological record.

There is considerable variability between mainland coastal and island environments. There is even substantial variability between island environments. For instance, limestone versus sedimentary islands can differ substantially, as the latter typically exhibit greater soil development and environmental diversity (deFrance 1988:28). Scudder (1991) has reported differences in the faunal assemblages of islands that have limited reefs (shores with steep sides), and those lower islands with substantial reefs (Petersen 1997: 125; Scudder 1991). Fitzhugh and Hunt (1997:382) remind us that "Islands are not closed systems but vary significantly in inter-island and island-mainland interactions". The species of fauna and flora present in the marine habitat are also affected by factors such as water cloudiness, salinity, temperature, turbidity, currents, and oxygen content, as well as the depth of the bottom sediments (Creamer 1983:397; Wing and Reitz 1982: 15).

Factors such as water sources and different soil types can greatly affect the means by which a group will obtain its resources (deFrance 1988:12, 28). Haviser (1989) conducted a site catchment analysis on the island of Curaçao in order to determine the various resources that were available to prehistoric and historic indigenous populations to better understand subsistence and settlement patterns. By examining the environment within a three-kilometer radius of known archaeological sites, measuring the distance of water resources, clay sources, mangrove areas, fertile soil areas, and others within the catchment profile, Haviser (1989:5-6) showed that similar resources surround settlements within each major period of the Caribbean. This type of analysis may aid in locating new archaeological sites, and to gain a better understanding of resource acquisition.

As archaeological investigations at the Doig's site are still in the preliminary stages of analysis, environmental variation and micro-habitat are not yet well understood. However, where possible, zooarchaeological data will be integrated with general knowledge of habitat variation to better interpret site context. In addition, preferred habitats of the species of crab, fish and shellfish found are described in order to provide interpretations of fishing strategies and possible environmental variation.

2.2. The Island of Antigua

Antigua is one of the Leeward Islands of the Lesser Antilles island arc in the Caribbean (Figure 1.1, 2.1). The island is roughly circular in shape and relatively small (280 km^2). It is one of the "Limestone Caribees" and is characterized by low elevations and Eocene and Oligocene volcanic deposits overlying carbonates (deMille and Turney 2002:4; Murphy 1999). The ecosystem of Antigua is often divided into two distinct ecological zones: the terrestrial zone and the aquatic zone (Murphy 1996). Both historically and prehistorically the aquatic ecological zone has been more diverse than the terrestrial zone (Murphy 1996, 1999). Antigua's coastlines are markedly indented, which provides numerous environmental niches for marine organisms including offshore reefs and sand bars, coral reefs, sea grass beds and mangrove environments (Horwith et al.

1991). Although the significance of marine resources has varied, exploitation of marine resources is characteristic of most Amerindian populations of the Lesser Antilles (Watters 1989).

Antigua can be divided into three broad geologic/physiographic regions (Multer et al. 1986; Weiss 1994:4-5). The Northeast portion of the island (the Antigua Formation) is comprised of emergent limestone, limy mudstone, claystone and fossil reef fragments overlying reworked volcanic material (Weiss 1994). Carbonate soils are present in this portion of the island. The central portion of the island (the Central Plain Group) is characterized by a rolling lowland trending Northeast to Southeast. It consists of eroded and reworked marine, non-marine and volcanic sediments (Martin-Kaye 1969; Weiss 1994). Making up the south-western portion of the island, the volcanic region (the Basal Volcanic Suite) is largely comprised of the eroded remnants of an extinct volcano, which originally formed the island (Weiss 1994). PA-15 is located within the southwest, volcanic region of the island. Soils within this region are comprised of intrusive and extrusive igneous rock such as basalt, andesite, quartz diorite, ash beds and agglomerates. The soils are neutral to slightly acidic (Murphy 1996:10; Rouse and Morse 1999:5; Stokes 1991:26). According to Stokes, (1991:28-29) high rainfall in this region would have permitted the growth of a mixed evergreen-deciduous forest. Flora useful from a human perspective (medicinal, for building, subsistence, or otherwise) included the silk cotton tree (*Ceiba pentadra*), fig (*Ficus citirfolia*), and locust tree (*Hymenaea courbaril*).

2.3. The Doig's Site (PA-15)

The site of Doig's (PA-15) was first found in 1990 by Desmond Nicholson, then Director of the Museum of Antigua and Barbuda (see Figure 2.1). The site was then classified as a Ceramic Age prehistoric site based on diagnostic ceramic traits. Martin Fuess, a graduate student with the University of Pittsburgh, narrowed the site chronology to the Saladoid Period of occupation based on diagnostic ceramic types, as well as radiocarbon dates (which indicate a date of approximately AD 250). Cultural material was observed to a depth of 160 cm below surface; however sterile soil was not reached. His excavations consisted of two shovel test transects and a single test unit. At the time the site was covered by heavy vegetation (Fuess 1993).

PA-15 is located on a coastal plain, approximately 400m from the present day coastline (deMille and Turney 2002:6; Murphy 1999:64). It is located in the south-western volcanic region of the island and is surrounded to the north, east, and west by a series of steep, eroded hills. The valley opens out into Rendezvous Bay to the south. The site measures approximately 140m by 200m (deMille and Turney 2002:6).

The flora present at PA-15 today is likely very different from what it was at the time of occupation. Antigua suffered almost total deforestation during the colonial period due to land clearance, mainly for the production of sugar (deMille and Turney 2002:9; Murphy 1999). As a result, the vegetation on most of Antigua, including the present site, consists of alien species, dominated by cassie (*Acacia farnesiana*). The vegetation on Antigua most likely resembled a more tropical environment prior to colonialism (Murphy 1999). A seasonal watercourse runs from the northeast to southwest just north of the site, indicating a likely prehistoric water source in the valley (deMille and Turney 2002:9).

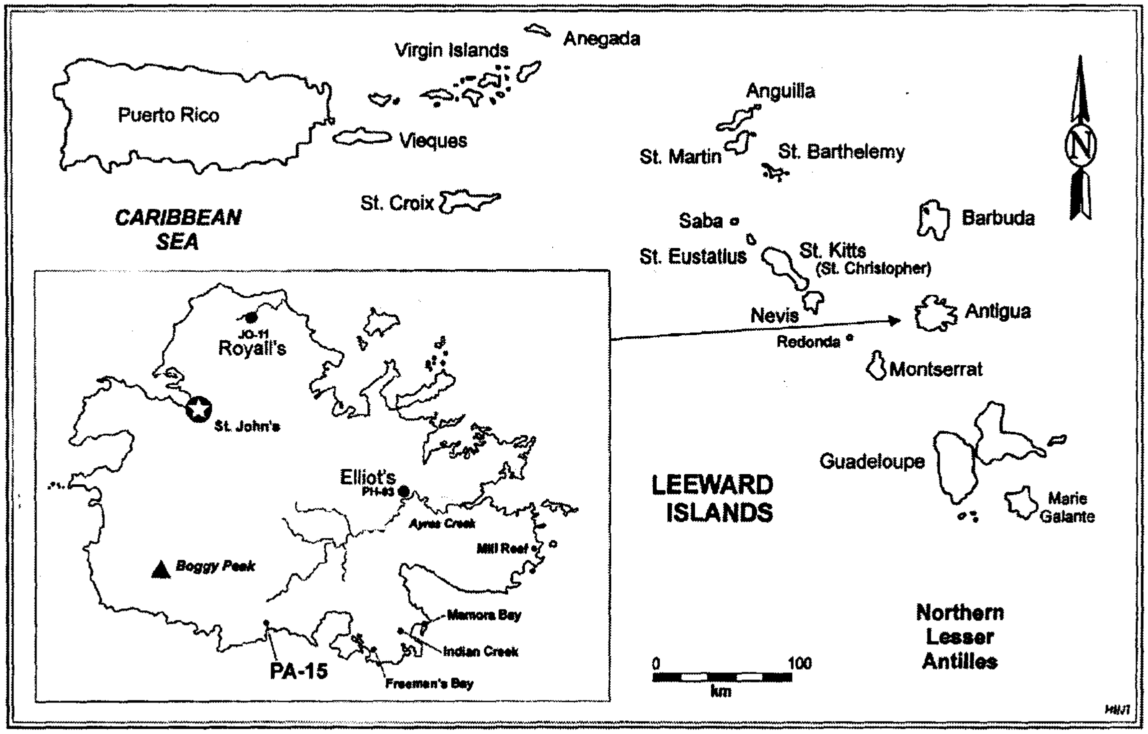


Figure 2.1. Location of Doig's (PA-15) on Antigua and the Leeward Islands (after deMille and Turney 2002, fig.2). Created and used with the kind permission of M.J. Turney.

In the summers of 2001 and 2002, the University of Calgary Department of Archaeology field school carried out surface survey and excavations at the site (deMille and Turney 2002:4) (Figures 2.2, 2.3, 2.4, 2.5). In contrast to the original excavations, surface visibility was greatly improved, as the site was being used as a grazing area for a farmer's livestock. Fuess' excavations are now likely covered by slope wash from subsequent hurricane activity. The field school concentrated its efforts on the central and southern portions of the site (deMille and Turney 2002:11).

The field school excavated Units 1 through 8 during the 2001 season, and Units 9 through 17 in 2002. The 1 x 1 metre units were separated into 5 excavation blocks where high densities of surface artifacts were observed through surface survey and test units. These concentrations may represent midden deposits (deMille, personal communication). Excavations were in ten cm arbitrary levels; within these, natural levels were also recorded.

All levels were excavated by trowel and were screened through 2mm mesh. Excavations reached a maximum depth of one meter, although little cultural material was found below 50 cm. Faunal material, ceramics, lithics, beads of shell and stone, as well as pendants typical of Early Saladoid sites were recovered (deMille and Turney 2002:15; deMille, personal communication). The inconsistency in depth from Fuess' excavations and the field school is likely the result of cultural deposits differing across the site, as the area of the field school excavations appears to be relatively undisturbed.

The 2001 and 2002 profiles show three distinct layers; all layers were of a reddish brown to red colour. The first layer, Visual Layer A, was between 0 and 15 cm, which contained slightly darker soil than the rest, with scattered artifacts. Located at fifteen to thirty cm below surface, was a redder layer (Visual Layer B), which contained the highest concentration of artifacts and faunal material (including crab concentrations). Sterile red clay (Visual Layer C) was present between 30 and 50 cm below surface (deMille and Turney 2002:16). Historical artifacts, such as ceramics and pipe stems associated with a

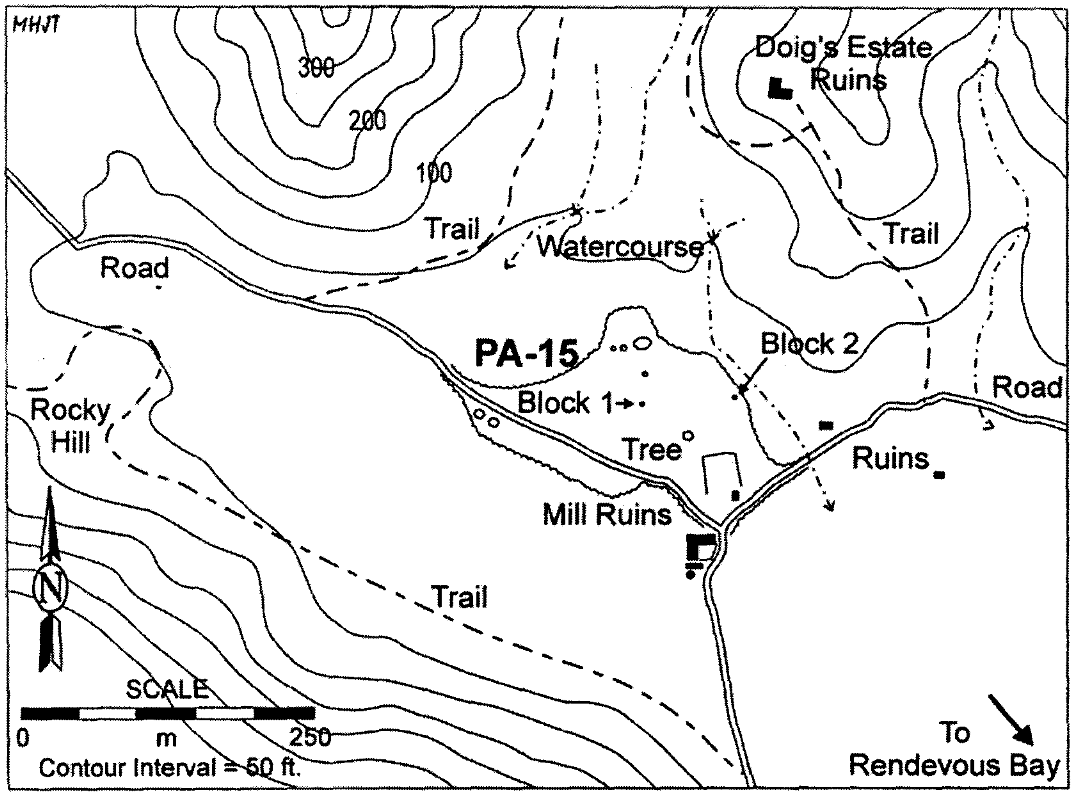


Figure 2.2. PA-15 sketch map (after deMille and Turney 2002, fig.3). Created and used with the kind permission of M.J. Turney.

Figure 2.3. View of Doig's from the southeast.

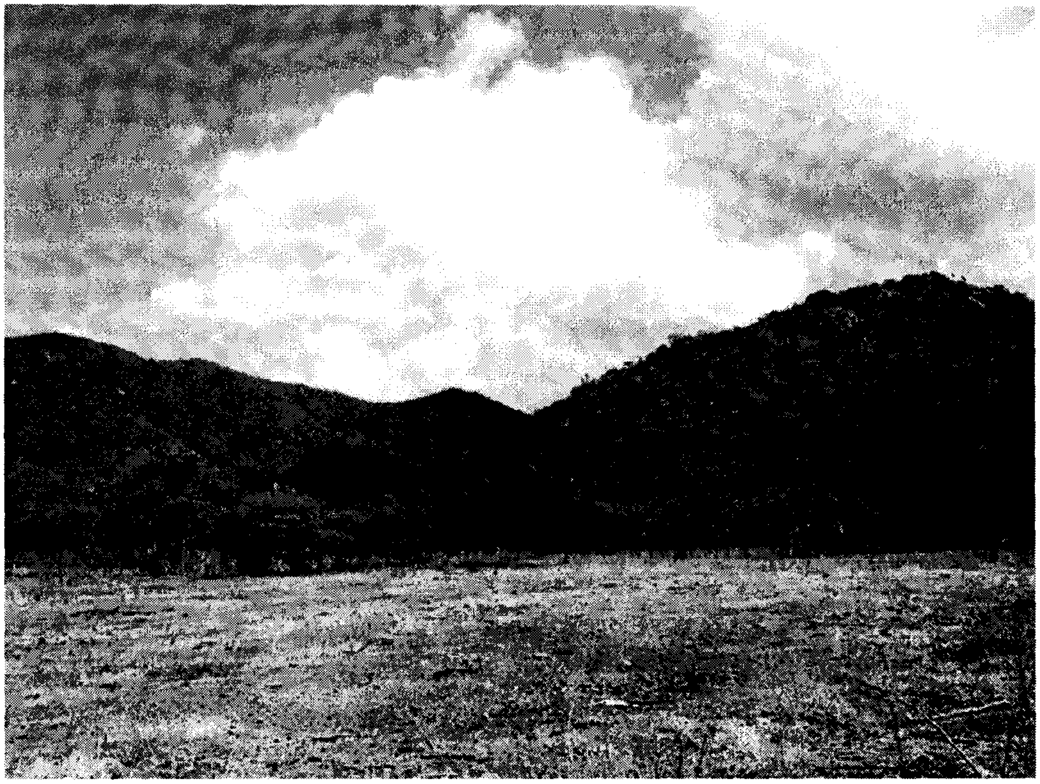


Figure 2.4. View looking northeast from the site.

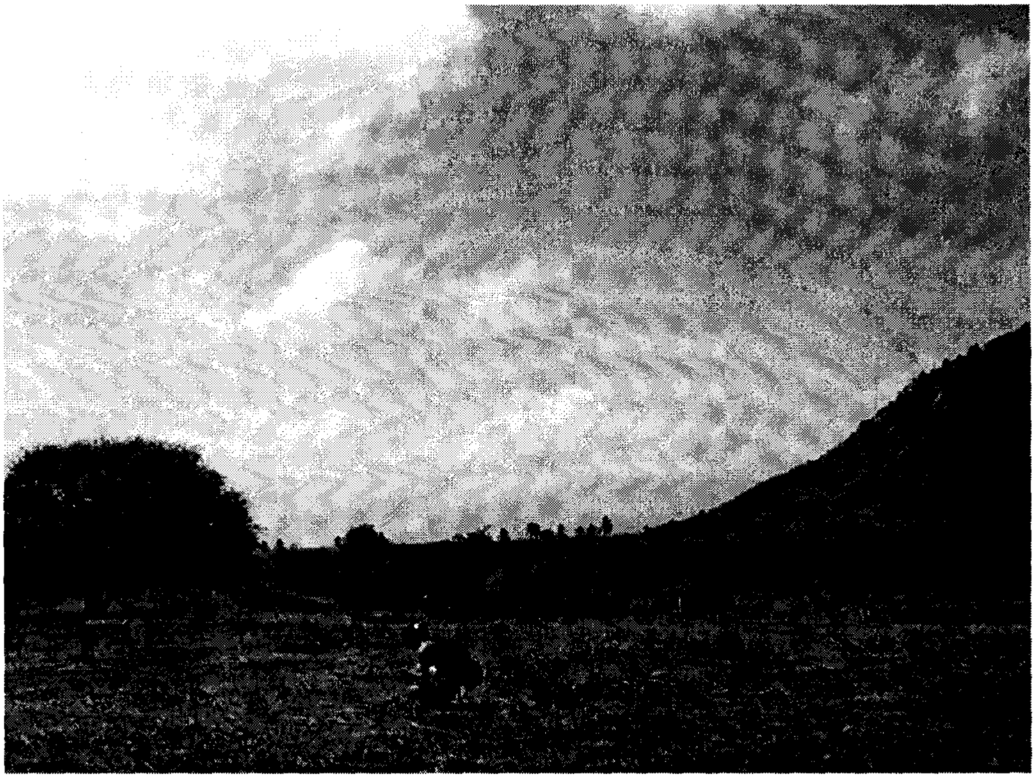


Figure 2.5. View looking southwest from the site (toward Rendezvous Bay).

mid 18th Century sugar plantation, were scattered on the surface (deMille and Turney 2002: 11).

In 2001, although changes in soil colour, texture and artifact densities were recorded, strata were divided into 10 cm arbitrary layers. In 2002, a better understanding of the site stratigraphy was attained and more detailed subdivisions within the strata were recorded. The visual layers are basically consistent across the site (Figure 2.6). However, the depth of these layers differs, as do the concentrations of faunal material and artifacts within them. It is likely that these visual layers do not correspond to various cultural layers. The visual consistency across the site is more likely the result of post depositional chemical processes. Notable exceptions within the visual layers include Units 11 and 12, which showed a distinctive rock layer beneath and within visual layer C. In addition, Units 15 and 16 contained cultural material that is significantly deeper than in the rest of the units (deMille, personal communication).

In 2002, the three distinct layers were labeled levels one, two, and three, respectively, but differences in zooarchaeological or artifact densities, or changes in stratigraphy warranted a layer subset. For example, if within layer 2, a change in artifact type or density was recorded, it was divided into 2a, 2b and 2c, et cetera. In addition, if a layer was more than 10 cm, it was also divided using a,b,c subdivisions (deMille, personal communication). DeMille (2004) provides a description of these layer subsets with interpretations of the corresponding natural and arbitrary level divisions from 2001. For purposes of comparison to the 2001 units, the 10 cm arbitrary levels are provided in Table 2 with the corresponding subdivisions from units excavated in 2003. It should be noted, however, that these comparisons are not entirely accurate. For example, cultural layers 4a and 4b may correspond to arbitrary level 4, but may be slightly shallower or deeper than 10 cm. In most cases cultural and natural levels range from between 7 and 15 cm.

Table 2.1. Arbitrary/Natural/Cultural Level Divisions from the 2001 and 2002 excavations (Revised from deMille 2004).

	Arbitrary Level Division 2001					
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Unit	**Corresponding Natural/Cultural Division 2002**					
9	1,2	3A	3B	3C	N/A	N/A
10	1	2,3	3B	4	N/A	N/A
11	1,2	3,4A	4B	4B	N/A	N/A
12	1,2	3	4A	4B	4B	N/A
13	1A, 1B	1B2	1C	2	N/A	N/A
14	1A	1B, 1C	N/A	N/A	N/A	N/A
15	1	2	3A	3B	3C,4C	N/A
16	1A	1B, 2	3A	3B	4B,4C	4D
17	N/A	N/A	N/A	N/A	N/A	N/A

Unfortunately, due to the lack of specific dating methods, the time of occupation and the pattern of settlement can only be inferred in a very broad sense. The different areas at the site may represent contemporaneous occupations, or conversely may be the result of different occupations over the course of the Saladoid period. The stratigraphy at the site is relatively compact, so the area may have been a temporary living site as part of a seasonal round or representative of a continuous occupation over a shorter period of time. More analysis of the stratigraphy and spatial information is needed to answer these questions.

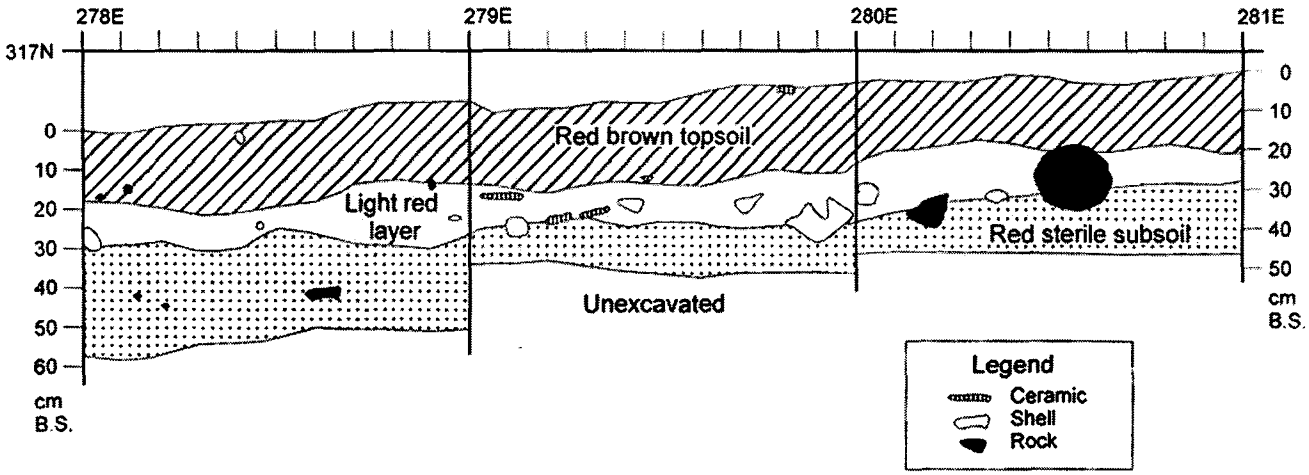


Figure 2.6. Typical stratigraphic profile. North wall, Block 1, 2001 excavations (after deMille and Turney 2002, fig.5). Created and used with the kind permission of M.J. Turney.

Preliminary analysis of spatial patterns at the site has been conducted through geophysical survey (Gent 2004). As a result of this survey, a roundhouse, a work hut, racks used for drying and storage or processing of cassava, potential burial pits, midden areas, and a large open hearth may have been identified. It is important to note that these interpretations are based on preliminary results of an electrical conductivity study. The results indicate that there is spatial variability at the site, however these interpretations have not yet been verified by excavation. Gent bases the interpretation of these structures on ethnographic data from Lowland South American societies, including the Waiwai, and Cubeo (Goldman 1979; Yde 1965 in Gent 2004). These analogies are used only to infer potential activity areas at PA-15.

The excavation units described herein were excavated prior to the survey conducted by Gent (2004), so the location of some features can only be approximated in relation to the units excavated. However, Unit 4 is located within or near midden 3, Unit 8 is located within or near the roundhouse, and Unit 13 is located within midden 1. The results of this survey will play a role in future excavations at PA-15, which will likely provide much more detailed interpretations of potential site structure.

Comprehensive studies of Saladoid settlement patterns have only just emerged, and the Saladoid settlement pattern likely changed from earlier to later occupations (i.e. traditional South American versus island adaptations already discussed). PA-15 represents the classic Cedrosan Saladoid culture, thought to parallel South American living, more inland, and closer to fresh water sources. Settlement and subsistence patterns likely varied between the different islands, as each island is unique in the resources available (Siegel 1991:319). Keegan (2000) asserts that although the earliest ceramic age sites in the West Indies were believed to have been located inland on river drainages, researchers (e.g. (Haviser 1997, Versteeg at al. 1993) are now finding that coastal sites are more common, and that both inland and coastal locations were used simultaneously (Curet 1992; Siegel 1992).

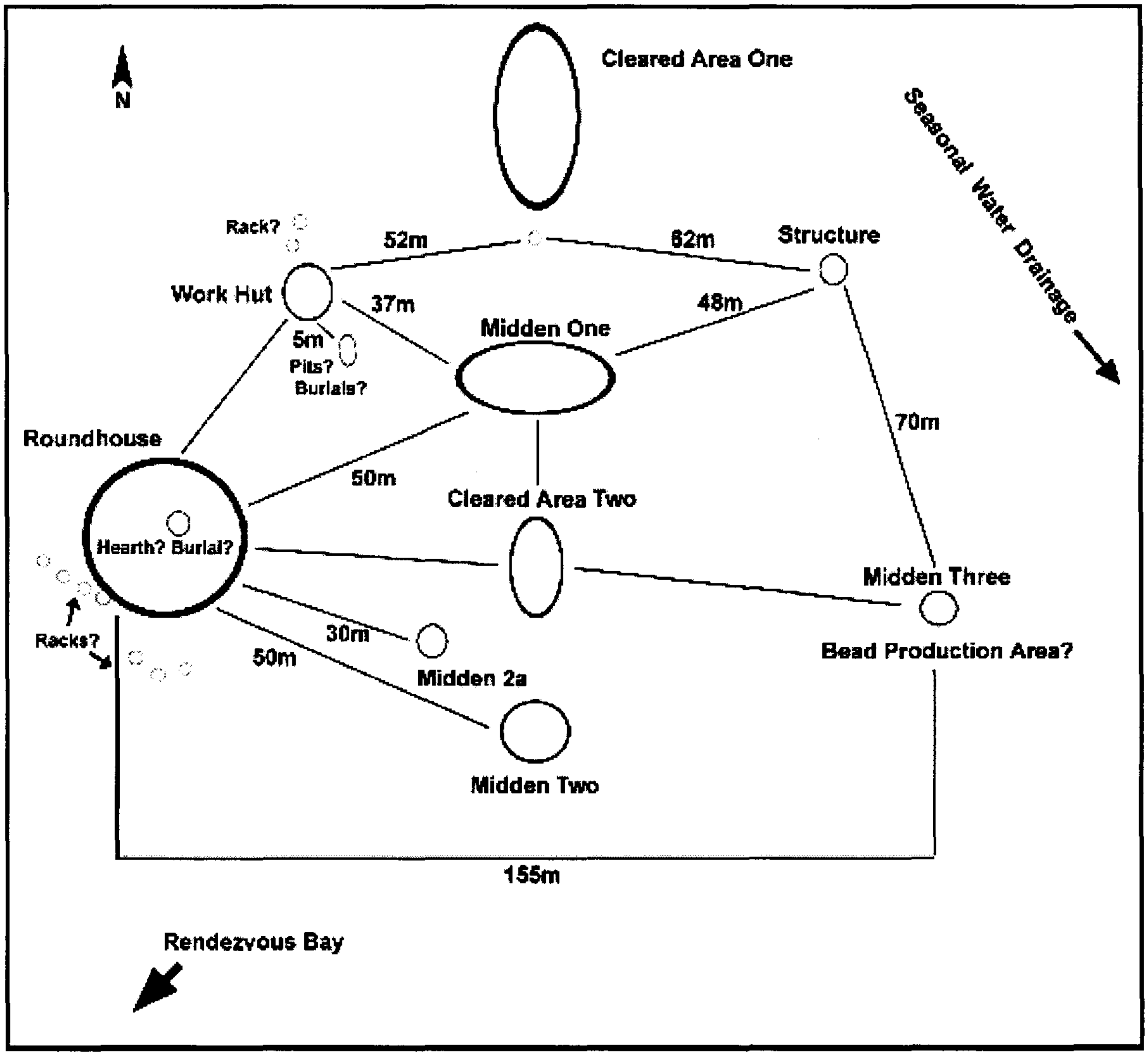


Figure 2.7. Approximate relationships between PA-15 features (after Gent 2004, fig.95). Created and used with the kind permission of Brock Gent.

Murphy (1999:269) found through a comparison of Saladoid and post-Saladoid sites on Antigua, that Saladoid sites tended to be one kilometer or more inland, and were dominated by terrestrial species. PA-15 is clearly associated with the Cedrosan Saladoid, based on ceramic traits, (personal communication, deMille) and is located 400 m inland. Although, technically it is an inland site, the data clearly suggest that the Early Saladoid relied heavily on marine resources. This suggests that Saladoid settlement patterns are more complex than previously understood.

CHAPTER 3

ANALYSIS OF FISH REMAINS

3.1. Research Strategy

The excavations at PA-15 have yielded a substantial amount of faunal remains. A subset of these was chosen for extensive zooarchaeological analysis in order to obtain a picture of resource use at the site. Three of the seventeen units excavated were analyzed in detail. Of the total number of faunal remains excavated at the site, 57% of them are fish or mollusk. Crab accounts for another 40% of the animal remains, indicating a strong reliance on coastal or near-shore resources (Table 3.1). The fish, shellfish and crab remains were chosen for analysis, as these remains are abundant and therefore most useful in determining resource productivity and subsistence strategies.

The best methods for quantifying faunal abundance has been a subject of considerable debate in zooarchaeological studies (e.g. Casteel 1977,1978; Cruz-Uribe 1988; Daly 1969; Gilbert and Singer 1982; Grayson 1981; Kintigh 1984; Wild and Nichol 1983). The most common methods rely on the use of NISP (number of identified specimens), MNI (minimum number of individuals) (e.g. Casteel 1977; Wild and Nichol 1983), and meat yield (e.g Lyman 1979).

MNI is determined by counting a number of elements that occur only once for each animal (such as the parasphenoid in fish), or using paired elements (such as the dentary), whereby the left and right elements can be identified (Wheeler and Jones

1989:149-150). MNI is sometimes described as a better indicator of relative abundance, because it is less susceptible to problems of fragmentation. With NISP, the more fragments you have, the more individuals you have. However, specimens are not likely to be identified if they are highly fragmented, whether by NISP or MNI. Another problem is that by choosing a particular element to determine MNI, such as the dentary, the density of the bone will be different for each species, and will be susceptible to differential preservation. Bone weight and live meat weights are other forms of identifying abundance of species. Bone weight may be useful for remains that are highly fragmented. However, as deFrance (1988:48) points out, the bone mass of different fauna vary considerably; therefore variation in relative abundances may be misleading. Estimates of live meat weight are useful only if proper meat yield estimates are available.

Regardless of which quantification method is chosen, researchers are still left with a partial picture of what species were being utilized in what proportion at a site. Grayson (1984) notes that for some archaeological studies, it is the *proportion* of species in relation to each other that is important, and not necessarily *how many* of each species are present. Researchers have noted that there is often a strong correlation between NISP and the MNI (e.g. Grayson 1984; Monks 2000:67).

The current study is concerned with comparing differences in resource use across time and space within the site. Therefore, the *relative abundances* of fish, shellfish and crab are seen to be the best way to determine contributions to the diet. Frequencies of these taxa are determined through time and space by comparing the NISP over time, between excavation blocks, and between families. This will determine if there are changes over time, and/or horizontal differences in the species present.

This chapter will present an overview of the faunal data for the vertebrate and invertebrate remains found at PA-15, followed by a more detailed examination and interpretation of the fish fauna. A detailed examination of the crab and shellfish remains found at PA-15 is presented in the following chapter.

3.2. The Faunal Assemblage

The total number of fish bones identified from the three units is 6,906; the units examined represent approximately 27% of the total fish assemblage. The units analyzed were chosen because of their location, as well as the abundance of marine faunal remains, based on preliminary counts. Units with greater amounts of marine remains provide a larger body of data, and a greater chance of finding statistically significant patterns in the archaeological assemblage. The Units chosen had a substantial amount of marine faunal remains, with the potential to be identified within a reasonable amount of time. There are five excavation blocks in total, units from three of the five excavation blocks were chosen to try to best represent the site as a whole. Units 4, 8 and 13 are located in separate excavation blocks and all three have a substantial amount of fish, crab, and shellfish, relative to other units in that excavation block (Table 3.1). Analysis of units from different areas at the site provides a better opportunity to observe potential differences across the site, as spatial variability and the potential for variation between activity areas are not yet well understood.

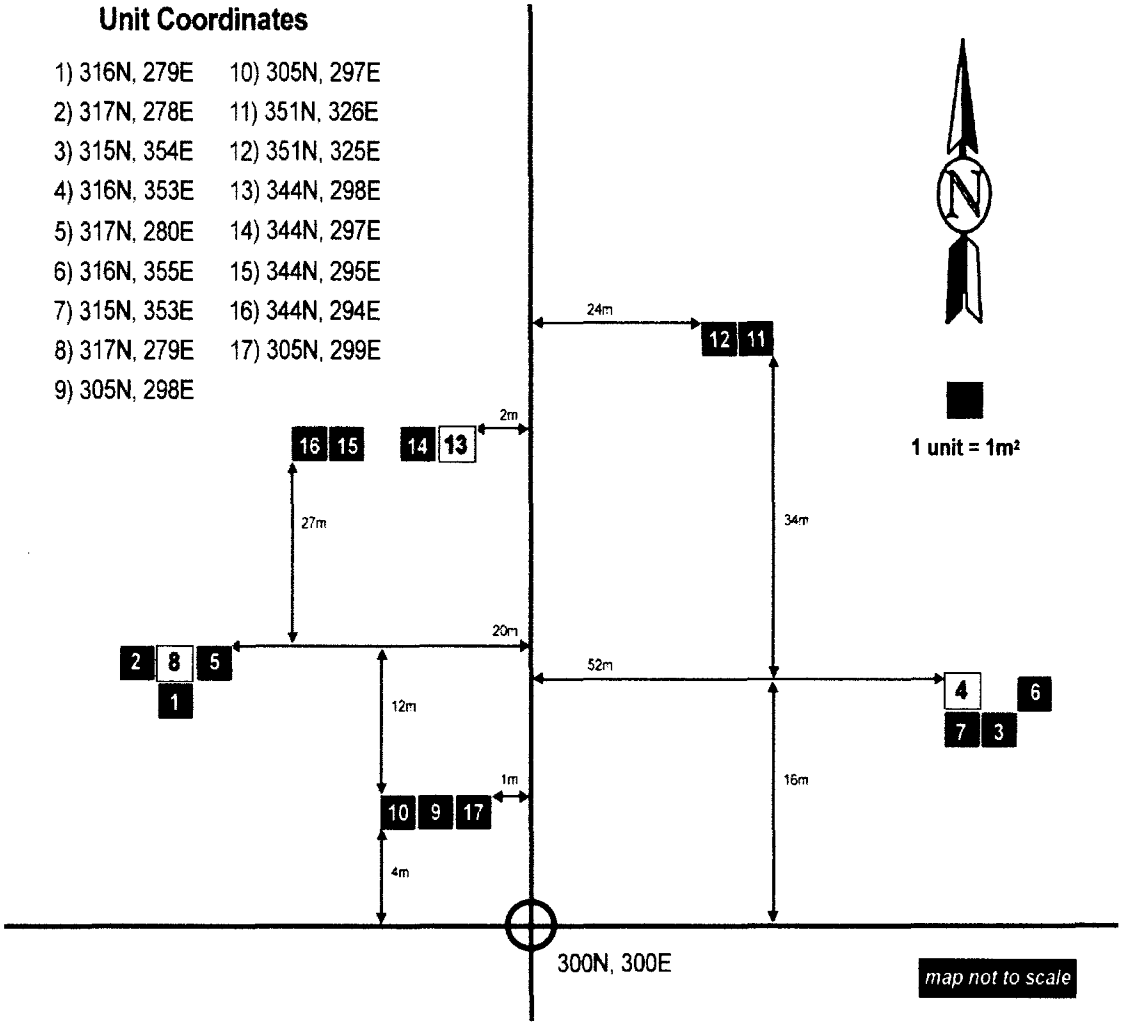
Table 3.1. Total NISP of fish, and weight of crab and shellfish by excavation block from PA-15 2001 and 2002 field seasons (Revised from deMille and Turney 2002 ,n.d).

2001 Season			Fish(n)	Crab(g)	Shellfish(g)
Block 1	Unit	1	2473	2957	8010
		2	788	3145	10733
		5	4848	2291	7790
		8*	2702	4472	19060
Block 2	Unit	3	255	872	7813
		4*	1454	2954	7302
		6	84	1297	12180
		7	771	1701	8642

* Units chosen for analysis, counts based on detailed analysis.

2002 Season			Fish(n)	Crab(g)	Shellfish(g)
Block 3	Unit	9	31	0	620
		10	38	21	590
		17	57	47	1410
Block 4	Unit	11	181	13	370
		12	100	13	540
Block 5	Unit	13*	2725	1721	7070
		14	6416	1473	4540
		15	1086	440	3860
		16	1612	431	3640
SITE TOTALS			25621	23848	104170

The fish faunal collection from PA-15 was washed and identified at the Fisheries Archaeology Laboratory in the Department of Anthropology, McMaster University. The weight and number of identified specimens (NISP) were determined for fish, shellfish, and crab. A partial comparative sample of fish, crab and shellfish was developed using species collected in Antigua in June of 2003. Additional species were identified using the comparative collection at the Fisheries Archaeology Laboratory at McMaster, and at the Vertebrate and Invertebrate Palaeontology Collections rooms at the Royal Ontario Museum in Toronto, Ontario. Mammal, bird, reptile and all other totals are based on rough counts conducted by the field school (deMille and Turney 2002, n.d.).



Unit Coordinates

1) 316N, 279E
2) 317N, 278E
3) 315N, 354E
4) 316N, 353E
5) 317N, 280E
6) 316N, 355E
7) 315N, 353E
8) 317N, 279E
9) 305N, 298E
10) 305N, 297E
11) 351N, 326E
12) 351N, 325E
13) 344N, 298E
14) 344N, 297E
15) 344N, 295E
16) 344N, 294E
17) 305N, 299E

Figure 3.1. Map of excavation plots, PA-15. Units analyzed are highlighted. Created and used with the kind permission of R.O Angelini.

Table 3.2. Total NISP by unit of faunal remains from PA-15 2001 and 2002 field seasons (Revised from deMille and Turney 2002, n.d.).

Unit	Fish	Crustacean	Mollusc	Mammal	Bird	Reptile	TOTAL
1	2473	3133	499	106	155	39	**6405**
2	788	2594	651	59	11	3	**4106**
3	255	873	434	241	0	0	**1803**
4	1454	3677	472	188	141	80	**6012**
5	4848	3296	1062	98	30	84	**9418**
6	84	965	159	91	0	0	**1299**
7	771	2268	673	146	37	79	**3974**
8	2702	5350	524	1	0	5	**8582**
9	31	0	160	21	0	2	**214**
10	38	31	427	18	0	0	**514**
11	181	8	296	28	0	3	**516**
12	100	18	542	77	1	1	**739**
13	2725	2649	3983	63	0	11	**9431**
14	6416	3620	4188	109	3	15	**14351**
15	1086	1506	2766	89	2	7	**5456**
16	1612	1369	1891	63	8	10	**4953**
17	57	88	899	42	2	1	**1089**
TOTAL	**25621**	**31445**	**19626**	**1440**	**390**	**340**	**78862**

3.3. Families Represented

Fifteen different families of fish and one Superorder (representing the sharks) were identified in the Doig's assemblage (Table 3.3). These families are known to inhabit three different marine environments subdivided by Newsom and Wing (2004): the shallow/inshore habitat, coral reefs, and pelagic waters. All of the fish identified, with the exception of shark, belong to the Class *Actinopterygii* (or ray-finned fishes). Based on the relative abundances of fish families, the Doig's site appears to be dominated by Serranidae (28.6% with vertebrae, 45.1% without), Scaridae (6.7% with vertebrae, 21.2% without), Carangidae (14.9% with vertebrae, 2% without), and Acanthuridae (11.4% with vertebrae, 4.5% without), thus suggesting that these taxa were important to the Saladoid diet at Doig's.

Twelve of the sixteen taxa belong to the order *Perciformes*. Perciformes are the most diverse of all fish orders, in fact the most diverse of all vertebrates. The Perciformes are distinguished by a variety of morphological similarities, such as the presence of spines in the fins, Ctenoid scales (with a tooted margin) or absent scales, the positioning of the pelvic fin at the thoracic or jugular (if present), and the absence of a swim bladder duct. There are 22 suborders, 150 families, approximately 1367 genera, and about 7800 species represented within the order (Nelson 1984:273-274). The families Balistidae and Diodontidae belong to the order *Tetraodontiformes*. Some characteristics of this order are the absence of parietals, nasals, and infraorbitals, sometimes the lower ribs are also absent. The postemporal is simple and fused if present, and the maxillae are usually firmly attached to the premaxilla. There are approximately eight families with 92 genera and 329 species represented in the order (Nelson 1984:379). The family Belonidae belongs to the order *Beloniformes*. These needlefishes have a nonprotrusible upper jaw, and the absence of an interhyal. The order consists of 5 families, 10 genera and 34 species (Froese and Pauly 2004). Shark was identified in the Doig's assemblage by the presence of teeth. An adequate shark comparative collection was not available; therefore, the teeth were identified to the level of the Superorder *Galeomorphii*. The subclass of sharks (the elasmobranchs) include four superorders, however all known shark species on Antigua belong to the Galeomorph Superorder (Froese and Pauly 2004).

The superorder Galeomorphii consists of approximately 71 percent of all shark species (Schwartz and Maddock 2002:491-2, Nelson 1994).

Table 3.3. Relative abundance of fish families at Doig's and the percentage they represent of the total fish assemblage.

	Excluding Vertebrae		Including Vertebrae	
Family Name (Common Name)	**NISP**	**% Site**	**NISP**	**% Site**
Acanthuridae (Surgeonfish, Tang, Unicornfish)	33	4.5	356	11.4
Balistidae (Triggerfish)	56	7.6	105	3.4
Belonidae (Needlefish)	0	0.0	283	9.1
Carangidae (Jacks and Pompanos)	15	2.0	464	14.9
Diodontidae (Porcupinefish and Burrfish)	3	0.4	5	0.2
Ephippidae (Spadefish, Batfish, Scat)	1	0.1	1	0.0
Haemulidae (Grunt)	53	7.2	180	5.8
Kyphosidae (Sea Chub)	2	0.3	2	0.1
Labridae (Wrass)	40	5.4	122	3.9
Lutjanidae (Snapper)	34	4.6	66	2.1
Scaridae (Parrotfish)	157	21.2	210	6.7
Scombridae (Mackerel, Tuna, Bonito)	6	0.8	183	5.9
Serranidae (Sea Bass)	334	45.1	893	28.6
Sparidae (Porgy)	5	0.7	205	6.6
Sphyraenidae (Barracuda)	0	0.0	43	1.4
Galeomorphii* (Shark)	2	0.3	2	0.1
Total Identified	**741**	**100.0**	**3120**	**100.0**

*Galeomorphii is a shark Superorder.

Certain factors will affect the representation of faunal remains in any zooarchaeological study. Two types of post-depositional processes may alter the representation of faunal material. The first order taphonomic processes over which archaeologists have no control include the degradation of certain species or anatomical parts, trampling at the time of site occupation, scavengers, insects, or burrowing animals; as well as wind, water, and plant growth (Reitz and Wing 1999:112).

The second-order factors for which archaeologists are "directly responsible" include "the choice of where to excavate, how to recover samples, the precision of the identification of the remains, and the completeness of analysis and report of the finds" (Reitz and Wing 1999:112). As a result, methods of recovery and excavation in the field will alter the sizes and types of species found. At PA-15, the faunal remains from all seventeen units were sieved through a 2mm mesh, smaller than the standard used in most excavations (the standard size is often 1/8 inch, or a little over 3mm) with the purpose of recovering as many of the smaller faunal remains as possible. However, it is likely that with future analysis of soil samples, smaller fishes and hence different species will be recovered. Bulk soil samples were taken from each of the units excavated; however analysis of these samples has not yet been undertaken. Wheeler and Jones (1989:40) recommend wet-sieving bulk samples using a 1mm mesh to recover smaller remains, such as juvenile fish, or anchovy.

In the laboratory, the experience of the analyst will also affect the accuracy of faunal identification. All identifications were conducted by the author, under the supervision of Dr. Aubrey Cannon. The identification of fish families is difficult, particularly the identification of vertebrae. For this reason, identification was assigned conservatively. If elements were similar to the comparative specimen, but there was some doubt as to the identification, these elements were counted as "unidentified". Occasionally, elements were extremely close to a certain family, but were not an exact match. These were grouped into the family in question, but a note was made on the identification sheet (see Appendix A).

Different families of fish have various elements that are distinctive or unique, making them more easily identifiable. Some families are closely related, and as such tend to have similar morphological characteristics. This presents a bias, as those families that have more distinctive elements will be over-represented, while those families that have more typical, or less distinctive elements will be under-represented. For the most part, however, each family will have a few elements that can distinguish them from other taxa of fish.

Another factor that will potentially affect the identification of any faunal assemblage is the extent of the comparative collection. Tropical reef fishes are particularly problematic, as there are thousands of different species (Wheeler and Jones 1989:14). As stated above, identifications were made using the following resources: fishes collected in Antigua, samples located at the Fisheries Archaeology Research Lab at McMaster University, and at the Royal Ontario Museum. It should be noted, however, that even with these resources, a more comprehensive comparative collection would allow one to see variations and similarities within and between fish families, making identifications more accurate.

Although often difficult to identify to family or species, vertebrae tend to survive well in archaeological contexts, and are often the most abundant element in fish archaeological collections (Casteel 1976:72). Certain families of fish have very distinctive vertebrae (such as Acanthuridae), while other families tend to be quite similar in their morphology (such as Serranidae, Sciaenidae and Lutjanidae). The families of fish that tend to have similar vertebrae were identified only if certain elements, such as the neural or haemal spine were present, and the overall morphology was distinctive enough to distinguish taxa. This again presents a bias in the relative abundance ratios, as those families that have distinctive vertebrae will be over-represented, while those taxa that have similar morphological characteristics will be under-represented. The results are presented with and without the identification of vertebrae so that the results may be interpreted separately. Not surprisingly, some taxa at Doig's (Acanthuridae, Belonidae and Sphyraenidae) are only present with the addition of vertebral identification (Table 3.4).

A short description of the families of fish represented at Doig's follows. The preferred habitat, feeding behaviour, social behaviours and other interesting points are included.

Acanthuridae – This Family is comprised of the surgeonfishes, tangs, and unicornfishes. There are 6 genera, and 72 known Species. They are found particularly around coral reefs. Most fish in this Family move about in large groups and graze on benthic algae; some feed mainly on zooplankton or detritus. This Family contains pelagic spawners, the young drift ashore and sink to the bottom until they mature. The surgeonfish and tang have a spine said to be as sharp as a surgeon's scalpel on each side of the body near the tail, while the unicorn fish has a spine on the top of its head. Generally Acanthurids are oval in shape, with compressed bodies, and eyes placed high on the head. They have small mouths, with a single row of close-set teeth (Froese and Pauly 2004; Nelson 1984:359).

Balistidae – This Family is also known as the triggerfishes. There are 11 Genera, and 40 known Species. They are found particularly around coral reefs. Most fish in this Family are solitary and diurnal. They are carnivores that feed on a variety of invertebrates, including crabs, molluscs, and urchins; as well as algae or zooplankton. This Family lays demersal eggs in a nest, which is often aggressively guarded by the female. The first dorsal spine on triggerfish is equipped with a locking mechanism, or trigger, which also acts as a defense against predators. Sometimes this trigger is used to wedge themselves into cavities in the reef so that predators cannot remove them. They have compressed bodies, and are capable of rotating their eyeballs independently. The upper jaw is non-protrusible, the upper jaw has 4 teeth in the outer and three in the inner part of each premaxilla. (Froese and Pauly 2004; Nelson 1984:381).

Belonidae – This Family is also known as the needlefishes. There are 10 Genera, and 34 known Species. They are slim, elongate fishes, with several needlelike teeth, that live at the surface of the water. They can leap from the water, in some cases people have been impaled by these fish; they can also skitter across the top in search of prey. Needlefish eggs attach themselves to floating sargassum in the water. The flesh is reported to have a good flavour, although there are many small bones with a green colour, so people today sometimes have misgivings about eating them (Froese and Pauly 2004; Nelson 1984:215).

Carangidae – This Family is comprised of the jacks and pompanos. There are 33 Genera, and 140 known Species. The Carangids are generally schooling fish when mature, and are quite variable in their body shape (very deep to shallow-bodies), although the body is usually compressed. They are fast swimmers, and are predatory. They do not reside on reefs, but are often found swimming above reefs, in the open sea, and occasionally rooting in sand in search for prey. This Family lives close to shore, spawning is believed to take place in pelagic waters. Today, Carangids are an important food Species (Froese and Pauly 2004; Nelson 1984:293-4).

Diodontidae – This Family is also known as the porcupinefishes or burrfishes. There are 6 Genera, and 19 known Species. They have inflatable bodies, with "well-developed" sharp spines, which are sometimes only erect when the body is inflated. Adults are found inshore, often lying in protected coral cavities. The eggs and young are pelagic. The front teeth are fused together; the premaxillaries and dentaries unite at the midline. They are carnivorous, feeding mostly on hard shelled invertebrates, which they crush with their beaks (Froese and Pauly 2004; Nelson 1984:385).

Ephippidae – This Family is comprised of the spadefishes, batfishes, and scats. There are 7 Genera, and 20 known Species. Fish in this Family are omnivores, feeding on algae and small invertebrates. This Family is thought to contain pelagic spawners. Generally Ephippidae bodies are deep, and laterally compressed. They have small mouths, with toothless palatines or vomer (Froese and Pauly 2004; Nelson 1984:308).

Haemulidae – The common name of this Family is the grunts. There are 17 Genera, and 150 known Species. They feed on benthic invertebrates at night, and are typically inactive during the day. They are pelagic spawners and have small mouths with thick lips. They are presently an important food fish (Froese and Pauly 2004).

Kyphosidae – This Family is known as the sea chubs. There are 15 Genera, and 42 known Species. Fish in the subfamilies Girellinae and Cyphosidae are herbivorous; while fish in the Scorpinidae Subfamily are mainly carnivorous (benthic invertebrates). Kyohosids generally congregate in pelagic waters in great numbers for spawning, otherwise they are found near shore (Froese and Pauly 2004; Nelson 1984:307).

Labridae – This Family is known as the wrasses. There are 60 Genera, and 500 known Species. Labridae are "one of the most diversified of all fish families in shape, color, and size" (Nelson 1984:327). Most have a protrusible mouth, the teeth jutting forward. They are carnivorous, feeding on planktivores, benthic invertebrates, and ectoparasites on other fish. Many Species are brilliantly coloured; which may change often throughout their lifetime. Most Species burrow in the sand at night (Froese and Pauly 2004; Nelson 1984:326-327).

Lutjanidae – This Family is known as the snappers. There are 17 Genera, and 103 known Species. Lutjanids have relatively large mouths, with enlarged canine teeth and small palatine teeth. Generally, this Family consists of predators, feeding on crustaceans and other fishes. They will sometime enter freshwater to feed (Froese and Pauly 2004; Nelson 1984:298-299).

Scaridae – The common name for this Family is the parrotfishes. There are 9 Genera, and 83 known Species. The jaw teeth are fused, making them look like parrot beaks. They are herbivores, mostly scraping algae from dead coral substrates. Parrotfish are important producers of sand on the reefs, as they crush rock with the algae to aid in digestion. Parrotfish are capable of changing sex; the males have a brilliant coloured terminal phase. They are pelagic spawners, some Species rest in a secretion of mucous at night. They are currently an important food fish (Froese and Pauly 2004).

Scombridae – This Family consists of the mackerels, tunas and bonitos. There are 15 Genera, and 51 known Species. They have a pointed snout, with a large mouth and strong jaws. Their bodies are elongate and fusiform. They are predatory, feeding on small fishes, crustaceans and squids. Some live in coastal waters, other Species are far from shore. Females generally attain larger sizes than the males. "Batch" spawning frequently takes place inshore, though the eggs are pelagic. They are one of the most important commercial and sport fishes today (Froese and Pauly 2004).

Serranidae – This Family contains the sea basses, which includes groupers and fairy basslets. There are 62 Genera and 449 known Species. Serranids are bottom-dwelling predators, feeding on crustaceans and other fishes or fish eggs. They can change sex from female to male, and are a highly valuable commercial food fish (Froese and Pauly 2004).

Sparidae – The common name for this Family is the porgies. There are 35 Genera, and 112 known Species. They are carnivores of hard-shelled benthic invertebrates. Many Species are hermaphroditic, some change sex later on in life. They are an important food and game fish (Froese and Pauly 2004).

Sphyraenidae – This Family is known as the barracudas. There is 1 genus, and 18 known Species. Sphyraenids have elongated bodies, with fanglike teeth, and jaws adapted to feeding on large prey. They are "voracious predators of other fish", and they can be dangerous to humans. They spawn in schools in pelagic waters (Froese and Pauly 2004).

Galeomorphii – This Superorder Taxon refers to sharks. Most sharks are fierce predators, feeding mostly on a variety of live fish. Sharks take a long time to mature, and some Species carry their young for a year or more. They grow teeth in parallel rows, and replacement teeth come forward as the older teeth fall out. Unlike bony fish, sharks do not have a swim bladder to enable them to float. Instead, this ability is provided by their light, cartilaginous skeletons (Whitehead 1971).

Table 3.4. Elements (NISP) identified by Family.

	Acanthuridae	Balistidae	Belonidae	Carangidae	Diodontidae	Ephippidae	Haemulidae	Kyphosidae	Labridae	Lutjanidae	Scaridae	Scombridae	Serranidae	Sparidae	Sphyraenidae	Squalomorphii	Unknown
Angular							4			2		1	43				17
Atlas				1			8		1		1	1	22				84
Basipterygium							1										2
Ceratohyal							5						8				5
Cleithrum													4				2
Dentary				3				2	5	7	8		60	1			13
Dentition Fragment/Tooth		7							3		1			1		1	127
Epihyal										2			10				14
Hyomandibular				1		1	2		2	1	6		12				43
Interhyal																	4
Maxilla				5			15		2	7	7	2	55				21
Opercle																	28
Otolith							2										1
Palatine													18				16
Parasphenoid																	7
Pharyngeal Plate					1				9		74						4
Postemporal													10				6
Premaxilla		11		1			18		9	12	44		41	3			15
Preopercle													4				4
Quadrate		10		3			2				3	2	53				32
Scapula	3			2			2		1	1	11		6				19
Spine	30	11			2								1				
Supracleithrum													2				5
Ultimate									10		6	1					22
Vomer													18				6
Caudal Vertebra	255	15	214	440	2		92		62	14	46	136	388	189	47		2667
Precaudal Vertebra	64	15	41	2			18		7	4	1	1	74	11	2		289
Thoracic Vertebra	3	21	5	5			8		10	12	2	39	70	25			174
Unknown Vertebra			23	1											1	1	159
Other		5															

Fifteen families of those identified in the PA-15 assemblage inhabit shallow inshore waters or coral reefs (Table 3.5). Two families, Belonidae and Scombridae tend to be pelagic species, however these fish do come near shore, and their occurrence at the site is relatively small (9.1% and 5.9% with vertebra, respectively). Lagler et al. (1977:428) note that fish that inhabit pelagic and particularly benthic environments are often cast close to shore or occasionally onshore by large waves. In addition, Scombridae make "seasonal coast-wise migrations" where they may be found close to shore (Wheeler and Jones 1989:24).

Table 3.5. Typical environments inhabited by fish families identified at PA-15 (Revised from Newsom and Wing 2004; Wheeler and Jones 1989).

Fish Families	Shallow Inshore Waters	Coral Reefs	Pelagic Waters
Acanthuridae (Surgeonfish, Tang, Unicornfish)		*	
Balistidae (Triggerfish)		*	
Belonidae (Needlefish)			*
Carangidae (Jacks and Pompanos)	*	*	
Diodontidae (Porcupinefish and Burrfish)		*	
Ephippidae (Spadefish, Batfish, Scat)	*		
Haemulidae (Grunt)		*	
Kyphosidae (Sea Chub)	*		
Labridae (Wrass)		*	
Lutjanidae (Snapper)	*	*	
Scaridae (Parrotfish)		*	
Scombridae (Mackerel, Tuna, Bonito)			*
Serranidae (Sea Bass)	*	*	
Sparidae (Porgy)	*		
Sphyraenidae (Barracuda)	*		
Galeomorphii (Shark)	*		*

Sharks in the Superorder Galeomorphii inhabit several environments, however through a comprehensive study of several sites in the Lesser and Greater Antilles Newsom and Wing (2004) found several occurrences of shark in the family Ginglymostomidae (nurse sharks), as well as Carcharhinidae (requiem sharks), both are often found in shallow inshore waters.

The habits and habitats of fishes can be used to deduce fishing strategies. Wing and Scudder (1983) note that very small, herbivorous fish are most easily caught with nets, while larger carnivorous fish can be caught with a hook and line. Although these families of fish may be more easily caught using these methods, all families may also be caught using spears, nets, or poison. Based on ethnographic data (Breton 1665 in Price 1966), "Island Caribs" used a variety of fishing techniques. The hook and line was often used close to shore from their dugout canoes, and shallow-water fishing was used with arrows and bows attached with cord. In addition "fish pots", or baskets were "set in streams and not far out in the sea…It was sunk by means of a rock or a large block of wood to which it was attached. The mouth was set facing the current in such a way that the water rushed into the orifice, facilitating the entrance of fish" (Anonymous 1776:4 in Price 1966:1365). The majority of fish families at Doig's are carnivorous, although a number of herbivores and omnivores are also present (namely Acanthuridae, Ephippidae, Scaridae and some Kyphosidae). This indicates that the inhabitants at Doig's were likely using a variety of fishing strategies.

3.4. Vertical Distributions

PA-15 is relatively large, and comparisons between levels are difficult without reliable chronological control. Stratigraphic depths do not apply across all units at the site. Without radiocarbon dates, it is difficult to determine associations between visual levels. As described in Chapter 2 (Table 2.1), the division of levels changed between the 2001 and 2002 excavations. However, upper levels at the site were deposited later than those below in any given unit. Therefore, to gain a general sense of trends over time, units were divided into an upper and lower component. The elements from these components were combined for all units for comparison. The upper component consists of the first two levels excavated; the lower component consists of levels 3 and lower. The major drawback of this method is, of course, that the levels between units are different depths and may represent different times. This method should however still provide data useful for a general comparison between the upper and lower levels. A summary of the divisions of the upper and lower components is provided in Table 3.6.

3.4.1. Trophic Level Analysis

Wing (2001) and Wing and Wing (2001) use calculations of the mean trophic level of reef fishes in the Caribbean to argue that declines in preferred species occurred along with a decline in trophic levels. This theory works on the premise that predatory fishes, which are higher up on the food web will be targeted sooner than herbivorous fishes. This is due to the fact that predatory fishes are more aggressive, and are therefore more willing to take a baited hook or enter a baited trap. These fishing techniques selectively target species that are high in the food web. As a consequence, their abundance declines relative to that of herbivorous fishes (Newsom and Wing 2004:55; Russ 1991; Wing and Wing 2001). Fishing "down food webs" (at lower trophic levels) tends to follow "a gradual transition in landings from long-lived, high trophic level, piscivorous bottom fish toward short-lived, low trophic level invertebrates and planktivorous pelagic fish" (Newsom and Wing 2004:54-55).

Table 3.6. Summary of upper and lower component divisions.

Unit	Upper Component Levels	Lower Component Levels
1	1,2	3,4,5
2	1,2	3,4,5
3	1,2	3
4	1,2	3,4
5	1,2	3,4
6	1,2	3,4
7	1,2	3
8	1,2	3,4,5
9	1,2	3A,3B,3C
10	1,2	3A,3B,4
11	1,2	3,4A,4B
12	1,2	3,4A,4B
13	1A, 1B1	1B2,1C,2
14	1A, 1B	1C
15	1,2	3A,3B,3C,4C
16	1A,1B	2,3A,3B,4B,4C,4D
17	1,2	3,4

Trophic levels were determined for the families of fish identified in the upper and lower components at the Doig site. Again, results are shown for families represented by the inclusion of vertebra and without to show potential differences. Trophic levels were determined using Antiguan species published on Fishbase www.fishbase.org (Froese and Pauly 2004).

Table 3.7. Fish families identified at Doig's (PA-15) and their mean trophic levels (from Froese and Pauly 2004).

Acanthuridae	2.00	Labridae	3.52
Balistidae	3.18	Lutjanidae	3.96
Belonidae	4.40	Scaridae	2.00
Carangidae	3.88	Scombridae	4.21
Diodontidae	3.50	Serranidae	4.00
Ephippidae	3.39	Sparidae	3.21
Haemulidae	3.42	Sphyraenidae	4.46
Kyphosidae	2.00	Galeomorphii	4.33

Trophic levels were calculated by using species listed for the island of Antigua. The trophic level of those species listed for Antigua was grouped into their appropriate families. The mean of those species represents the family trophic levels in Table 3.7. A typical trophic level pyramid has 5 levels, the lowest level includes plants and detritus, the top level consists of "top predators". In the Caribbean Sea, all animals will fall within the range of 2.00 and 4.50. Values in the above table that have a value of 2.00 are classified as omnivores, herbivores and detritivores; those that range from 3.18 to 3.96 are mid-level carnivores, and those that range from 4.00 to 4.46 are high-level carnivores (Froese and Pauly 2004).

Table 3.8. Mean trophic level of the upper and lower components including and excluding vertebra.

	Excluding Vertebrae		Including Vertebrae	
	n	TL	n	TL
Upper	55	3.76	768	3.65
Lower	686	3.31	2352	3.76

Table 3.8 summarizes the results of the trophic level analysis. The results of the upper and lower components differ depending on the inclusion or exclusion of vertebrae. With the inclusion of vertebra identification, the trophic level is only slightly higher in the lower levels, and lower in the upper levels, possibly indicating that the most desired fish were more available in the earlier component, though the difference is minimal. However, with the exclusion of vertebral identifications, the opposite pattern emerges, with the lower component showing a lower trophic level than the upper component. The families Acanthuridae and Belonidae have very distinctive vertebrae, and have only been identified in the PA-15 assemblage by this element. These families represent relatively high numbers within the total families identified (together they make up approximately 20.5% of the total assemblage). Because these vertebrae are so distinctive, the trophic data with the inclusion of vertebral elements is likely the most representative, as these fish were undoubtedly present. However, the difference between the trophic data with and without the inclusion of vertebrae clearly demonstrates potential problems with the effect that the identification of fishes has on the resulting patterns. These data show that the representation of families is affected by the inclusion or exclusion of vertebrae.

Potential bias such as differential preservation and identification is a problem for all archaeological faunal assemblages. The best way to reduce this bias is to conduct a multilineal analysis. Gathering as many lines of evidence as possible and comparing the resulting patterns provides the best basis for interpretation. With this in mind, further analysis of the representation of families in the PA-15 assemblage follows.

3.4.2. Representation of Families

The relative representation of fishes present at PA-15 may indicate which families were the most desired as well as information about site taphonomy. In addition, the representation of fishes may aid in the understanding of which habitats were exploited, and by extension the level of technology of Saladoid populations. Table 3.9 shows the families identified, divided into upper and lower components without vertebrae; Table 3.10 shows the families present with the addition of vertebrae.

Based on totals for the upper and lower components without the inclusion of vertebrae, Serranidae are the most abundant food source within both components (upper levels 67.3%, lower levels 43.3%). The lesser percentage of Serranidae in the lower levels is offset by a greater number of Scaridae (22.4% versus only 5.5% in the upper levels). Other fishes do not seem to vary significantly, except that the Balistidae are not represented at all in the upper levels, while they represent 8.2% of the total fish assemblage in the lower levels.

With the inclusion of vertebral elements, again there is a greater representation of Serranidae in the upper levels than the lower levels of the site (67.3% compared to

30.0%). Families more highly represented in the lower levels include Acanthuridae (12.9%), Carangidae (12.5%), as well as Belonidae (9.4%).

The reasons for the variability in the representation of families between upper and lower components are not immediately apparent. Variability could represent different time periods, activity areas, social differentiation or depositional patterns. However, based on the representation of fish, Serranidae appears to be the most preferred catch across all time periods. Today, Serranidae continue to be a highly valued commercial food fish (Froese and Pauly 2004). They contain an abundance of lean, firm white flesh (True Star Health 2004), which would have made a sensible preferred food choice. While Serranidae appear to be the preferred food fish at PA-15, variability in representation exists between the upper and lower components. The earlier levels contain considerably less Serranidae, and are marked by the presence of a greater variety of fishes. If it were resource depression that contributed to declines in access to Serranidae, one would expect the lower levels at the site would contain a greater proportion of Serranidae; this is not the case. By taking a preliminary glance at Tables 3.9 and 3.10, it appears that these differences in the upper and lower components are greatly affected by differences between the units (particularly Unit 13 compared to 4 and 8). A comparison of the representation of families between units will follow the current discussion of vertical distributions.

3.4.3. Study of Fish Vertebrae

The size of fishes can help to determine whether or not human populations had a deleterious effect on fish populations. Sutherland (1990) found that animals under intense predation show a decline in body size and age reduction of targeted families. Declines in size may also reduce the age at which animals breed and the size of the progeny they produce (Reitz and Wing 1999: 67-68). This results in a population with primarily immature individuals, which are too young to maintain a population. "Growth overfishing" occurs as the larger, older individuals are selectively removed, leaving only the smaller individuals (Newsom and Wing 2004:55).

Evidence of resource depletion has been found in other prehistoric contexts (Butler 2001; Cannon and Cannon 2001; Reitz 2004; Wing 2001; Wing and Wing 2001). Methods of size reconstruction for fish include measurement of the centra of vertebrae, of otoliths (ear stones) and scales (Casteel 1974, 1975; Colley 1990:218). Because vertebrae are abundant (n= 11,556) in the Doig's assemblage, they were used to assess variation in the size of fishes (See Appendix B for fish vertebral data).

Analysis of these remains show the extent of variability in the average size of fish over time and space. To determine gross size variation of fish vertebrae between excavation levels a nested series of sieves and a sieve shaker was used. Using the sieve shaker and 7 sieves, size grades of fish vertebrae from all units were determined. The seven sieves were stacked on top of one another and vertebrae from each level were "shaken" for 60 seconds. This time interval was sufficient to sort all vertebrae into their proper categories without damage to the bone. The spinous processes were not present on the majority of the vertebrae, so these features were not generally an issue for determining size grades. If the neural or haemal spine was present, the centrum was measured using digital calipers and placed into the proper size category.

The results show that the lower levels of units across the site contain a smaller proportion of small vertebrae than the upper levels. The smallest size category represented makes up almost 35% of the upper assemblages, but only 26% of the vertebrae in the lower levels. While a 9% difference is relatively modest, the consistency of the data and the large sample size indicate that the variation is significant. Similarly, 5.9% of the vertebrae in the upper levels fall into the largest categories (9.5 mm and above); while 7.2% of the vertebrae in the lower levels fall into this size category (a difference of 1.3%). In summary, the upper levels contain more small vertebrae, while the lower levels contain more large vertebrae.

Table 3.9. Results of gross vertebra size study-upper and lower components.

	>12.5 mm		**9.5-12.5**		**8-9.4**		**6.3-7.9**		**4.75-6.2**		**4-4.74**		**<4**		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	**Total**
Upper	44	1.0	224	4.9	278	6.0	551	12.0	1001	21.7	768	16.7	1743	37.8	4609
Lower	96	1.4	411	5.8	556	7.8	1175	16.5	1750	24.6	1297	18.2	1825	25.7	7110
															11719

In addition to using these robust size categories, the average vertebra centra width was calculated for the upper and lower components of the site. This was done by taking the median measurement in each size category (Tables 3.12 and 3.13).

Table 3.10. Relative abundance (without vertebrae) of fish families identified-upper and lower components.

Fish Families	Unit 4				Unit 8				Unit 13				TOTAL			
	Upper		Lower		Upper		Lower		Upper		Lower		Upper		Lower	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Acanthuridae	1	2.5	0	0.0	0	0.0	0	0.0	0	0.0	32	7.5	1	1.8	32	4.7
Balistidae	0	0.0	0	0.0	0	0.0	26	11.4	0	0.0	30	7.0	0	0.0	56	8.2
Belonidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Carangidae	2	5.0	1	3.2	0	0.0	3	1.3	0	0.0	9	2.1	2	3.6	13	1.9
Diodontidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	0.7	0	0.0	3	0.4
Ephippidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	1	0.1
Haemulidae	3	7.5	2	6.5	0	0.0	5	2.2	0	0.0	43	10.1	3	5.5	50	7.3
Kyphosidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.5	0	0.0	2	0.3
Labridae	3	7.5	0	0.0	0	0.0	18	7.9	0	0.0	19	4.4	3	5.5	37	5.4
Lutjanidae	2	5.0	0	0.0	2	13.3	6	2.6	0	0.0	24	5.6	4	7.3	30	4.4
Scaridae	3	7.5	7	22.6	0	0.0	4	1.8	0	0.0	143	33.5	3	5.5	154	22.4
Scombridae	0	0.0	0	0.0	0	0.0	4	1.8	0	0.0	2	0.5	0	0.0	6	0.9
Serranidae	25	62.5	21	67.7	12	80.0	160	70.2	0	0.0	116	27.2	37	67.3	297	43.3
Sparidae	1	2.5	0	0.0	1	6.7	1	0.4	0	0.0	2	0.5	2	3.6	3	0.4
Sphyraenidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Galeomorphii	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0	1	0.2	0	0.0	2	0.3
TOTAL IDENTIFIED	40	100.0	31	100.0	15	100.0	228	100.0	0	0.0	427	100.0	55	100.0	686	100.0
Unidentified Fish	25	-	8	-	6	-	91	-	0	-	246	-	31	-	345	-
TOTAL FISH	65	-	39	-	21	-	319	-	0	-	673	-	86	-	1031	-

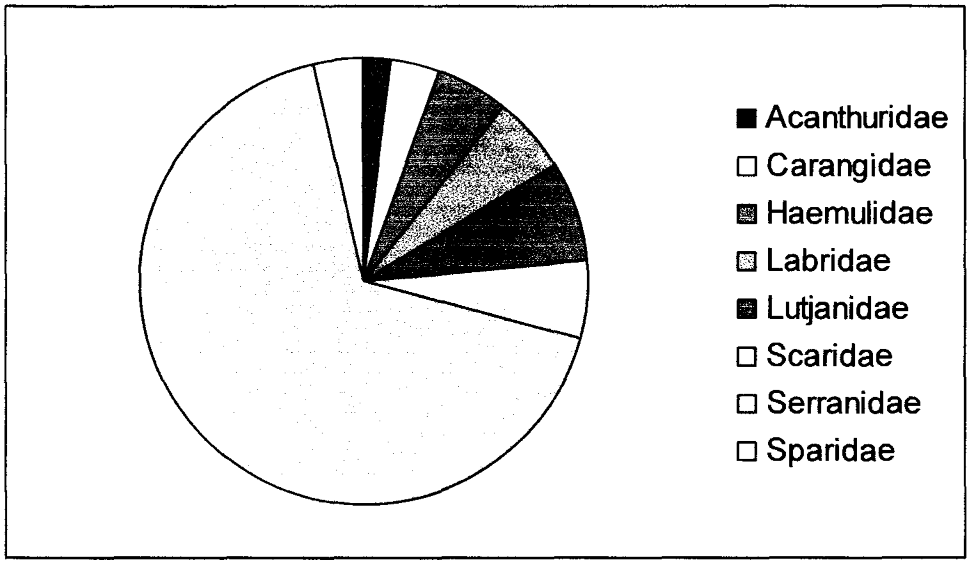


Figure 3.2. Relative abundance (without vertebrae) of fish families identified-upper component.

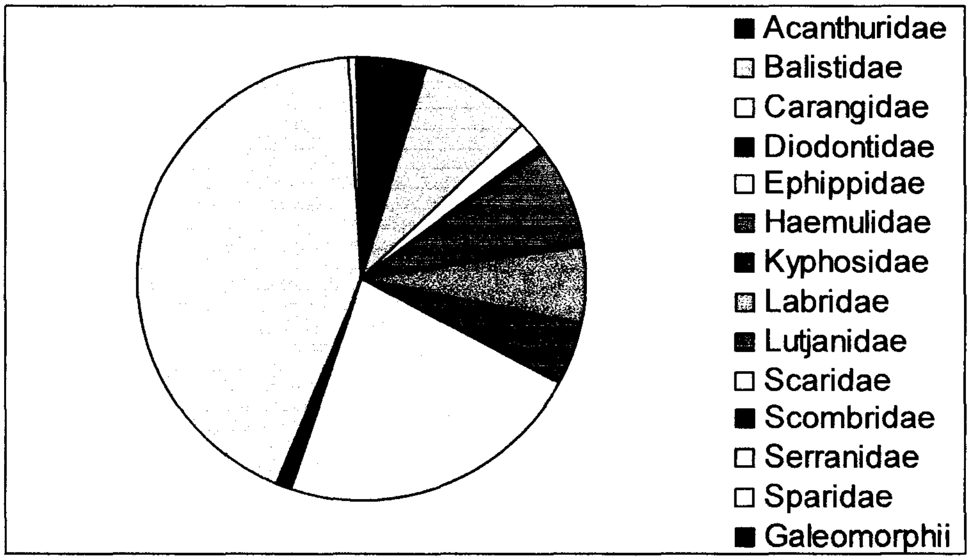


Figure 3.3. Relative abundance (without vertebrae) of fish families identified-lower component.

Table 3.10. Relative abundance (vertebrae included) of fish families identified-upper and lower components.

Fish Families	Unit 4				Unit 8				Unit 13				TOTAL			
	Upper		Lower		Upper		Lower		Upper		Lower		Upper		Lower	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Acanthuridae	13	2.4	8	5.8	15	18.8	11	1.2	24	15.8	285	25.0	52	1.8	304	12.9
Balistidae	8	1.5	1	0.7	0	0.0	46	5.0	1	0.7	49	4.0	9	0.0	96	4.1
Belonidae	32	6.0	12	8.6	12	15.0	174	18.9	17	11.1	36	3.8	61	0.0	222	9.4
Carangidae	158	29.5	36	25.9	4	5.0	196	21.2	9	5.9	61	5.2	171	3.6	293	12.5
Diodontidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	0.3	0	0.0	5	0.2
Ephippidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.0	0	0.0	1	0.0
Haemulidae	22	4.1	8	5.8	1	1.3	23	2.5	21	13.8	105	7.2	44	5.5	136	5.8
Kyphosidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.3	0	0.0	2	0.0
Labridae	11	2.1	1	0.7	0	0.0	18	2.0	13	8.6	79	6.2	24	5.5	98	4.2
Lutjanidae	16	3.0	1	0.7	4	5.0	12	1.3	0	0.0	33	2.9	20	7.3	46	2.0
Scaridae	8	1.5	10	7.2	3	3.7	10	1.1	9	5.9	170	11.8	20	5.5	190	8.1
Scombridae	37	6.9	6	4.3	6	7.5	52	5.6	13	8.6	69	7.2	56	0.0	127	5.4
Serranidae	130	24.2	51	36.7	32	40.0	349	37.8	27	17.8	304	21.3	189	67.3	704	30.0
Sparidae	99	18.4	3	2.2	3	3.7	4	0.4	17	11.1	79	4.3	119	3.6	86	3.7
Sphyraenidae	2	0.4	2	1.4	0	0.0	27	2.9	1	0.7	11	0.5	3	0.0	40	1.7
Galeomorphii	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	1	0.0	0	0.0	2	0.0
TOTAL IDENTIFIED	536	100.0	139	100.0	80	100.0	923	100.0	152	100.0	1290	100.0	768	100.0	2352	100.0
Unidentified Fish	657	-	122	-	80	-	1644	-	239	-	1044	-	976	-	345	-
TOTAL FISH	1193	-	261	-	160	-	2561	-	391	-	2334	-	1744	-	1031	-

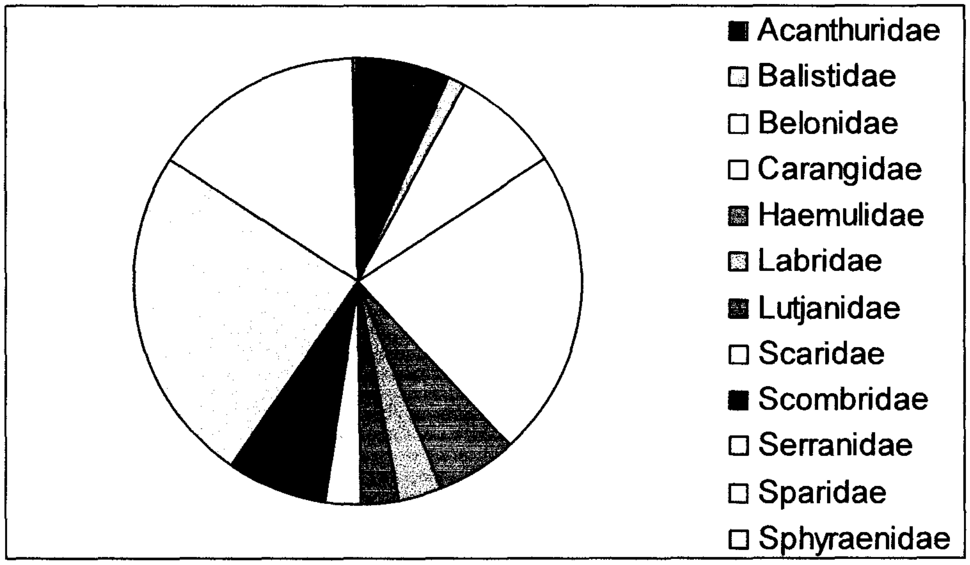


Figure 3.4. Relative abundance (with vertebrae) of fish families identified-upper component.

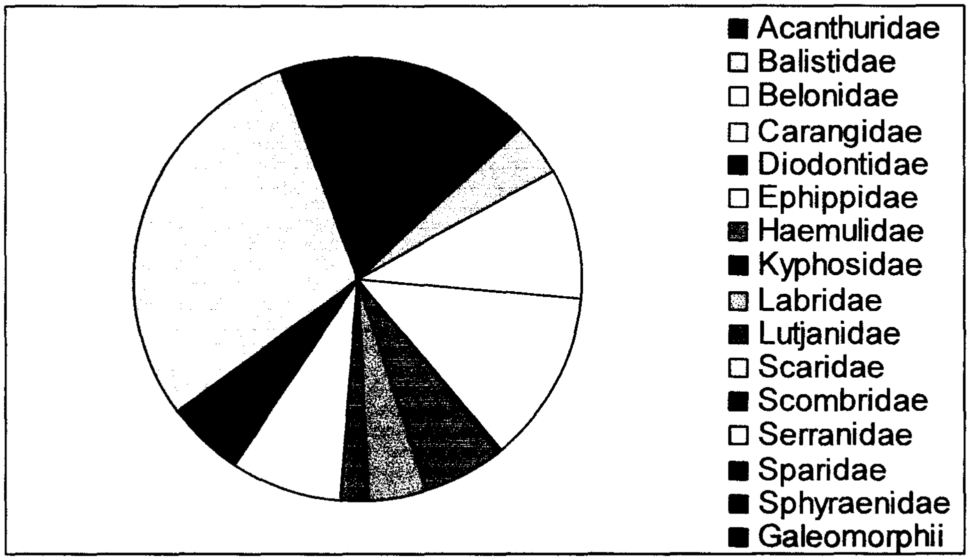


Figure 3.5. Relative abundance (with vertebrae) of fish families identified-lower component.

Table 3.12. Averages used for vertebrae centra width calculations.

Size Category	Median Measurement
>12.5 mm	12.5 mm
9.5-12.5	11
8-9.4	8.7
6.3-7.9	7.1
4.75-6.2	5.5
4-4.74	4.4
<4 mm	4 mm

The overall pooled vertebral centra mean for the site shows that all upper levels have smaller vertebrae than the lower levels. In addition, the mean vertebral sizes for Units 4, 8 and 13 were isolated to see if the same pattern could be seen in the individual excavation units. The means from Units 4, 8 and 13 show the same consistent trend across the site. Although these data do identify a broad trend at PA-15, vertebrae are problematic indicators of size variation. Each fish has several different sizes of vertebra depending on its position in the vertebral column. The spine consists of thoracic, caudal and precaudal vertebra, each of which is a different shape and size. In addition each species will vary in its average vertebral width which creates size variation within these elements. As all fish taxa are pooled together in the vertebra study, this creates further

Table 3.13. Average vertebrae centra width—upper and lower components.

	Site	Unit 4	Unit 8	Unit 13
Upper Average	5.5 mm	5.3	5.0	5.2
Lower Average	5.8 mm	6.2	5.4	5.8

variation. To circumvent this problem, measures of the Serranidae atlas and premaxilla were used to interpret variability within the site. These elements were also selected from all units at the site, and were pooled into upper and lower components, using the same subdivisions as above.

3.4.4. Serranidae Atlas and Premaxilla Measurements

Wing and Wing (2001) and Wing (2001) have used the average sizes of particular fish elements to identify size differences in fish fauna. The fact that Serranidae appear to be a preferred food source, have a high trophic value (4.00), and are present in every unit excavated, suggests that if resource pressure has occurred at the site, Serranidae are likely to show this stress earlier than lower, non-predatory fish. Two elements were chosen to compare the sizes of Serranidae between units. These measurements are the width of the atlas (Figures 3.6 and 3.7) and the height of the premaxilla (Figures 3.8 and 3.9).

According to Wheeler and Jones (1989:140) the criteria for choosing fish bones to measure for size estimation will differ within each assemblage, as the species composition and preservation will vary. However, they list three qualifications for the selection of bones to measure:

1. they should be possible to identify without doubt;
2. they should be solid structures with clear-cut features which allow accurate and reproducible measurement;
3. the measurement points permit the maximum possible distance

Serranidae atlas and premaxillae are easily identifiable; they are also robust bones with easily identifiable features. These elements were chosen for analysis, as they are present in high numbers compared to other elements. The chosen points of measurement allow a maximum possible distance (see figures 3.7 and 3.9).

The atlas is the first vertebra behind the head. According to Wheeler and Jones (1989:106) the atlas and axis "are highly modified for the attachment of the anterior ends of the great blocks of swimming muscle that run along the back. These vertebrae are attached by strong ligaments to the posterior surface of the basioccipital." The premaxilla is a head bone, which is part of the upper jaw of the fish. The premaxilla is "typically an elongate bone with teeth on one edge and a complex articulating surface at the anterior end" (Wheeler and Jones 1989:91). The other upper jaw bone, the maxilla articulates to the anterior internal portion of the premaxilla.

The Serranidae data, at least vertically, are consistent with the overall site pattern of declining vertebrae sizes. The average width of the Serranidae atlas is larger (x=7.3) in lower than in the upper levels (x=6.1). A t-test indicates that this difference is significant (t=14.52, p=0.08). The lower levels show a mean Serranidae premaxilla height of 12.1, while the upper levels show a mean premaxilla height of 11.1, though this difference is not statistically significant (t=4.95, p=0.20).

There do appear to be some differences between the sizes of fish vertebrae and premaxilla between the upper and lower components at the site. However, this pattern could be the result of taphonomic processes rather than the result of resource pressure. The larger vertebrae and premaxillae may preserve better in lower levels, while smaller elements are better preserved in upper levels. Clear evidence of declines in the size of fish between the upper and lower levels of the site would be a good indication of resource pressure. However, differences between upper and lower levels at Doig's reveal a tentative pattern which may or may not be consistent with resource depression. A pattern of larger to smaller vertebrae would emerge if certain families of fish were over-exploited. However, a similar pattern would also emerge if inhabitants at PA-15 simply began to incorporate smaller fishes into their diet. In addition, the trophic data are ambiguous, as species representations differ with and without the inclusion of vertebra identification.

Table 3.14. Results of Serranidae atlas and premaxilla calculations.

	no.	Range (mm)	Mean	Sdev
Atlas				
Upper	39	2.9-15.6	6.1	3.0
Lower	32	2.6-18.0	7.3	2.9
Premaxilla				
Upper	21	7.0-16.7	11.1	2.7
Lower	60	7.4-18.6	12.1	3.2

Based on the representation of families, Serranidae appear to be an important food source. Based on the data obtained from size variation in fish vertebra, as well as Serranidae atlas and premaxilla measurements, there appear to be smaller elements in the upper component of the site. However, other factors may contribute to this pattern. In addition, Doig's is a relatively large site, and it is quite possible that different areas were occupied at different times.

Without detailed knowledge of the stratigraphy and spatial patterning at the site, it is difficult to determine if differences in the upper and lower components are the result of resource pressure. Separate areas of the site may or may not represent a greater

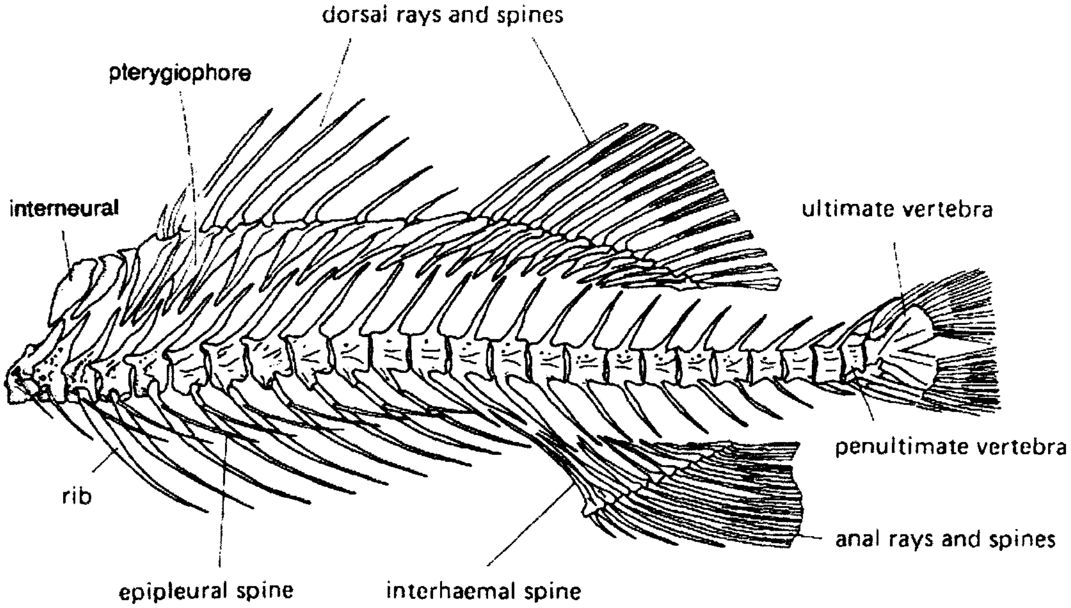


Figure 3.6. Location of atlas. Revised from Cannon 1987, pg.21.

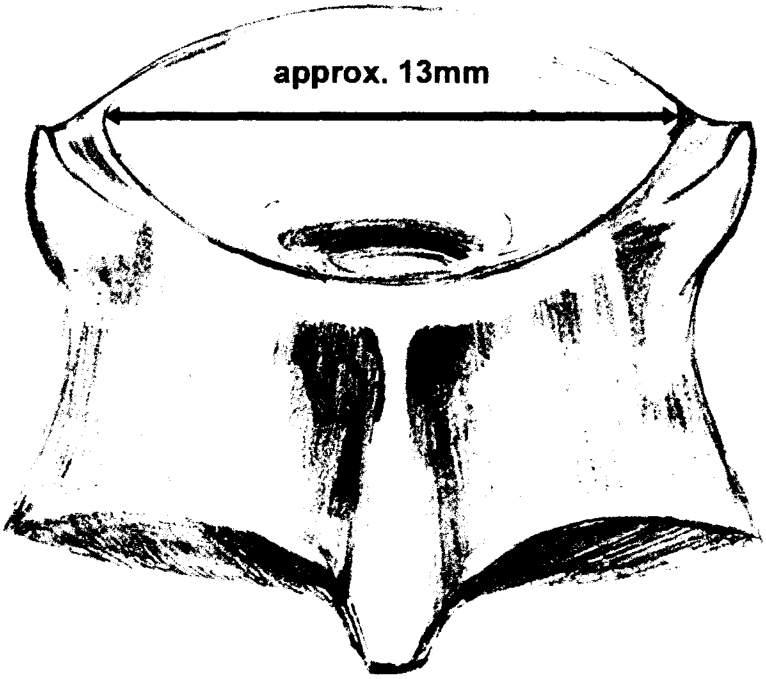


Figure 3.7. Location of atlas measurement. Drawn by R.O. Angelini.

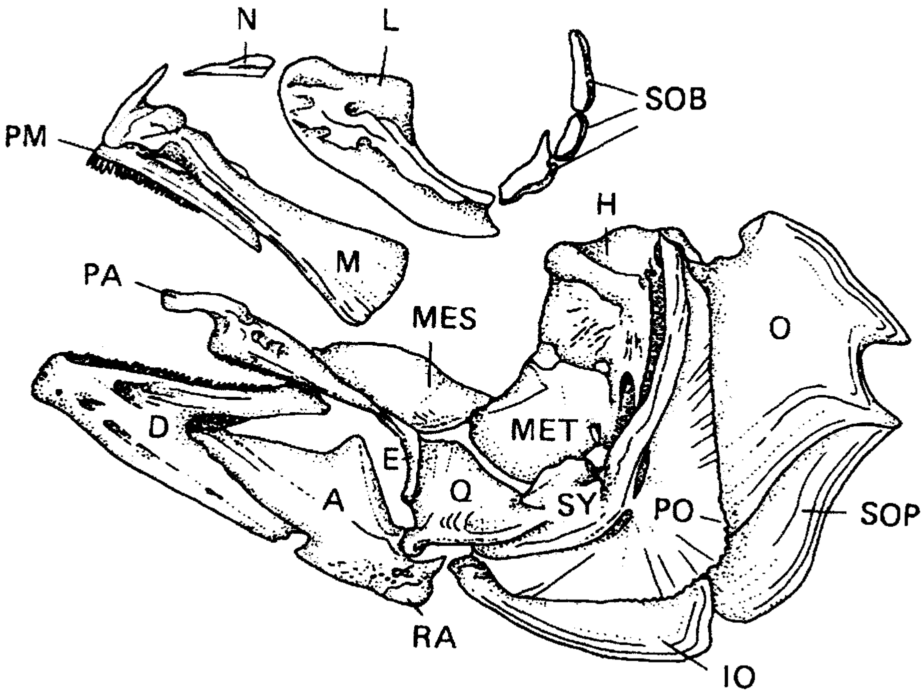


Figure 3.8. Location of premaxilla. Revised from Cannon, pg.19.

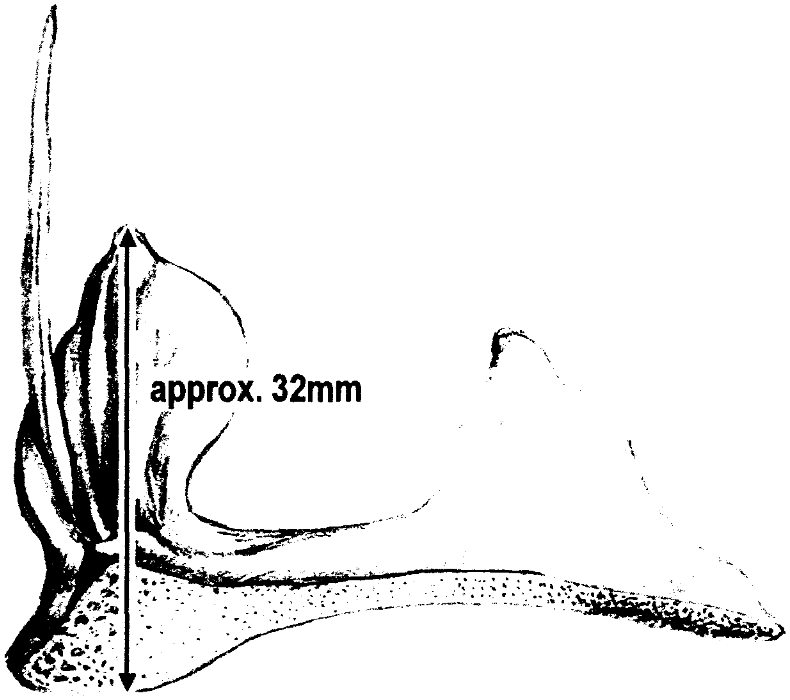


Figure 3.9. Location of atlas measurement. Drawn by R.O. Angelini.

difference in time than the upper versus the lower layers. For this reason, analyses of the faunal remains are also analyzed horizontally; differences in the representation of fishes by excavation block and unit are presented, with and without the inclusion of vertebrae.

3.5. Horizontal Distributions

Comparison of the upper and lower components of the site show that there are minor differences in the representation and size of marine fauna, however the source of these differences is ambiguous. Analysis of Units 4, 8 and 13 was undertaken, as each unit is part of a separate excavation block. Units 4 and 8 consistently show a similar pattern in the representation of marine fauna, while the difference in fish family representation in Unit 13 was immediately apparent. In particular, identifications indicate that Unit 13 has a high number of Scaridae and Acanthuridae. Preliminary inspection of other units within this area (specifically Units 14, 15 and 16) show they also contain a high number of these families. Although Units 4 and 8 are located in different excavation areas, they are combined for analysis due to the consistency in the fauna they contain. Unit 4 is 73 meters east of Unit 8, however they are situated in similar northerly locations; 16 and 17 meters north of the east-west baseline (Figure 3.1). Unit 13 is located further north, at 27m N, 54m W of Unit 4 and 28m N, 19m E of Unit 8.

3.5.1. Trophic Level Analysis

Trophic levels were determined for Units 4, 8 and 13 using the same protocol as used to compare the upper and lower components. Again, results are shown for families represented by the inclusion of vertebra and without to show potential differences. For a summary of the trophic level of each family refer back to Table 8.

Table 3.15. Average trophic level of three units analyzed including and excluding vertebra.

	Excluding Vertebrae		**Including Vertebrae**	
	n	**TL**	**n**	**TL**
Units 4 and 8	314	3.72	1678	3.83
Unit 13	427	3.02	1442	3.18

Examination of mean trophic levels indicates that the mean trophic level is lower in Unit 13 than it is in Units 8 and 4 (Table 3.15). This is true with or without the inclusion of fish vertebrae, and the corresponding added families (particularly larger numbers of Belonidae, Sphyraenidae, Balistidae, Scombridae and Acanthuridae). The composition of these families, coupled with the mean trophic levels of the units, suggest that there is a tendency to select fish from families at lower trophic levels, at least horizontally across the site.

3.5.2. Representation of Families

The consistency of the trophic data, with and without the inclusion of vertebrae suggests that the differences may be significant. Representation of fish families in the separate units shows which families of fish contribute to the differences in trophic levels. Examination of the relative abundances of fish taxa in the three excavation units, suggests that there are differences across the site. Serranidae, the most abundant family, is particularly prevalent in Units 8 (71% Serranidae) and 4 (66% Serranidae). While Unit 13 also has a substantial amount of Serranidae remains (28%), the Scaridae family is the most abundant (34%).

Based on the families represented in the three units, it does appear that access to the preferred food fish (Serranidae) differs in the separate areas at the site. This may be indicative of groups (the same or different) using the site at different times. It could also be indicative of social differentiation; certain people may have had access to the preferred fishes over others. Variation in the use of different areas at the site might contribute to this pattern; the processing of more Serranidae may have occurred at different areas of the site. The simplest explanation is that the family representations simply correspond to the fish that were available at the time of occupation. If this is the case, representations of different fish families could be related to resource pressure. Therefore, the units with a greater amount of the preferred food fish (Serranidae) may represent earlier occupations at the site, while units with less preferred fishes represent later occupations. Other lines of evidence support this possibility. Variation in trophic levels, used as an indication of stress on marine resources by other researchers, (Newsom and Wing 2004; Reitz 2004,

Table 3.16. Relative abundance (without vertebrae) of fish families identified-Unit 4.

Families Unit 4	Level1		Level2		Level3		Level4		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%
Acanthuridae	0	0.0	1	2.5	0	0.0	0	0.0	1	1.4
Balistidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Belonidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Carangidae	0	0.0	2	5.0	1	3.2	0	0.0	3	4.2
Diodontidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Ephippidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Haemulidae	0	0.0	3	7.5	2	6.5	0	0.0	5	7.0
Kyphosidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Labridae	0	0.0	3	7.5	0	0.0	0	0.0	3	4.2
Lutjanidae	0	0.0	2	5.0	0	0.0	0	0.0	2	2.8
Scaridae	0	0.0	3	7.5	7	22.6	0	0.0	10	14.2
Scombridae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Serranidae	0	0.0	25	62.5	21	67.7	0	0.0	46	64.8
Sparidae	0	0.0	1	2.5	0	0.0	0	0.0	1	1.4
Sphyraenidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Galeomorphii	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TOTAL IDENTIFIED	0	0.0	40	100.0	31	100.0	0	0.0	71	100.0
Unidentified Fish	0	-	25	-	8	-	0	-	33	-
TOTAL FISH	0	-	65	-	39	-	0	-	104	-

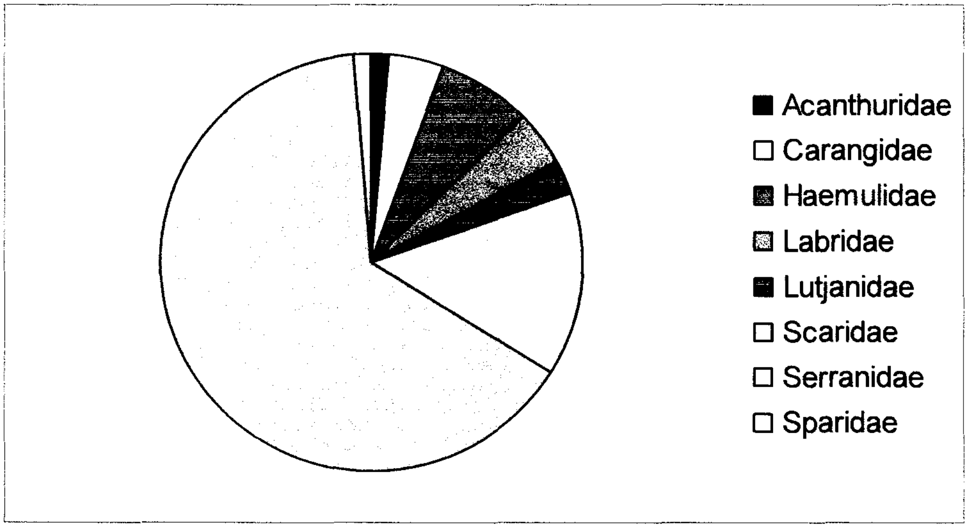


Figure 3.10. Relative abundance (without vertebrae) of fish families-Unit 4.

Table 3.17. Relative abundance (without vertebrae) of fish families-Unit 8.

Families Unit 8	Level1		Level2		Level3		Level4		Level5		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Acanthuridae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Balistidae	0	0.0	0	0.0	12	14.5	14	9.6	0	0.0	26	10.7
Belonidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Carangidae	0	0.0	0	0.0	0	0.0	3	2.1	0	0.0	3	1.2
Diodontidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Ephippidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Haemulidae	0	0.0	0	0.0	0	0.0	5	3.4	0	0.0	5	2.1
Kyphosidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Labridae	0	0.0	0	0.0	7	8.4	11	7.6	0	0.0	18	7.4
Lutjanidae	0	0.0	2	13.3	6	7.2	0	0.0	0	0.0	8	3.3
Scaridae	0	0.0	0	0.0	1	1.2	3	2.1	0	0.0	4	1.6
Scombridae	0	0.0	0	0.0	2	2.4	2	1.4	0	0.0	4	1.6
Serranidae	0	0.0	12	80.0	54	65.1	106	73.1	0	0.0	172	70.9
Sparidae	0	0.0	1	6.7	0	0.0	1	0.7	0	0.0	2	0.8
Sphyranidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Galeomorphii	0	0.0	0	0.0	1	1.2	0	0.0	0	0.0	1	0.4
TOTAL IDENTIFIED	0	0.0	15	100.0	83	100.0	145	100.0	0	0.0	243	100.0
Unidentified Fish	1	-	5	-	26	-	65	-	0	-	97	-
TOTAL FISH	1	-	20	-	109	-	210	-	0	-	340	-

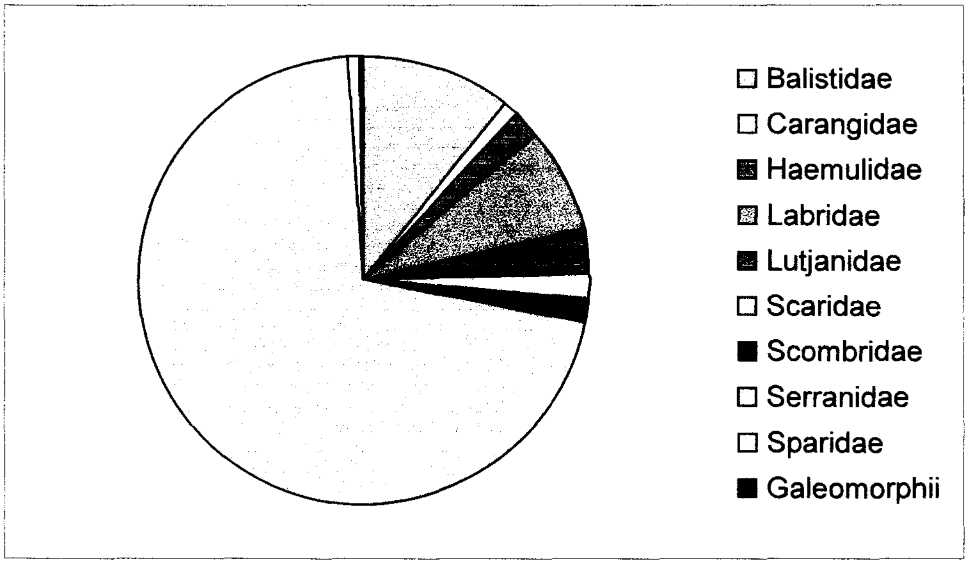


Figure 3.11. Relative abundance (without vertebrae) of fish families-Unit 8.

Table 3.18. Relative abundance (without vertebrae) of fish families-Unit 13.

Families Unit 13	Level1A		Level1B1		Level1B2		Level1C		Level2		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Acanthuridae	0	0.0	0	0.0	14	8.0	16	7.5	2	5.0	32	7.5
Balistidae	0	0.0	0	0.0	11	6.4	17	8.0	2	5.0	30	7.0
Belonidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Carangidae	0	0.0	0	0.0	3	1.7	4	1.9	2	5.0	9	2.1
Diodontidae	0	0.0	0	0.0	2	1.1	1	0.5	0	0.0	3	0.7
Ephippidae	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	1	0.2
Haemulidae	0	0.0	0	0.0	14	8.0	25	11.7	4	10.0	43	10.1
Kyphosidae	0	0.0	0	0.0	2	1.1	0	0.0	0	0.0	2	0.5
Labridae	0	0.0	0	0.0	11	6.4	6	2.8	2	5.0	19	4.4
Lutjanidae	0	0.0	0	0.0	10	5.7	13	6.1	1	2.5	24	5.6
Scaridae	0	0.0	0	0.0	61	35.1	71	33.3	11	27.5	143	33.5
Scombridae	0	0.0	0	0.0	1	0.6	1	0.5	0	0.0	2	0.5
Serranidae	0	0.0	0	0.0	44	25.3	57	26.7	15	37.5	116	27.2
Sparidae	0	0.0	0	0.0	1	0.6	0	0.0	1	2.5	2	0.5
Sphyranidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Galeomorphii	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	1	0.2
TOTAL IDENTIFIED	0	0.0	0	0.0	174	100.0	213	100.0	40	100.0	427	100.0
Unidentified Fish	0	-	0	-	142	-	79	-	25	-	246	-
TOTAL FISH	0	-	0	-	316	-	292	-	65	-	673	-

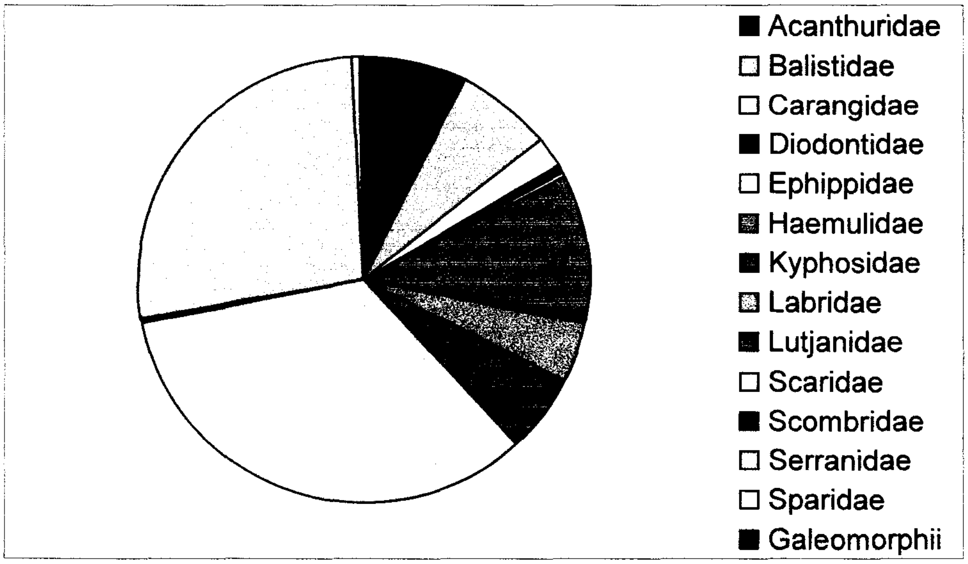


Figure 3.12. Relative abundance (without vertebrae) of fish families-Unit 13.

Table 3.19. Relative abundance (vertebrae included) of fish families-Unit 4.

Families Unit 4	Level1		Level2		Level3		Level4		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%
Acanthuridae	2	3.3	11	2.3	8	5.8	0	0.0	21	3.1
Balistidae	1	1.5	7	1.5	1	0.7	0	0.0	9	1.3
Belonidae	7	11.5	25	5.3	12	8.8	0	0.0	44	6.5
Carangidae	14	23.0	144	30.3	35	25.5	1	50.0	194	28.7
Diodontidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Ephippidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Haemulidae	4	6.6	18	3.8	8	5.8	0	0.0	30	4.4
Kyphosidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Labridae	2	3.3	9	1.9	1	0.7	0	0.0	12	1.8
Lutjanidae	3	4.9	13	2.7	1	0.7	0	0.0	17	2.5
Scaridae	2	3.3	6	1.3	10	7.3	0	0.0	18	2.7
Scombridae	7	11.5	30	6.3	6	4.4	0	0.0	43	6.5
Serranidae	16	26.2	114	24.0	50	36.6	1	50.0	181	26.8
Sparidae	3	4.9	96	20.2	3	2.2	0	0.0	102	15.1
Sphyraenidae	0	0.0	2	0.4	2	1.5	0	0.0	4	0.6
Galeomorphii	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TOTAL IDENTIFIED	61	100.0	475	100.0	137	100.0	2	100.0	675	100.0
Unidentified Fish	98	-	559	-	121	-	1	-	779	-
TOTAL FISH	159	-	1034	-	258	-	3	-	1454	-

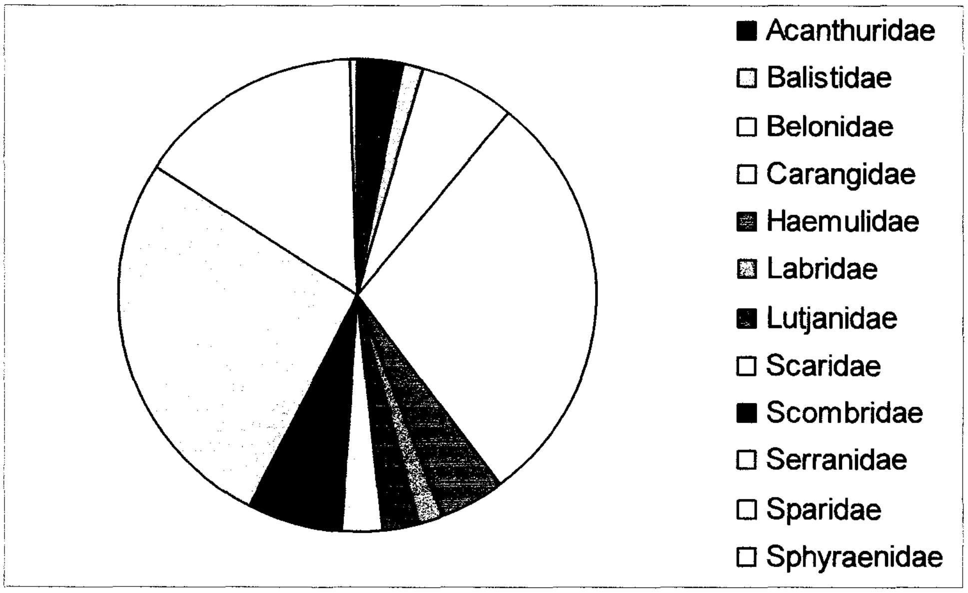


Figure 3.13. Relative abundance (vertebrae included) of fish families-Unit 4.

Table 3.20. Relative abundance (vertebrae included) of fish families-Unit 8.

Families Unit 8	Level1		Level2		Level3		Level4		Level5		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Acanthuridae	4	28.7	11	16.7	8	2.3	2	0.3	1	33.3	26	2.6
Balistidae	0	0.0	0	0.0	17	5.0	29	5.0	0	0.0	46	4.6
Belonidae	0	0.0	12	18.2	42	12.3	132	22.8	0	0.0	186	18.5
Carangidae	0	0.0	4	6.1	47	13.8	148	25.6	1	33.3	200	19.9
Diodontidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Ephippidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Haemulidae	1	7.1	0	0.0	14	4.1	9	1.6	0	0.0	24	2.4
Kyphosidae	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Labridae	0	0.0	0	0.0	7	2.1	11	1.9	0	0.0	18	1.8
Lutjanidae	2	14.2	2	3.0	12	3.5	0	0.0	0	0.0	16	1.6
Scaridae	1	7.1	2	3.0	6	1.8	3	0.5	1	33.3	13	1.3
Scombridae	1	7.1	5	7.6	33	9.7	19	3.3	0	0.0	58	5.8
Serranidae	4	28.7	28	42.4	143	41.9	206	35.6	0	0.0	381	38.0
Sparidae	1	7.1	2	3.0	1	0.3	3	0.5	0	0.0	7	0.7
Sphyranidae	0	0.0	0	0.0	10	2.9	17	2.9	0	0.0	27	2.7
Galeomorphii	0	0.0	0	0.0	1	0.3	0	0.0	0	0.0	1	0.1
TOTAL IDENTIFIED	14	100.0	66	100.0	341	100.0	579	100.0	3	100.0	1003	100.0
Unidentified Fish	12	-	68	-	169	-	1472	-	3	-	1835	-
TOTAL FISH	26	-	134	-	510	-	2045	-	6	-	2838	-

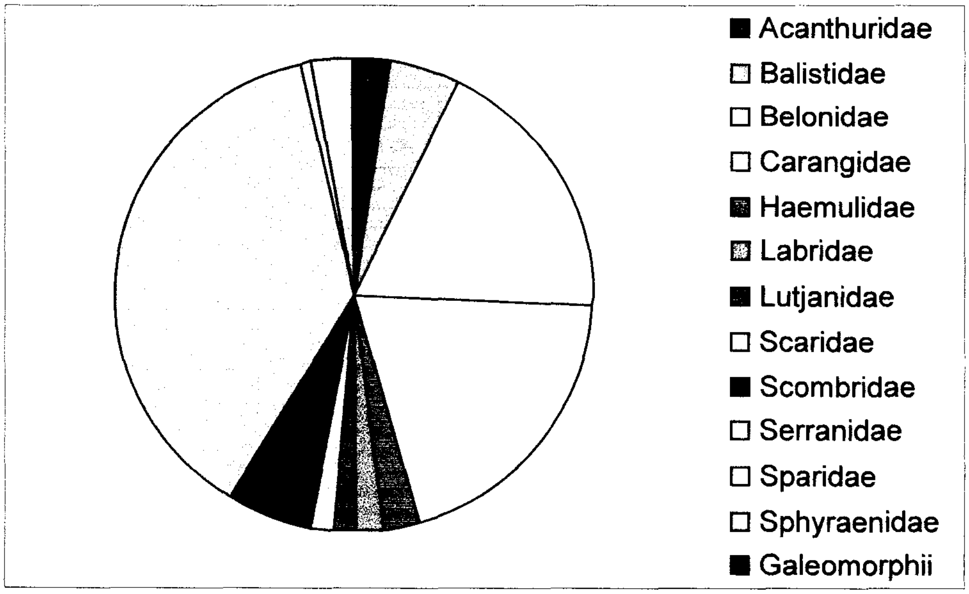


Figure 3.14. Relative abundance (vertebrae included) of fish families-Unit 8.

Table 3.21. Relative abundance (vertebrae included) of fish families-Unit 13.

Families Unit 13	Level1A		Level1B1		Level1B2		Level1C		Level2		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Acanthuridae	6	10.0	18	19.7	157	25.0	121	21.1	7	8.1	309	21.4
Balistidae	0	0.0	1	1.1	25	4.0	21	3.7	3	3.5	50	3.5
Belonidae	5	8.4	12	13.0	24	3.8	10	1.7	2	2.3	53	3.7
Carangidae	4	6.7	5	5.4	33	5.2	23	4.0	5	5.8	70	4.9
Diodontidae	0	0.0	0	0.0	2	0.3	3	0.5	0	0.0	5	0.3
Ephippidae	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	1	0.1
Haemulidae	8	13.3	13	14.1	45	7.2	54	9.4	6	7.0	126	8.7
Kyphosidae	0	0.0	0	0.0	2	0.3	0	0.0	0	0.0	2	0.1
Labridae	8	13.3	5	5.4	39	6.2	36	6.3	4	4.7	92	6.4
Lutjanidae	0	0.0	0	0.0	18	2.9	14	2.4	1	1.2	33	2.3
Scaridae	3	5.0	6	6.5	75	11.8	79	13.7	16	18.6	179	12.4
Scombridae	4	6.7	9	9.8	45	7.2	14	2.4	10	11.6	82	5.7
Serranidae	14	23.3	13	14.1	134	21.3	146	25.4	24	27.9	331	23.0
Sparidae	8	13.3	9	9.8	27	4.3	45	7.8	7	8.1	96	6.6
Sphyranidae	0	0.0	1	1.1	3	0.5	7	1.2	1	1.2	12	0.8
Galeomorphii	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	1	0.1
TOTAL IDENTIFIED	60	100.0	92	100.0	629	100.0	575	100.0	86	100.0	1442	100.0
Unidentified Fish	112	-	127	-	560	-	424	-	60	-	1475	-
TOTAL FISH	172	-	219	-	1189	-	999	-	146	-	2917	-

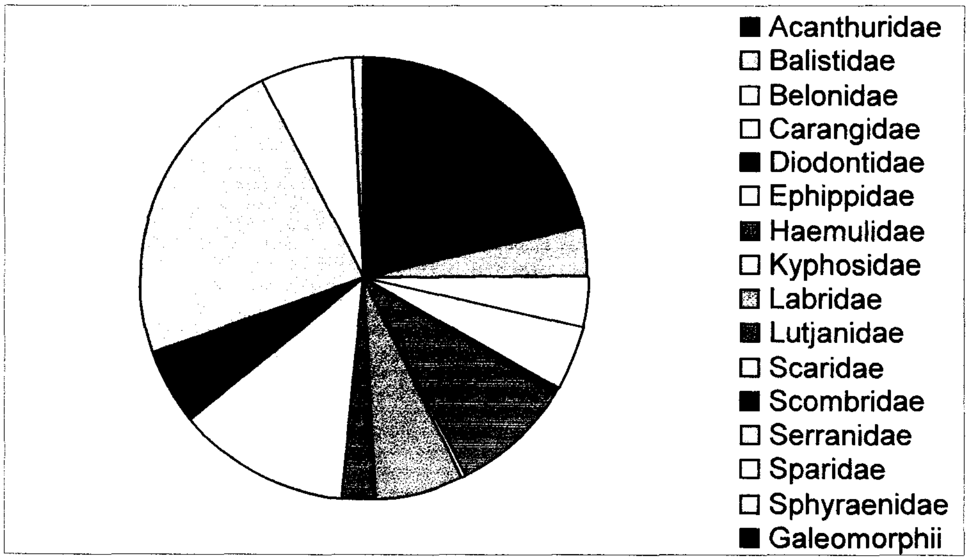


Figure 3.15. Relative abundance (vertebrae included) of fish families-Unit 13.

Wing 2001, Wing and Wing 2001) also suggest that the Unit 13 deposits represent a period of resource depression.

3.5.3. Study of Fish Vertebrae

The fish vertebrae within the upper and lower components at the site show variation in size. However, the pattern may be the result of taphonomic processes. Based on the representation of families, it appears that more significant differences in the fauna may occur between the different spatial areas of the site, rather than the different levels at the site. The same vertebra size study is applied to Units 4, 8 and 13 to determine if there are significant differences in the size of vertebra between these units.

The results show that Units 4 and 8 contain a larger proportion of small vertebrae than Unit 13. The smallest size category represented makes up 31.3% of Units 4 and 8, and 26.9% of the vertebrae in Unit 13. The difference of 4.4% is relatively minor. In Units 4 and 8, 4.6% of the vertebrae fall into the largest categories (>9.5mm); while 9.1% of the vertebrae in Unit 13 fall into this size category (a difference of 4.5%). Based on the representation of families and trophic data, Unit 13 likely represents a later time period. If the vertebral data were indicative of resource pressure, however, the expectation is that Unit 13 would contain more small vertebrae and fewer large vertebrae. This is the opposite of the pattern seen in the vertebral sizes.

Table 3.22. Results of gross vertebra size study-Units 4, 8 and 13.

	>12.5 mm		9.5-12.5		8-9.4		6.3-7.9		4.75-6.2		4-4.74		<4		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	**Total**
Units 4 & 8	34	0.9	136	3.7	205	5.5	492	13.3	954	25.7	724	19.5	1161	31.3	3706
Unit 13	40	2.0	146	7.1	155	7.6	319	15.6	508	24.8	329	16.1	551	26.9	2048
															5754

In addition, the mean vertebral sizes for Units 4, 8 and 13 were isolated to see if the same pattern could be seen in the individual excavation units. Based on the gross vertebra size data, the mean vertebral width is the same between Units 13, 4 and 8 (Table 3.23).

Table 3.23. Average vertebrae centra width-Units 4, 8 and 13.

	Units 4& 8	**Unit 13**
Vert Avg (mm)	5.5	5.5

Unit 13 consistently shows larger average vertebral size than Units 4 and 8, although 4 and 8 are expected to be earlier based on the representation of fish families. This may indicate that the vertebral size variability is, in fact, the result of taphonomic processes, and not the result of resource pressure at the site. Alternatively, it may indicate size differences in the families of fish represented.

3.5.4. Serranidae Atlas and Premaxilla Measurements

Using the Serranidae atlas and premaxilla as a measurement, the results show that there is no significant difference in the size of Serranidae between the units analyzed (atlas t=2.10, p=0.91, premaxilla t=2.00, p=0.80). Differences in the abundance of fish within units (particularly that of Serranidae and Scaridae), in conjunction with differing trophic levels potentially indicate that the different areas at the site represent different time periods, with declining access to the preferred food fish (Serranidae). The results of comparisons of the sizes of Serranidae atlas and premaxilla are ambiguous.

Table 3.24. Results of Serranidae atlas and premaxilla calculations.

	no.	Range (mm)	Mean	Sdev
Atlas				
Units 4 and 8	9	2.9-9.4	7.5	2.2
Unit 13	11	2.6-17.9	7.3	4.3
Premaxilla				
Units 4 and 8	35	7.4-17.6	11.2	2.8
Unit 13	8	8.1-16.1	10.9	2.4

Analysis at the Doig's site is at a very preliminary stage, and no radiocarbon dates for this site are yet available. The depth of the units is not substantial, and the occupation of the site is not expected to surpass more than a few hundred years. Dating the site may prove problematic, as the range of radiocarbon dates is likely to overlap. This coupled with the similarity of ceramic types across the site make temporal comparisons difficult. However, the results of this study show that there is potential for temporal change at PA-15. In addition, the results of comparisons between units are consistent with declines in the trophic level of reef fishes on other archaeological sites in the Caribbean (Wing 2001, Wing and Wing 2001). Differences in the size of fish vertebrae may or may not be a valid indication of pressure on this resource.

Wing (2001) states that significant population increase in the Caribbean occurred in the late Ceramic Period. Because the site appears to be Early Ceramic, perhaps the population at PA-15 was not yet large enough to have a greater depressing effect on marine resources. PA-15 is a large site, and the chronology and spatial distributions are not yet well understood. The results of the fish faunal data indicate that the vertical data at PA-15 do not show any significant variability. The large size and potential variation between levels makes vertical comparisons difficult, but differences in fauna between excavation blocks suggest the possibility of temporal variability across the site. The spatial data presented here may parallel temporal data obtained at other archaeological sites in the Caribbean that possess greater time depth than that at PA-15.

The study of the size of fish at Doig's is not clear. In particular, the study of the size of fish vertebra is problematic, as there are bound to be different representations of fish families in different levels at the site. Although it does not mean that resource pressure is not taking place, some families of fish are on average smaller or larger than others. The unknown mixture of families within the different levels and areas of the site make the comparison of fish size difference difficult.

To further understand the data presented here, the relative abundances of crab and shellfish at the site are compared to the fish results. In addition, variations in the sizes of crab and shellfish are assessed to see if they correspond to patterns present in the fish data.

CHAPTER 4

ANALYSIS OF CRAB AND SHELLFISH REMAINS

Most crab and shellfish remains were analyzed at the Antigua Archaeological Laboratory, where they are currently being held. As crab and shellfish remains tend to be highly fragmented, and difficult to quantify, they are compared using weights, but, NISP counts are also provided. Although the results of the fish faunal data is not as clear as one might desire, there is variation in the assemblage across the site. Size and abundance of crab and shellfish remains were consistent between Units 4 and 8, so again these are combined for comparison with Unit 13.

4.1. Variation in Shellfish (*Cittarium pica*)

There are thirty-four species of shellfish present in the PA-15 assemblage (see Table 27). These include fifteen bivalve species, seventeen gatstropods, one echinoderm, and one polyplacophora (see Appendix C for complete catalogue). The West Indian Top Shell (*Cittarium pica*) was chosen to represent variation in shellfish size. This gastropod is the most common shell found in Caribbean archaeological sites (Newsom and Wing 2004:80). It is common across the site, and the shell is thick, so was less susceptible to

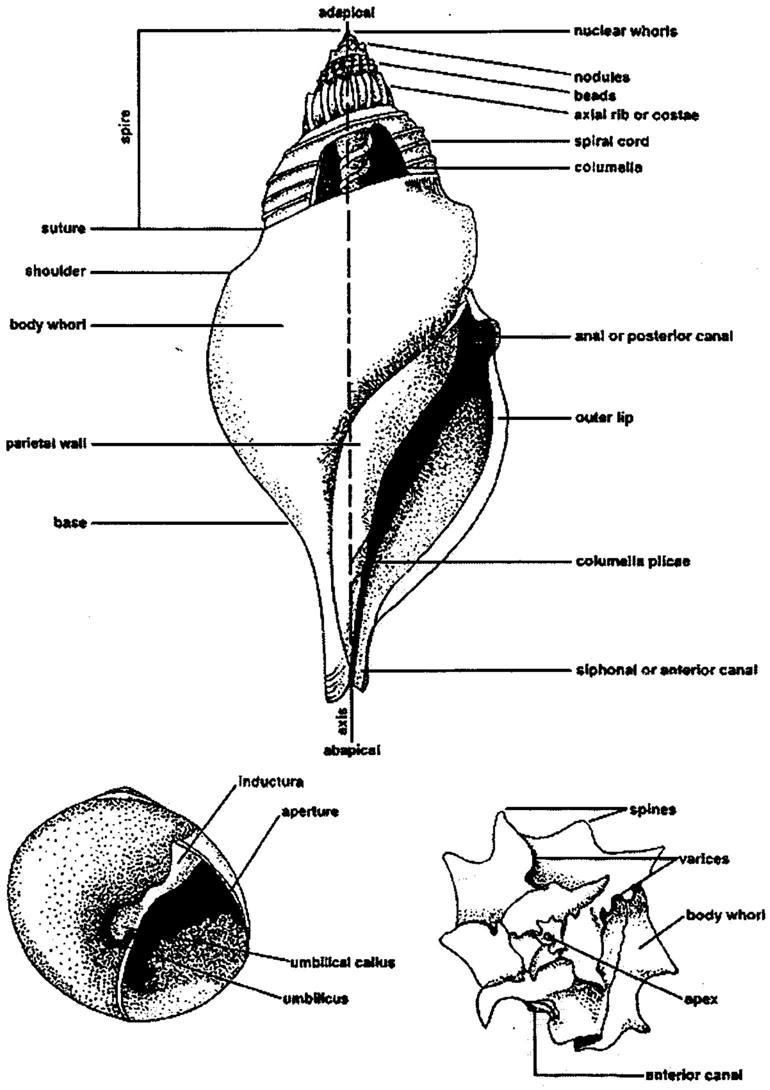


Figure 4.1. Gastropod terms and morphology. From Claassen (1998), Figure 4.

breakage. Gastropods normally have a single coiled shell; the whorls of the shell steadily grow wider during shell formation. The shell is enlarged by the addition of minerals from the outer edge of the mantle (the inside lining) to the lips of the aperture. The growth pattern changes once maturity is reached, and the shell no longer grows. At this point, a lip may form around the mouth, strengthening the shell (Claassen 1998:22-26;

Figure 4.1). Overexploitation by humans has been documented to effect change in the age, size and species of shellfish in a particular region (e.g. Hockey et al 1988, Swadling 1977). At the Doig's site, *Cittarium pica* (West Indian Topsnail) was measured laterally across the bottom of the shell (see Figure 4.3). The average size of the shell is compared across the site and between levels.

Table 4.1. Total shellfish weight (g) recovered from PA-15 by unit and excavation block.

Unit	Weight (g)	%
1	8010	7.69
2	10733	10.30
3	7813	7.50
4	7302	7.01
5	7790	7.48
6	12180	11.69
7	8642	8.30
8	19060	18.30
9	620	0.60
10	590	0.57
11	370	0.36
12	540	0.52
13	7070	6.79
14	4540	4.36
15	3860	3.71
16	3640	3.49
17	1410	1.35
TOTAL	**104170**	**100.00**

Block	Weight (g)	%
1	45593	43.77
2	35937	34.50
3	2620	2.52
4	910	0.87
5	19110	18.35
TOTAL	**104170**	**100.00**

4.1.1. Vertical Distributions

Two hundred and four shellfish were complete enough to be measured for the analysis. No complete *Cittarium pica* were found during the 2002 excavations, so the levels were divided easily into Levels 1, 2, 3, 4 and 5 from the first year's excavations (refer back to Table 3.6). Table 4.2 shows the results of the analysis.

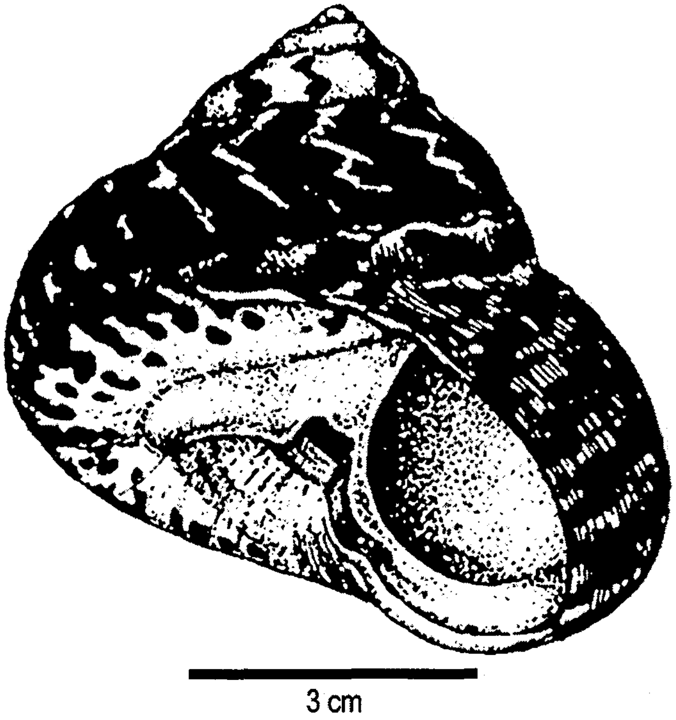


Figure 4.2. *Cittarium pica* (West Indian Topsnail) (after Newsom and Wing 2004, figure 6.2).

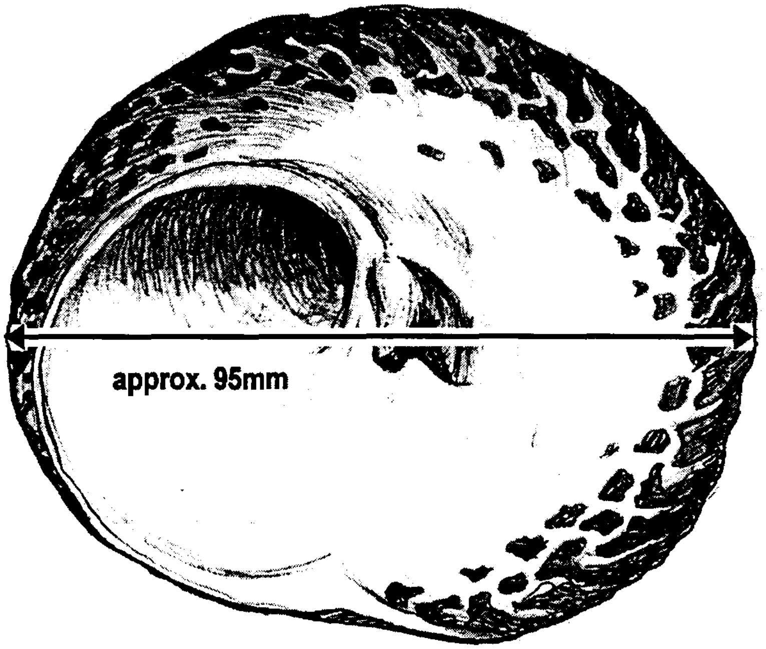


Figure 4.3. Location of *Cittarium pica* measurement. Drawn by R.O. Angelini.

It appears that generally, the lower layers of the site contain larger shells than the upper layers. When the levels are divided into upper and lower components, the means are different; the upper component shows a mean of 61.9mm, while the lower has a mean of 80.3mm. Thus, the shellfish, on average, are smaller in upper layers, than in the lower layers.

Table 4.2. Mean values of *Cittarium pica* recovered from PA-15.

Upper Mean		**No.**	**Mean Shell Width (mm)**	**Range (mm)**
	Level 1	9	46.5	20.1-80.2
61.9 mm	**Level 2**	25	77.3	23.8-101.0
Lower Mean	**Level 3**	96	77.0	17.7-109.7
80.3 mm	**Level 4**	63	83.1	31.0-113.5
	Level 5	11	80.7	59.0-94.3

4.1.2. Horizontal Distributions

Calculations of the average size of *Cittarium pica* are possible for block 1 (Units 1,2,5 and 8), and block 2 (Units 3,4,6, and 7) (Table 4.3). Excavation blocks 3, 4, and 5 did not contain any complete West Indian Topsnail.

Table 4.3. Average size of *Cittarium pica*, excavation blocks 1 and 2.

	Avg (mm)	NISP
Block 1 (Units 1,2,5,8)	76.5	129

	Avg (mm)	NISP
Block 2 (Units 3,4,6,7)	80.3	75

The average size of the West Indian Topsnail in Block 1 is 76.5mm, while in block 2, measurement results in an average of 80.3mm. The size difference varies by only 3.8 mm, which is not a significant difference. As with fish vertebrae and premaxillae, larger West Indian Topsnail shells may preserve better in lower levels, while smaller shells are better preserved in upper levels.

Claassen (1998:45) warns that the criteria used by archaeologists for identifying overexploitation in shellfish can also result from environmental change. Changes of substantially different conditions, from increased sedimentation, decreasing water temperature, decreasing dissolved oxygen, a retreating saltwater boundary, to industrial pollutants, increased sea birds attracted to garbage dumps, artificial warming of water, etc., can and do cause changes in the sizes and proportions of species available to the collector (Claassen 1998:49). These changes could result from a variety of factors, including seasonal fluctuations, regional warming and cooling, and weather irregularities such as hurricanes. The ability to separate variables such as environmental change from variations due to pressure from human harvesting will not be possible until an examination of the environmental data from the site has been completed.

4.2. Variation in Crab Species

Two families of crab have been identified in the Doig's assemblage. Family *Gearcinidae* is the most common type of land crab found, the species Blue (or Great) Land Crab (*Cardisoma guanhami*), Black Land Crab (*Gecarcinus lateralis*) and the Black/Blue Mountain Crab (*Gecarcinus ruricola*) are members of this family found in prehistoric contexts on Antigua (Wing 1997). Crab remains were identified in the field to the family level only, however, based on the comparative collection, most crabs found are likely the Blue Land Crab (*Cardisoma guanhami*). The second family, *Coenobitidae* includes the small hermit crabs. Because of their small size, the presence of Coenobitidae in a midden context may be as a result of scavenging activities, not as a result of human exploitation (Wing 1977). *Gearcinidae* is the most dominant type of crab found at Doig's, accounting for 98.3% of the total crab assemblage.

Crab exoskeletons are fragile, and are often highly fragmented. However, some denser elements do survive in the archaeological record. In the PA-15 assemblage, chelae (dominant claws), claws, legs, and mandibles were present among other body fragments (see the Appendix D for detailed catalogue). Crab legs and claws are also difficult to side (deFrance 1988:52), making individual numbers difficult to determine, and are few in number at the site, likely due to their fragile nature.

Table 4.4. Total crab weight (g) recovered from PA-15 by unit and excavation block.

Unit	Weight (g)	%
1	2957	12.40
2	3145	13.19
3	872	3.66
4	2954	12.39
5	2291	9.61
6	1297	5.44
7	1701	7.13
8	4472	18.75
9	0	0.00
10	21	0.09
11	13	0.05
12	13	0.05
13	1721	7.22
14	1473	6.18
15	440	1.84
16	431	1.81
17	47	0.20
TOTAL	**23848**	**100.00**

Block	Weight (g)	%
1	12865	53.95
2	6824	28.61
3	68	0.29
4	26	0.11
5	4065	17.05
TOTAL	**23848**	**100.00**

The Blue Land Crab (*Cardisoma guanhumi*) is described as semi-terrestrial, though they are rarely found more than 5 miles from the coast. They live in burrows deep enough to allow water to seep in for moisture and normally return to the sea only to drink or breed. After mating, which occurs most often during full moons in the summer, an adult female migrates to the ocean to release her eggs into shallow inshore waters. The Blue Land Crab (*Cardisoma guanhumi*) is most active on moonlit nights during warmer, wetter months making them easier to capture at these times (University of Florida 2004; Wing 1997).

In her M.A. thesis, deFrance (1988:51-59) uses "dimensional allometric scaling" to produce estimates of carapace width and average live weights of the Blue Land Crab (*Cardisoma guanhumi*). She found a strong correlation between the height of the mandible and the average carapace width. Although the present study is not concerned with live weights, measurements of the height of the mandible will be used to determine the average size of crab between levels at the Doig's site.

4.2.1. Vertical Distributions

A total of 274 crab mandibles were measured from different units across the site. These mandibles were identified as belonging to the Blue Land Crab (*Cardisoma guanhumi*), using a comparative specimen caught in Antigua in the summer of 2003. The mean mandible height was calculated for the upper and lower components at the site. It was not possible to divide the mandible measurements by level as with the

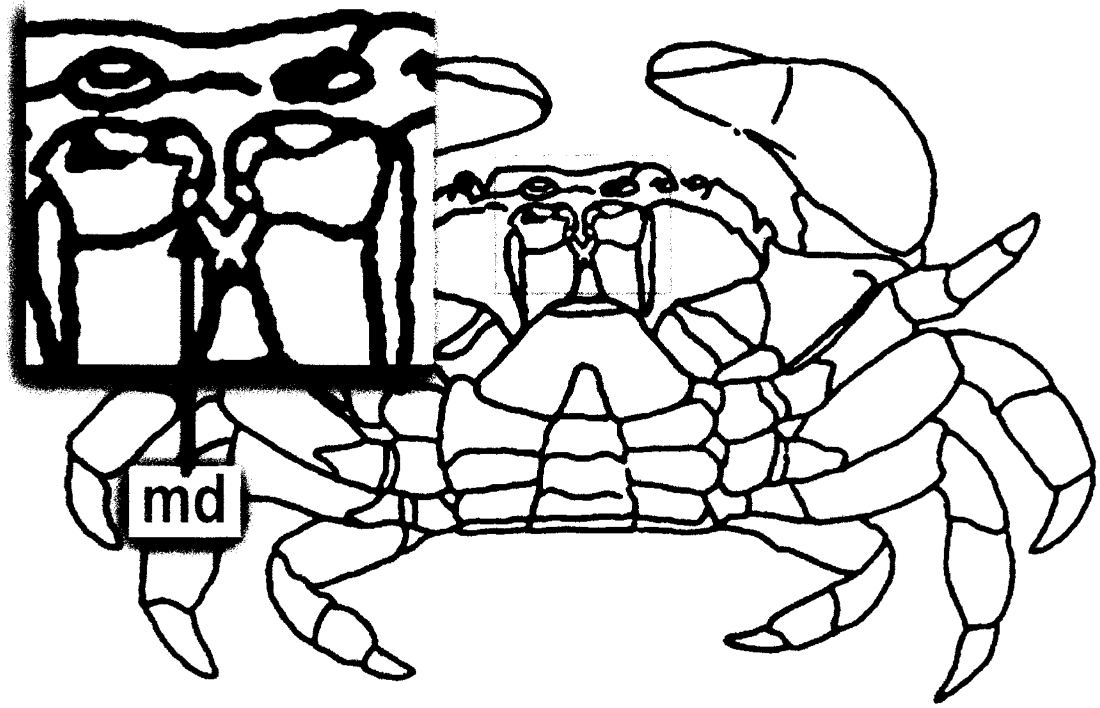


Figure 4.4. Location of (md) mandible (revised from deFrance 1988, figure 6). Used with the kind permission of Susan deFrance.

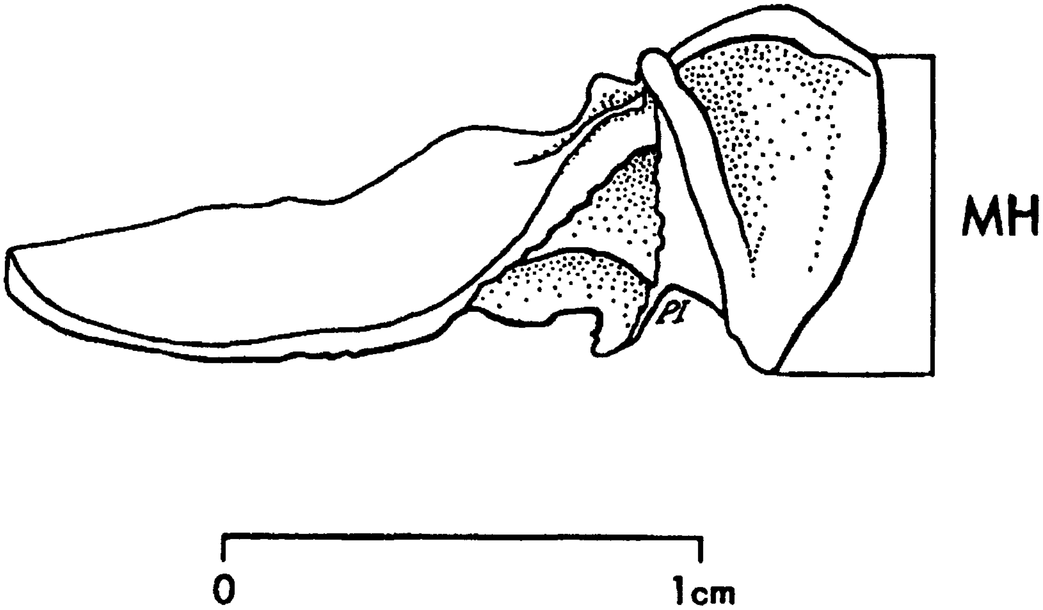


Figure 4.5. Location of mandible measurement (after deFrance 1988, figure 7, MH=Mandible Height). Used with the kind permission of Susan deFrance.

shellfish because the levels were different depths in this case (refer back to table 3.1). Table 4.5 shows the results of this study.

Table 4.5. Mean values of *Cardisoma guanhumi* mandibles recovered from PA-15 by level.

	No.	**Mean Mandible Height (mm)**	**Range (mm)**
Upper Component	41	10.8	8.1-14.0
Lower Component	233	10.5	7.1-14.0

The mean mandible height, and by extension the size of crab does not appear to differ between the upper and lower components. The later component shows the larger mean (10.8 mm), but a difference of only 0.3 mm. It appears that, assuming the upper layers are more recent than the lower layers, the average size of crab was not negatively affected by human predation.

4.2.2. Horizontal Distributions

Table 4.6. Mean values of *Cardisoma guanhumi* mandibles recovered from PA-15 by excavation block.

	Avg	**NISP**
Block 1 (Units 1,2,5,8)	10.7mm	103
Block 2 (Units 3,4,6,7)	11.2mm	31
Block 5 (Units 13,14,15,16)	10.3mm	140

It has been proposed that different areas at the site may have a greater time difference than those represented by the upper and lower components used in this analysis. Calculation of the mean mandible height is presented for Blocks 1, 2 and 5. Excavation blocks 3 and 4 contained no *Gearcinidae* mandibles. The mean size value of

Gearcinidae mandibles follows a similar pattern to that of the different representation of fish families and trophic data. Crab mandibles are smaller in Block 5, which contains Unit 13. This may be the result of Block 5 representing a later time period than Blocks 1 and 2.

4.3. Crab/Shell Abundance

One of the main debates within zooarchaeological studies in the Caribbean has centered upon changes in subsistence base from the collection of land crabs in the Saladoid phase to the collection of shellfish in the Post-Saladoid phase. The site of Doig's is an Early Saladoid site, so the relationship between the use of crab and shellfish cannot be compared between these two phases. However, comparing the relative abundances of crab and shellfish at PA-15 will help to determine if the decline in one resource tends to result in an increase in the other. Based on data obtained from the fish and crab remains at the site, it is possible that Unit 13 is part of a later component. Table 4.7 shows the percentages of crab and shellfish relative to each other in Units 4 and 8 together, compared to Unit 13.

Table 4.7. Relative abundance of crab and shellfish-Units 4, 8 and 13.

	Units 4 and 8		**Unit 13**	
	weight (g)	%	weight (g)	%
Crab	7426	22	1721	20
Shellfish	26362	78	7070	80
TOTAL	**33788**	**100**	**8791**	**100**

The results show that crab and shellfish are taken in equivalent amounts, possibly indicating that the presence of these resources is the result of isolated consumption and processing episodes. If different areas of the site are chronologically distinct, this suggests that the use of crab and shellfish does not differ over time. Comparisons between Saladoid and Post-Saladoid cultural phases are not possible at PA-15, however the pattern of crab and shellfish consumption does not indicate that crab remains increase, as shellfish declines. This pattern is consistent with other zooarchaeological studies on Antigua. Through an analysis of the faunal remains at Indian Creek, a Saladoid/Post-Saladoid settlement with known stratigraphy and chronology, Jones (1989:46) found that in the earliest levels the "transition" from shellfish gathering to terrestrial crabs were "due to the addition of bivalves to the diet rather than their displacing crabs which in fact never completely disappear from the faunal record". A more local, detailed examination of crab and shellfish remains at Saladoid and Post-Saladoid sites of known time depth are needed to better understand details of crab and shellfish consumption.

The results of the crab mandible height indicate that there is no significant variation vertically across the site. Analysis of *Cardisoma guanhumi* mandibles does indicate that there is significant variation between the different areas of the site, which are consistent with the trophic and vertebral fish data. Variation in shellfish size, demonstrated by *Cittarium pica* does not appear to differ significantly between the different areas at PA-15, however there are marked differences between the upper and lower components. In similar fashion to the fish vertebral data, this may be the result of taphonomic processes.

CHAPTER 5

INTEGRATED ANALYSIS AND DISCUSSION

5.1. Variability at PA-15

Data from PA-15 were presented both vertically and horizontally, in order to look for different patterns of site use. A case has been made that the variability seen is the result of shifting availability of resources over time. The resulting pattern in the archaeological record at PA-15 may indicate that shifts in the marine fauna are indeed the result of resource pressure. The representation of fish families and differences in the size of fauna spatially across the site are used as evidence of temporal change. However, similar patterns in the archaeological record may result from other causes as well.

Table 5.1 summarizes the evidence which indicates that there are significant differences between Units 4 and 8, compared to Unit 13. The shellfish and crab remains were compared using weight, as these are particularly subject to fragmentation, while the fish were compared using NISP. The fish values are based on the inclusion of vertebrae. To assess their relative abundance, the weight of crab and shellfish are divided by the total number of fish.

If the recovered fauna are an accurate representation of consumption patterns, then the comparison between Units 4 and 8 and Unit 13 shows the consumption of lesser amounts of Serranidae, a preferred fish, greater consumption of fish drawn from lower trophic levels, less consumption of shellfish and crab, and consumption of smaller crab in

Table 5.1. Results of fish, shellfish and crab measurements.

	Fish			Shellfish		Crab		
	Families Identified (n)	Top 3 Families	Trophic Level	wt(g)	wt/fish	wt(g)	wt/fish	mand (mm)
Units 4 and 8	1678	Serranidae 33.5%/fish Carangidae 23.5%/fish Belonidae 13.7%/fish	3.83	26362	15.7	7425	4.4	10.9
Unit 13	1442	Serranidae 23.0%/fish Acanthuridae 21.4%/fish Scaridae 12.4%/fish	3.18	7070	4.9	1721	1.2	10.3

association with the deposits in Unit 13. All of these indicators are consistent with the potential over-exploitation of marine resources. However, potential causes of variability are not as clear. It is likely that a number of variables were responsible for the patterns of faunal variation at PA-15; it is unlikely that a sole factor can be isolated. Given these limitations, potential factors responsible for the differences in the representation of fish families, in the sizes of fauna and trophic values can be assessed at PA-15.

5.2. Factors Affecting Marine Fauna Variation

Optimal foraging models are based on the assumption that humans make decisions based on the most efficient means of obtaining food resources, with the least amount of energy (Bettinger 1991:84; Butler 2000:650; deFrance 1988:23-24; Keegan 1985). Those resources that are the highest ranking for any culture would be expected to have the highest representation in the archaeological faunal assemblage (Keegan 1985). Based on this assumption, greater numbers of Serranidae at PA-15 may indicate that these fishes are more desirable. Therefore, when these fishes are present in fewer numbers, it is to be expected that the availability of these fish also declined.

The food values of most resources are difficult to measure directly, but selection can be assessed in relation to individual size and the relative quantities of various taxa. The potential impact of resource pressure has been evaluated in relation to a reduction in the average trophic level of fish, as well as differing sizes of fish, shellfish and crab in the archaeological record. These differences appear to occur horizontally across the site, rather than vertically.

The value of particular resources may vary between culture groups, and perhaps between sites within the same culture group, as each site reflects a local and particular history. The degree to which each resource was utilized will vary depending not only on which are most "optimal" to consume, but also on how each group perceives the environment around them. Indeed, this is one of the main criticisms of optimal foraging models (see Watters and Rouse 1989). While economic rationality undoubtedly played a role in food-getting strategies, they are, to a certain extent, also based on our own ethnocentric interpretations of rationality.

> Environment, as understood here, includes both cultural as well as natural factors which act as constraints. This is important to remember given that it is people's perceptions of the environment and not the environment itself which largely governs their decisions. Both natural and cultural factors interact to produce a resource utilization and settlement pattern which is a compromise, short of optimal. Natural and cultural factors form a confusing circle, difficult to break into and find causal relationships. One way of dealing with this problem is by starting with something quantifiable, such as the physical environment and working outwards to form relationships between it and culture (Turney 2000:2).

The exploitation of resources may be the result, not only of decisions based on caloric needs, but the result of social factors. There are many reasons that an individual or group may find certain fishes favourable to eat or capture. Factors such as taste, appearance and ease of capture will be potential causes for variation, which may be specific to each culture group. With these limitations in mind, results of this analysis may be the result of three factors: resource pressure, environmental variability, or cultural or social factors.

Resource pressure may have contributed to the patterns seen at PA-15. Resource pressure can be seen through the sizes of animals, as well as through different representations of taxa. Zooarchaeological analysis at PA-15 does show variation in the representation of marine taxa between different excavation areas. Sizes of crab, indicated by mandible height and trophic levels of fishes also differ between excavation areas. Evidence of resource depletion by the analysis of fish remains has recently been argued in the Caribbean (Reitz 2004; Wing 2001; Wing and Wing 2001). As stated above, the patterns identified horizontally at PA-15 correspond to what these researchers have found as vertical patterns. Further analysis is needed at PA-15 in order to understand factors of variability, by finding evidence for, and ruling out alternative potential causes. As well, further dating of the site is needed in order to obtain better chronological control at the site.

Wing (2001) and Wing and Wing (2001) use calculations of the mean trophic level of reef fishes on five islands in the Caribbean to understand changes in species abundances and sizes through time. Using allometric formulas, an estimation of the average body weights of fish, the "biomass of the catch", and the mean trophic level index (published on fishbase http://www/fishbase.org, Pauly et al. (1998)) demonstrate that fishes with higher trophic levels, i.e. territorial reef fishes such as groupers (Serranidae) and snappers (Lutjanidae) declined through time, where more emphasis was placed onto marine resources with lower trophic levels, such as molluscs and inshore and pelagic fishes (Wing 2001:117; Wing and Wing 2001).

Similarly, Reitz (2004) compares data from St. John's County, Florida from both archaeological and modern fisheries to demonstrate long-term changes using trophic level analysis. Reitz uses the same formula as Wing (2001) and Wing and Wing (2001) to determine that there were changes in body size and mean age of fish species from 1450 B.C. up to A.D. 2000. Using changes in trophic-levels, Reitz was able to estimate the time of certain declines and collapses in fishing industries. These results indicate that prehistoric populations were capable of having a deleterious effect on marine fauna.

Although recent evidence in the Caribbean supports resource depletion caused by overexploitation, Claassen (1998) argues that those criteria used for overexploitation are the same criteria that can be used for environmental variability. Claassen's data deals specifically with shellfish, however the same principles may apply to other marine fauna as well. Mannino and Thomas (2002), based on Claassen (1998), list the following criteria for overexploitation of shellfish:

- Absolute abundance of preferred species will decrease through a midden deposit.
- Mean shell size will decrease through samples taken from the bottom of a midden to the top.
- Mean or modal shell size of the archaeological samples of a species will be significantly smaller than in a non-exploited population.
- Less easily procured species will increase in number up through a midden deposit.

- Less easily processed species will increase in number.

Claassen argues that these criteria alone are not sufficient to verify resource pressure caused by human predation. She further argues (1986:130) that overexploitation is a reasonable argument only if there is a reduction in the mean age of the shells from the bottom to the top of a midden without a difference in the mean shell size within each of the age groups. Pauly et al. (1998) also note that overfishing results in an age reduction of targeted species, as overfishing results in "a population with primarily immature individuals which are too young to reproduce and maintain the population" (Newsom and Wing 2004:54). Manino and Thomas (2002:459) reason that as the average age of shellfish decline, the degree of predation was likely more intense. Analysis of growth lines in shells to determine age has been used by others (e.g. Koike 1986; Lightfoot and Cerrato 1988) to explore human impacts on shellfish. The age of fish may also be assessed using circuli or growth rings on scales, as well as growth lines on otolithis, and vertebra centra (Wheeler and Jones 1989).

At PA-15 environmental variability cannot at this time be ruled out as a cause of patterns seen in the zooarchaeological assemblage. Seasonal variability in precipitation occurs within the Lesser Antilles, and generally the wet season lasts from August to November and the dry season lasts from January to April; May June, July and December are transitional months. In addition, some yearly disparities may occur depending on larger scale variations in climate. For instance, Antigua lies within a hurricane zone, which, historically, and to this day has devastating effects on the island (Davis 2000:13). Variability in the representation of fauna at the site may reflect some of these seasonal or occasional changes. Other studies at PA-15 may shed light on the environmental variation and subsistence strategies at the site.

Phytoliths and starch grains are useful in defining past environment and subsistence strategies. Preliminary analysis of palaeobotanical studies conducted by Kooyman (2002) and Quon (2003) indicate that there is variability in the species of plants and phytolith frequency at different areas of the site. Results are tentative, as the palaeobotanical comparative sample in Antigua is not yet comprehensive, although it is currently being developed. Differences across the site indicate variation in the occurrence of grasses, and possibly the presence of the coconut husk or thatch palm in potential midden and house areas. In addition, starch grains possibly representing maize, and others indicative of unknown roots or tubers are also present. It is not yet known whether species found represents use by the inhabitants at PA-15, or simply their presence in the surrounding environment (Kooyman 2003:5). These differences show promise for identifying different activity areas or different microenvironments across the site. These studies also indicate that the environment was indeed likely much different at the time of occupation than it is at present. The palaeobotanical evidence supports variability of marine faunal remains across the site.

More direct evidence of environmental variation has been identified by others using stable isotopes to interpret shifts in sea temperatures during periods of site occupation (Mannino and Thomas 2002:459). These changes can be correlated with changes in species composition and the mean size of certain species. At present, no such studies have been conducted on Antigua; they would however aid greatly in correlating changes in subsistence use with changes in the environment.

Understanding the organization of activities at the site will aid in the interpretation of the pattern of zooarchaeological remains, as well as potential cultural expressions of resource use. For instance, in some cases differential access to preferred food fishes may result in a pattern similar to that seen at PA-15. Serranidae, as a preferred food fish may have only been accessible to certain members of the community. In this case, differential access to preferred food fishes is unlikely, as the Saladoid are believed to have been a tribal-based, egalitarian group (Curet 1992b; Rodríguez 1992 in Keegan 2000).

Moreover, the units excavated are believed to be midden deposits, so differentiating the status of individuals at various areas of the site would be problematic, as house floors are often used to distinguish these patterns. Identifying social relationships using the remains at PA-15 would be difficult, and will likely not be apparent from the study of fish remains alone. Colley (1990:224) notes that studies of structures, artifacts, settlement patterns, and other archaeological evidence is necessary to place a reconstructed fishing strategy in a wider economic and social context, and to recognize the degree of social stratification.

The preservation of house structures seem to be rare at Saladoid sites in the Caribbean, however Gent (2004) has identified a possible house structure at PA-15 through geophysical survey. His spatial data point to a single house settlement "in which multiple nuclear family groups were accommodated under one roof" (Gent 2004:217).

Gent's (2004) interpretations suggest that the features seen are contemporaneous. However, the faunal data presented here suggest temporal variability spatially across the site. Future excavations in combination with temporal control through radiocarbon dating of site levels will provide valuable information about the organization and occupation of Doig's.

Studies of subsistence strategies in the Caribbean have centered upon differences in the representation of marine and terrestrial species. Sites that are termed "coastal" in the Caribbean are today located directly on the coast (Boomert 2000; Murphy 1999). "Inland" sites are often located within coastal plains, in the case of PA-15 only 400 m from the coastline. Although a group may not be living directly on the coast, the inhabitants of these sites are using resources from the sea, or from the "marine environment" nearby. Fitzhugh's (1975) definition of marine peoples is defined by their reliance on marine resources, and not necessarily how far they are living from the source of those maritime resources. Furthermore, as Cruz (2001) points out, some species, such as crabs and turtles will inhabit both marine and terrestrial environments in the Inshore/Estuarine habitat as defined by Wing and Reitz (1982). As a result, the delineation between "terrestrial" and "marine" resources remains unclear. This is particularly problematic in the Caribbean, as resource variability has largely been based on "marine" and "terrestrial" shifts. Boomert (2000) argues that shifts between "marine" and "terrestrial" remains in Saladoid and Post-Saladoid phases are not in fact as straightforward as is often depicted. One may prefer instead to interpret Saladoid and Post-Saladoid cultures not on the amount of "terrestrial" versus "marine" animals they consume, but on their pattern of settlement. The Post-Saladoid appear to have settled directly on the coast, however inland sites have also been found, which indicates that these fishing villages were likely part of a seasonal round (Murphy 1999).

In depth studies of variation within faunal assemblages in the Caribbean show that previous attempts to correlate migrations of different groups of people with changes in the procurement of different taxa are too simplistic. The presence of faunal remains at an archaeological site is the product of multiple, complex factors which may be particular to each group of people. The interpretation of faunal data requires recursive lines of evidence and thorough demonstration of patterns, particularly if these patterns are to be the basis of conclusions about culture history. At present, there are still too few data from too few sites to make such conclusions. More data and in-depth analysis is needed in order to fully evaluate the merits of these historical trends.

5.3. Conclusions

In the Caribbean and elsewhere, terrestrial animals are normally assumed to be the most optimal resources to consume. Researchers therefore interpret the incorporation of marine resources, particularly mollusks, as a sign of resource shortage. However, past Caribbean peoples may have expanded their diet for a variety of reasons. Marine remains in Caribbean sites are present throughout time, as are terrestrial remains. There are many potential reasons for the presence of greater numbers of crab in Early Saladoid assemblages and an increase in the numbers of shellfish in Post-Saladoid assemblages. As more Caribbean sites are excavated, the picture of resource use becomes more complicated. Zooarchaeological analysis at PA-15, which clearly shows that marine resources were important in the early Saladoid diet, indicates that high ranked resources included marine foods.

The potential causes of faunal variation at the site are many. The contrasts between Units 4 and 8 and Unit 13 are consistent with and therefore suggest pressure on marine resource over time. However, an understanding of the patterns of deposition at PA-15 is needed to delineate temporal differences. Further evidence of site seasonality will help to reconstruct settlement patterns and seasonal movements, and age reconstructions of marine fauna, in particular fish and shellfish will aid in determining if variation is the result of environmental influences or resource pressure caused by human predation. These studies may also be conducted regionally on a site by site basis in order to understand local variability.

More in-depth analyses of the variability within zooarchaeological assemblages are needed. A basic pattern of long-term subsistence in the Caribbean has begun to be established, but consideration of local variability in the representation and variation of taxa is rare. At a local level, it has been shown that that there is variability within the marine fauna and that in-depth, small-scale analysis may be used to understand larger patterns of resource exploitation.

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Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	4	1	Haemulidae	quadrate	L	
1	4	1	Labridae	lower pharyngeal plate	A	
1	4	1	Labridae	ultimate	A	
2	4	1	Lutjanidae	premaxilla	L	
2	4	1	Scaridae	premaxilla		fragmented
2	4	1	Serranidae	maxilla	L	
2	4	1	Serranidae	dentary	L	
1	4	1	Serranidae	scapula	R	
1	4	1	Unknown	ultimate	A	
1	4	1	Unknown	epihyal	R	
1	4	1	Unknown	quadrate	R	
1	4	1	Unknown	angular	R	
1	4	1	Unknown	epihyal		
1	4	1	Unknown	angular	R	
1	4	1	Unknown	quadrate		fragmented
1	4	1	Acanthuridae	precaudal vertebra	A	<4mm
1	4	1	Belonidae	caudal vertebra	A	<4mm
2	4	1	Carangidae	caudal vertebra	A	<4mm
1	4	1	Serranidae	caudal vertebra	A	<4mm
1	4	1	Sparidae	caudal vertebra	A	<4mm
18	4	1	Unknown	caudal vertebra	A	<4mm
1	4	1	Belonidae	precaudal vertebra	A	4-4.75mm
1	4	1	Haemulidae	caudal vertebra	A	4-4.75mm
1	4	1	Serranidae	precaudal vertebra	A	4-4.75mm
1	4	1	Unknown	thoracic vertebra	A	4-4.75mm
3	4	1	Unknown	precaudal vertebra	A	4-4.75mm
20	4	1	Unknown	caudal vertebra	A	4-4.75mm
3	4	1	Belonidae	caudal vertebra	A	4.75-6.3mm
10	4	1	Carangidae	caudal vertebra	A	4.75-6.3mm
1	4	1	Haemulidae	caudal vertebra	A	4.75-6.3mm
1	4	1	Haemulidae	caudal vertebra	A	4.75-6.3mm
1	4	1	Lutjanidae	thoracic vertebra	A	4.75-6.3mm
2	4	1	Serranidae	caudal vertebra	A	4.75-6.3mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
2	4	1	Serranidae	thoracic vertebra	A	4.75-6.3mm
1	4	1	Serranidae	caudal vertebra	A	4.75-6.3mm
1	4	1	Serranidae	precaudal vertebra	A	4.75-6.3mm
2	4	1	Sparidae	caudal vertebra	A	4.75-6.3mm
1	4	1	Unknown	thoracic vertebra	A	4.75-6.3mm
2	4	1	Unknown	precaudal vertebra	A	4.75-6.3mm
8	4	1	Unknown	caudal vertebra	A	4.75-6.3mm, 1 burned
19	4	1	Unknown	caudal vertebra	A	4.75-6.3mm
1	4	1	Unknown	atlas	A	4.75-6.3mm
1	4	1	Acanthuridae	precaudal vertebra	A	6.3-8mm
1	4	1	Balistidae	precaudal vertebra	A	6.3-8mm
2	4	1	Belonidae	precaudal vertebra	A	6.3-8mm
1	4	1	Carangidae	caudal vertebra	A	6.3-8mm
1	4	1	Carangidae	caudal vertebra	A	6.3-8mm
1	4	1	Scombridae	thoracic vertebra	A	6.3-8mm
1	4	1	Serranidae	thoracic vertebra	A	6.3-8mm
1	4	1	Serranidae	caudal vertebra	A	6.3-8mm
11	4	1	Unknown	caudal vertebra	A	6.3-8mm
1	4	1	Unknown	precaudal vertebra	A	6.3-8mm
2	4	1	Unknown	thoracic vertebra	A	6.3-8mm
3	4	1	Scombridae	caudal vertebra	A	8-9.5mm
1	4	1	Unknown	thoracic vertebra	A	8-9.5mm
3	4	1	Scombridae	caudal vertebra	A	9.5-12.5mm
1	4	1	Serranidae	caudal vertebra	A	9.5-12.5mm
2	4	1	Unknown	caudal vertebra	A	9.5-12.5mm
1	4	1	Unknown	thoracic vertebra	A	>12.5mm
1	4	2	Acanthuridae	spine	A	
1	4	2	Carangidae	quadrate	L	
1	4	2	Carangidae	premaxilla	R	
1	4	2	Haemulidae	premaxilla	L	fragmented
1	4	2	Haemulidae	maxilla	R	
1	4	2	Haemulidae	hyomandibular	L	
1	4	2	Labridae	lower pharyngeal plate	A	

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	4	2	Labridae	premaxilla	R	
1	4	2	Labridae	dentary		fragmented
1	4	2	Lutjanidae	maxilla	R	
1	4	2	Lutjanidae	dentary	R	
2	4	2	Scaridae	premaxilla	R	
1	4	2	Scaridae (scarus)	upper pharyngeal plate		
3	4	2	Serranidae	premaxilla	R	9.6, 9.7, 12.1
1	4	2	Serranidae	premaxilla	L	14.6
1	4	2	Serranidae	maxilla	R	
1	4	2	Serranidae	maxilla	L	
2	4	2	Serranidae	angular	R	
1	4	2	Serranidae	angular	L	
5	4	2	Serranidae	dentary	L	
2	4	2	Serranidae	dentary	R	
2	4	2	Serranidae	angular	R	
2	4	2	Serranidae	angular	L	
1	4	2	Serranidae	scapula	R	
1	4	2	Serranidae	hyomandibular	R	
1	4	2	Serranidae	vomer	A	
1	4	2	Serranidae	preopercle	R	
1	4	2	Serranidae	supracleithrum	L	
1	4	2	Sparidae	premaxilla	L	
1	4	2	Unknown	maxilla	L	
1	4	2	Unknown	vomer	A	
1	4	2	Unknown	scapula	L	
1	4	2	Unknown	ultimate	A	
1	4	2	Unknown	epihyal		
2	4	2	Unknown	dentary	R	
13	4	2	Unknown	dentition fragments		
1	4	2	Unknown	postemporal	L	
1	4	2	Unknown	premaxilla	R	
1	4	2	Unknown	maxilla	L	
1	4	2	Unknown	quadrate	L	

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	4	2	Unknown	quadrate	R	
3	4	2	Acanthuridae	caudal vertebra	A	<4mm
2	4	2	Belonidae	caudal vertebra	A	<4mm
66	4	2	Carangidae	caudal vertebra	A	<4mm
1	4	2	Carangidae	thoracic vertebra	A	<4mm
1	4	2	Haemulidae	atlas	A	<4mm
2	4	2	Labridae	caudal vertebra	A	<4mm
1	4	2	Lutjanidae	thoracic vertebra	A	<4mm
1	4	2	Serranidae	atlas	A	<4mm
13	4	2	Serranidae	caudal vertebra	A	<4mm
1	4	2	Serranidae	thoracic vertebra	A	<4mm
78	4	2	Sparidae	caudal vertebra	A	<4mm
30	4	2	Unknown	thoracic vertebra	A	<4mm
7	4	2	Unknown	atlas	A	<4mm
166	4	2	Unknown	caudal vertebra	A	<4mm
63	4	2	Unknown	precaudal vertebra	A	<4mm
1	4	2	Acanthuridae	caudal vertebra	A	4-4.75mm
3	4	2	Belonidae	caudal vertebra	A	4-4.75mm
3	4	2	Belonidae	precaudal vertebra	A	4-4.75mm
45	4	2	Carangidae	caudal vertebra	A	4-4.75mm
4	4	2	Carangidae	caudal vertebra	A	4-4.75mm
5	4	2	Haemulidae	caudal vertebra	A	4-4.75mm
2	4	2	Haemulidae	precaudal vertebra	A	4-4.75mm
1	4	2	Labridae	caudal vertebra	A	4-4.75mm
1	4	2	Labridae	thoracic vertebra	A	4-4.75mm
3	4	2	Unknown	caudal vertebra	A	4-4.75mm
3	4	2	Lutjanidae	thoracic vertebra	A	4-4.75mm
1	4	2	Scaridae	caudal vertebra	A	4-4.75mm
23	4	2	Serranidae	caudal vertebra	A	4-4.75mm
2	4	2	Serranidae	precaudal vertebra	A	4-4.75mm
4	4	2	Serranidae	thoracic vertebra	A	4-4.75mm
12	4	2	Sparidae	caudal vertebra	A	4-4.75mm
1	4	2	Sphyranidae	caudal vertebra	A	4-4.75mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
8	4	2	Unknown	thoracic vertebra	A	4-4.75mm
2	4	2	Unknown	atlas	A	4-4.75mm
7	4	2	Unknown	precaudal vertebra	A	4-4.75mm, 2 are burned
51	4	2	Unknown	caudal vertebra	A	4-4.75mm
1	4	2	Acanthuridae	caudal vertebra	A	4.75-6.3mm
1	4	2	Balistidae	thoracic vertebra	A	4.75-6.3mm
6	4	2	Belonidae	caudal vertebra	A	4.75-6.3mm
2	4	2	Belonidae	precaudal vertebra	A	4.75-6.3mm
13	4	2	Carangidae	caudal vertebra	A	4.75-6.3mm
1	4	2	Carangidae	caudal vertebra	A	4.75-6.3mm
3	4	2	Haemulidae	caudal vertebra	A	4.75-6.3mm
1	4	2	Haemulidae	precaudal vertebra	A	4.75-6.3mm
1	4	2	Haemulidae	atlas	A	4.75-6.3mm
1	4	2	Labridae	caudal vertebra	A	4.75-6.3mm
1	4	2	Labridae*	precaudal vertebra	A	4.75-6.3mm*similar to Labridae comparative specimen
4	4	2	Lutjanidae	caudal vertebra	A	4.75-6.3mm
1	4	2	Scaridae	atlas	A	4.75-6.3mm
1	4	2	Scaridae	caudal vertebra	A	4.75-6.3mm
12	4	2	Serranidae	caudal vertebra	A	4.75-6.3mm
2	4	2	Serranidae	precaudal vertebra	A	4.75-6.3mm
1	4	2	Serranidae	thoracic vertebra	A	4.75-6.3mm
5	4	2	Sparidae	caudal vertebra	A	4.75-6.3mm
1	4	2	Sphyranidae*	precaudal vertebra	A	4.75-6.3mm*similar to Sphyranidae comparative specimen
82	4	2	Unknown	caudal vertebra	A	4.75-6.3mm
9	4	2	Unknown	precaudal vertebra	A	4.75-6.3mm
1	4	2	Unknown	atlas	A	4.75-6.3mm
3	4	2	Unknown	thoracic vertebra	A	4.75-6.3mm
3	4	2	Acanthuridae	precaudal vertebra	A	6.3-8mm
3	4	2	Balistidae	caudal vertebra	A	6.3-8mm
1	4	2	Balistidae	thoracic vertebra	A	6.3-8mm
4	4	2	Belonidae	caudal vertebra	A	6.3-8mm
2	4	2	Belonidae	precaudal vertebra	A	6.3-8mm
7	4	2	Carangidae	caudal vertebra	A	6.3-8mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
2	4	2	Haemulidae	atlas	A	6.3-8mm
8	4	2	Serranidae	caudal vertebra	A	6.3-8mm
3	4	2	Serranidae	precaudal vertebra	A	6.3-8mm
2	4	2	Serranidae	thoracic vertebra	A	6.3-8mm
9	4	2	Unknown	precaudal vertebra	A	6.3-8mm
5	4	2	Unknown	thoracic vertebra	A	6.3-8mm
1	4	2	Unknown	atlas	A	6.3-8mm
40	4	2	Unknown	caudal vertebra	A	6.3-8mm
1	4	2	Acanthuridae	caudal vertebra	A	8-9.5mm
1	4	2	Acanthuridae	precaudal vertebra	A	8-9.5mm
2	4	2	Balistidae	precaudal vertebra	A	8-9.5mm
2	4	2	Belonidae	caudal vertebra	A	8-9.5mm
1	4	2	Belonidae	precaudal vertebra	A	8-9.5mm
2	4	2	Carangidae	caudal vertebra	A	8-9.5mm
2	4	2	Lutjanidae	caudal vertebra	A	8-9.5mm
1	4	2	Lutjanidae	precaudal vertebra	A	8-9.5mm
2	4	2	Scombridae	thoracic vertebra	A	8-9.5mm
6	4	2	Scombridae	caudal vertebra	A	8-9.5mm
8	4	2	Serranidae	caudal vertebra	A	8-9.5mm
2	4	2	Serranidae	precaudal vertebra	A	8-9.5mm
2	4	2	Serranidae	thoracic vertebra	A	8-9.5mm
2	4	2	Serranidae	atlas	A	8-9.5mm
22	4	2	Unknown	caudal vertebra	A	8-9.5mm
4	4	2	Unknown	precaudal vertebra	A	8-9.5mm
1	4	2	Unknown	thoracic vertebra	A	8-9.5mm
2	4	2	Carangidae	caudal vertebra	A	9.5-12.5mm
1	4	2	Carangidae	caudal vertebra	A	9.5-12.5mm
3	4	2	Scombridae	thoracic vertebra	A	9.5-12.5mm
15	4	2	Scombridae	caudal vertebra	A	9.5-12.5mm
3	4	2	Serranidae	caudal vertebra	A	9.5-12.5mm
15	4	2	Unknown	caudal vertebra	A	9.5-12.5mm
1	4	2	Unknown	atlas	A	9.5-12.5mm
4	4	2	Scombridae	caudal vertebra	A	>12.5mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
2	4	2	Unknown	thoracic vertebra	A	>12.5mm
2	4	2	Unknown	caudal vertebra	A	>12.5mm
1	4	3	Carangidae	quadrate	L	
1	4	3	Haemulidae	maxilla	R	
1	4	3	Haemulidae	basipterygium	R	
1	4	3	Scaridae	premaxilla	L	
1	4	3	Scaridae	dentary	L	
1	4	3	Scaridae	ultimate	A	
1	4	3	Scaridae	hyomandibular	L	
1	4	3	Scaridae	premaxilla	R	
1	4	3	Scaridae (scarus)	lower pharyngeal plate	A	
1	4	3	Scaridae (sparisoma)	upper pharyngeal plate	A	
2	4	3	Serranidae	vomer	A	
1	4	3	Serranidae	epihyal	R	
1	4	3	Serranidae	epihyal	L	very large
2	4	3	Serranidae	premaxilla	R	8.2, 9.9
4	4	3	Serranidae	maxilla	L	
1	4	3	Serranidae	maxilla	R	
2	4	3	Serranidae	dentary	R	
2	4	3	Serranidae	dentary	L	
2	4	3	Serranidae	quadrate	R	
1	4	3	Serranidae	quadrate	L	
2	4	3	Serranidae	angular	L	
1	4	3	Serranidae	angular	R	
1	4	3	Unknown	supracleithrum	L	
1	4	3	Unknown	maxilla	L	
1	4	3	Unknown	maxilla	R	
2	4	3	Unknown	ultimate	A	
1	4	3	Unknown	postemporal		fragmented
1	4	3	Unknown	premaxilla	R	
1	4	3	Unknown	supracleithrum		
12	4	3	Unknown	dentition fragment		fragmented
15	4	3	Carangidae	caudal vertebra	A	<4mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	4	3	Haemulidae	caudal vertebra	A	<4mm
2	4	3	Haemulidae	precaudal vertebra	A	<4mm
1	4	3	Haemulidae	thoracic vertebra	A	<4mm
1	4	3	Serranidae	caudal vertebra	A	<4mm
2	4	3	Sparidae	caudal vertebra	A	<4mm
2	4	3	Unknown	thoracic vertebra	A	<4mm
15	4	3	Unknown	caudal vertebra	A	<4mm
2	4	3	Belonidae	caudal vertebra	A	4-4.75mm
10	4	3	Carangidae	caudal vertebra	A	4-4.75mm
3	4	3	Serranidae	caudal vertebra	A	4-4.75mm
1	4	3	Serranidae	atlas	A	4-4.75mm
1	4	3	Serranidae	precaudal vertebra	A	4-4.75mm
2	4	3	Unknown	precaudal vertebra	A	4-4.75mm
15	4	3	Unknown	caudal vertebra	A	4-4.75mm
2	4	3	Acanthuridae	precaudal vertebra	A	4.75-6.3mm
3	4	3	Acanthuridae	caudal vertebra	A	4.75-6.3mm
5	4	3	Belonidae	precaudal vertebra	A	4.75-6.3mm
1	4	3	Belonidae	caudal vertebra	A	4.75-6.3mm
6	4	3	Carangidae	caudal vertebra	A	4.75-6.3mm
1	4	3	Haemulidae	caudal vertebra	A	4.75-6.3mm
1	4	3	Haemulidae	precaudal vertebra	A	4.75-6.3mm
3	4	3	Scaridae	caudal vertebra	A	4.75-6.3mm
1	4	3	Serranidae	thoracic vertebra	A	4.75-6.3mm
1	4	3	Serranidae	precaudal vertebra	A	4.75-6.3mm
3	4	3	Serranidae	caudal vertebra	A	4.75-6.3mm
1	4	3	Sparidae	caudal vertebra	A	4.75-6.3mm
1	4	3	Unknown	thoracic vertebra	A	4.75-6.3mm
1	4	3	Unknown	atlas	A	4.75-6.3mm
2	4	3	Unknown	precaudal vertebra	A	4.75-6.3mm
24	4	3	Unknown	caudal vertebra	A	4.75-6.3mm
2	4	3	Acanthuridae	caudal vertebra	A	6.3-8mm
1	4	3	Acanthuridae	precaudal vertebra	A	6.3-8mm
1	4	3	Belonidae	caudal vertebra	A	6.3-8mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	4	3	Belonidae	precaudal vertebra	A	6.3-8mm
3	4	3	Carangidae	caudal vertebra	A	6.3-8mm
1	4	3	Lutjanidae	caudal vertebra	A	6.3-8mm
1	4	3	Scombridae	thoracic vertebra	A	6.3-8mm
8	4	3	Serranidae	caudal vertebra	A	6.3-8mm
1	4	3	Serranidae	precaudal vertebra	A	6.3-8mm
3	4	3	Serranidae	thoracic vertebra	A	6.3-8mm
1	4	3	Sphyranidae	caudal vertebra	A	6.3-8mm
3	4	3	Unknown	thoracic vertebra	A	6.3-8mm
18	4	3	Unknown	caudal vertebra	A	6.3-8mm
3	4	3	Unknown	precaudal vertebra	A	6.3-8mm
1	4	3	Balistidae	precaudal vertebra	A	8-9.5mm
1	4	3	Belonidae	precaudal vertebra	A	8-9.5mm
1	4	3	Belonidae	caudal vertebra	A	8-9.5mm
1	4	3	Scombridae	caudal vertebra	A	8-9.5mm
4	4	3	Serranidae	caudal vertebra	A	8-9.5mm
1	4	3	Serranidae	precaudal vertebra	A	8-9.5mm
1	4	3	Serranidae	thoracic vertebra	A	8-9.5mm
1	4	3	Unknown	atlas	A	8-9.5mm
2	4	3	Unknown	caudal vertebra	A	8-9.5mm
1	4	3	Unknown	precaudal vertebra	A	8-9.5mm
1	4	3	Labridae	caudal vertebra	A	9.5-12.5mm
1	4	3	Unknown	thoracic vertebra	A	9.5-12.5mm
4	4	3	Scombridae	caudal vertebra	A	9.5-12.5mm
1	4	3	Sphyranidae	caudal vertebra	A	9.5-12.5mm
1	4	3	Unknown	precaudal vertebra	A	9.5-12.5mm
6	4	3	Unknown	caudal vertebra	A	9.5-12.5mm
1	4	3	Unknown	precaudal vertebra	A	>12.5mm
2	4	3	Unknown	caudal vertebra	A	>12.5mm
1	4	4	Serranidae	caudal vertebra	A	<4mm
1	4	4	Carangidae	caudal vertebra	A	<4mm
1	4	4	Unknown	caudal vertebra	A	4.75-6.3mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	8	1	Unknown	parasphenoid	A	fragmented
1	8	1	Acanthuridae	caudal vertebra	A	<4mm
1	8	1	Haemulidae	caudal vertebra	A	<4mm
1	8	1	Scaridae	caudal vertebra	A	<4mm
1	8	1	Sparidae	caudal vertebra	A	<4mm
4	8	1	Unknown	vertebra	A	<4mm
1	8	1	Lutjanidae	caudal vertebra	A	4-4.75mm
1	8	1	Scombridae	caudal vertebra	A	4-4.75mm
2	8	1	Serranidae	caudal vertebra	A	4-4.75mm
1	8	1	Unknown	vertebra	A	4-4.75mm
3	8	1	Acanthuridae	caudal vertebra	A	4.75-6.3mm
1	8	1	Lutjanidae	caudal vertebra	A	4.75-6.3mm
2	8	1	Serranidae	caudal vertebra	A	4.75-6.3mm
2	8	1	Unknown	vertebra	A	4.75-6.3mm
4	8	1	Unknown	vertebra	A	6.3-8mm
1	8	2	Lutjanidae	dentary	R	
1	8	2	Lutjanidae	maxilla	L	
2	8	2	Serranidae	premaxilla	L	16.7,15.8mm
2	8	2	Serranidae	premaxilla	R	9.4,10mm
1	8	2	Serranidae	dentary	R	
2	8	2	Serranidae	angular	R	
1	8	2	Serranidae	angular	L	
2	8	2	Serranidae	maxilla	L	
1	8	2	Serranidae	maxilla	R	
1	8	2	Serranidae	epihyal	L	
1	8	2	Sparidae	dentition fragment		fragmented, one tooth present
4	8	2	Unknown	dentition fragment		
1	8	2	Unknown	dentary	R	
9	8	2	Acanthuridae	caudal vertebra	A	<4mm
3	8	2	Belonidae	caudal vertebra	A	<4mm
2	8	2	Unknown	precaudal vertebra	A	<4mm
1	8	2	Sparidae	caudal vertebra	A	<4mm
5	8	2	Unknown	thoracic vertebra	A	<4mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	8	2	Unknown	atlas	A	<4mm
16	8	2	Unknown	caudal vertebra	A	<4mm
3	8	2	Belonidae	vertebra	A	4-4.75mm
4	8	2	Carangidae	caudal vertebra	A	4-4.75mm
1	8	2	Unknown	thoracic vertebra	A	4-4.75mm
5	8	2	Serranidae	caudal vertebra	A	4-4.75mm
1	8	2	Serranidae	thoracic vertebra	A	4-4.75mm
9	8	2	Unknown	caudal vertebra	A	4-4.75mm
2	8	2	Acanthuridae	caudal vertebra	A	4.75-6.3mm
6	8	2	Belonidae	caudal vertebra	A	4.75-6.3mm
3	8	2	Unknown	caudal vertebra	A	4.75-6.3mm
2	8	2	Scaridae	caudal vertebra	A	4.75-6.3mm
2	8	2	Scombridae	caudal vertebra	A	4.75-6.3mm
4	8	2	Serranidae	precaudal vertebra	A	4.75-6.3mm
1	8	2	Serranidae	caudal vertebra	A	4.75-6.3mm
14	8	2	Unknown	caudal vertebra	A	4.75-6.3mm
2	8	2	Serranidae	caudal vertebra	A	6.3-8mm
1	8	2	Serranidae	precaudal vertebra	A	6.3-8mm
1	8	2	Serranidae	atlas	A	6.3-8mm
9	8	2	Unknown	caudal vertebra	A	6.3-8mm
2	8	2	Scombridae	caudal vertebra	A	8-9.5mm
1	8	2	Serranidae	caudal vertebra	A	8-9.5mm
4	8	2	Unknown	vertebra	A	8-9.5mm
1	8	2	Scombridae	caudal vertebra	A	9.5-12.5mm
1	8	2	Unknown	caudal vertebra	A	9.5-12.5mm
1	8	2	Unknown	thoracic vertebra	A	9.5-12.5mm
1	8	3	Balistidae	premaxilla	R	
1	8	3	Balistidae	premaxilla	L	
2	8	3	Balistidae	tooth		
8	8	3	Balistidae	unidentified element		
2	8	3	Labridae	pharyngeal plate	A	
1	8	3	Labridae	premaxilla	R	
2	8	3	Labridae	dentition fragment		

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
2	8	3	Labridae	ultimate	A	
3	8	3	Lutjanidae	premaxilla	R	
1	8	3	Lutjanidae	dentary	L	
1	8	3	Lutjanidae	dentary	R	
1	8	3	Lutjanidae	dentary	R	
1	8	3	Scaridae	ultimate	A	
1	8	3	Scombridae	ultimate	A	
1	8	3	Scombridae	quadrate	R	
4	8	3	Serranidae	premaxilla	L	10.9,12.8,14.5,10.2mm
3	8	3	Serranidae	premaxilla	R	9.8,13.6mm, 1 is fragmented
1	8	3	Serranidae	vomer	A	
4	8	3	Serranidae	quadrate	L	
2	8	3	Serranidae	quadrate	R	
3	8	3	Serranidae	maxilla	R	
2	8	3	Serranidae	maxilla	L	
5	8	3	Serranidae	dentary	L	
6	8	3	Serranidae	dentary	R	
2	8	3	Serranidae	ceratohyal	L	
1	8	3	Serranidae	ceratohyal	R	
1	8	3	Serranidae	epihyal	L	
3	8	3	Serranidae	angular	R	
1	8	3	Serranidae	angular	L	
4	8	3	Serranidae	cleithrum		fragmented
3	8	3	Serranidae	preopercle		fragmented
1	8	3	Serranidae	hyomandibular	R	
1	8	3	Serranidae	hyomandibular	L	
1	8	3	Serranidae	postemporal	R	
2	8	3	Serranidae	palatine	R	
1	8	3	Serranidae	scapula	R	fragmented
1	8	3	Serranidae	postemporal	L	fragmented
1	8	3	Serranidae	postemporal	R	fragmented
1	8	3	Serranidae	palatine	L	fragmented
4	8	3	Unknown	premaxilla	R	

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	8	3	Unknown	dentary	L	
1	8	3	Unknown	maxilla	R	
1	8	3	Unknown	quadrate	L	
3	8	3	Unknown	quadrate		fragmented
2	8	3	Unknown	epihyal		fragmented
2	8	3	Unknown	angular		fragmented
2	8	3	Unknown	parasphenoid	A	fragmented
3	8	3	Unknown	hyomandibular		fragmented
2	8	3	Unknown	ceratohyal	R	fragmented
1	8	3	Unknown	ceratohyal	L	fragmented
3	8	3	Unknown	angular	L	fragmented
1	8	3	Unknown	angular	R	fragmented
1	8	3	Acanthuridae	caudal vertebra	A	<4mm
7	8	3	Carangidae	caudal vertebra	A	<4mm
2	8	3	Unknown	precaudal vertebra	A	<4mm
1	8	3	Sphyraenidae	caudal vertebra	A	<4mm
45	8	3	Unknown	caudal vertebra	A	<4mm
1	8	3	Unknown	atlas	A	<4mm
7	8	3	Belonidae	caudal vertebra	A	4-4.75mm
11	8	3	Carangidae	caudal vertebra	A	4-4.75mm
4	8	3	Carangidae	thoracic vertebra	A	4-4.75mm
3	8	3	Haemulidae	thoracic vertebra	A	4-4.75mm
1	8	3	Unknown	thoracic vertebra	A	4-4.75mm
2	8	3	Unknown	caudal vertebra	A	4-4.75mm
2	8	3	Unknown	precaudal vertebra	A	4-4.75mm
1	8	3	Serranidae	precaudal vertebra	A	4-4.75mm
3	8	3	Serranidae	thoracic vertebra	A	4-4.75mm
9	8	3	Serranidae	caudal vertebra	A	4-4.75mm
1	8	3	Sparidae	caudal vertebra	A	4-4.75mm
1	8	3	Acanthuridae	precaudal vertebra	A	4.75-6.3mm
20	8	3	Belonidae	vertebra	A	4.75-6.3mm
1	8	3	Carangidae	caudal vertebra	A	4.75-6.3mm
18	8	3	Carangidae	caudal vertebra	A	4.75-6.3mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
5	8	3	Lutjanidae	caudal vertebra	A	4.75-6.3mm
1	8	3	Lutjanidae	thoracic vertebra	A	4.75-6.3mm
1	8	3	Scaridae	caudal vertebra	A	4.75-6.3mm
6	8	3	Serranidae	caudal vertebra	A	4.75-6.3mm
12	8	3	Serranidae	caudal vertebra	A	4.75-6.3mm
3	8	3	Serranidae	precaudal vertebra	A	4.75-6.3mm
4	8	3	Serranidae	thoracic vertebra	A	4.75-6.3mm
1	8	3	Serranidae	atlas	A	4.75-6.3mm
7	8	3	Sphyraenidae	caudal vertebra	A	4.75-6.3mm
1	8	3	Unknown	thoracic vertebra	A	4.75-6.3mm
1	8	3	Unknown	precaudal vertebra	A	4.75-6.3mm
3	8	3	Unknown	caudal vertebra	A	4.75-6.3mm
4	8	3	Acanthuridae	caudal vertebra	A	6.3-8mm
1	8	3	Acanthuridae	precaudal vertebra	A	6.3-8mm
5	8	3	Belonidae	caudal vertebra	A	6.3-8mm
4	8	3	Belonidae	precaudal vertebra	A	6.3-8mm
1	8	3	Belonidae	thoracic vertebra	A	6.3-8mm
2	8	3	Carangidae	caudal vertebra	A	6.3-8mm
1	8	3	Squalomorphii	vertebra	A	6.3-8mm
9	8	3	Haemulidae	caudal vertebra	A	6.3-8mm
1	8	3	Haemulidae	precaudal vertebra	A	6.3-8mm
4	8	3	Scaridae	caudal vertebra	A	6.3-8mm
21	8	3	Serranidae	caudal vertebra	A	6.3-8mm
3	8	3	Serranidae	precaudal vertebra	A	6.3-8mm
3	8	3	Serranidae	thoracic vertebra	A	6.3-8mm
2	8	3	Sphyraenidae	caudal vertebra	A	6.3-8mm
22	8	3	Unknown	caudal vertebra	A	6.3-8mm
5	8	3	Unknown	precaudal vertebra	A	6.3-8mm
1	8	3	Acanthuridae	caudal vertebra	A	8-9.5mm
4	8	3	Belonidae	precaudal vertebra	A	8-9.5mm
1	8	3	Belonidae	thoracic vertebra	A	8-9.5mm
1	8	3	Haemulidae	caudal vertebra	A	8-9.5mm
2	8	3	Scombridae	thoracic vertebra	A	8-9.5mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	8	3	Serranidae	thoracic vertebra	A	8-9.5mm
2	8	3	Serranidae	atlas	A	8-9.5mm
1	8	3	Serranidae	precaudal vertebra	A	8-9.5mm
8	8	3	Serranidae	caudal vertebra	A	8-9.5mm
14	8	3	Unknown	caudal vertebra	A	8-9.5mm
5	8	3	Unknown	precaudal vertebra	A	8-9.5mm
1	8	3	Unknown	thoracic vertebra	A	8-9.5mm
1	8	3	Unknown	atlas	A	8-9.5mm
2	8	3	Balistidae	precaudal vertebra	A	9.5-12.5mm
2	8	3	Balistidae	caudal vertebra	A	9.5-12.5mm
2	8	3	Carangidae	caudal vertebra	A	9.5-12.5mm
13	8	3	Scombridae	caudal vertebra	A	9.5-12.5mm
8	8	3	Scombridae	thoracic vertebra	A	9.5-12.5mm
7	8	3	Serranidae	caudal vertebra	A	9.5-12.5mm
4	8	3	Unknown	caudal vertebra	A	9.5-12.5mm
1	8	3	Unknown	thoracic vertebra	A	9.5-12.5mm
1	8	3	Balistidae	thoracic vertebra	A	>12.5mm
1	8	3	Carangidae	atlas	A	>12.5mm
1	8	3	Carangidae	caudal vertebra	A	>12.5mm
1	8	3	Unknown	precaudal vertebra	A	>12.5mm
2	8	3	Scombridae	thoracic vertebra	A	>12.5mm
6	8	3	Scombridae	caudal vertebra	A	>12.5mm
1	8	3	Serranidae	caudal vertebra	A	>12.5mm
3	8	3	Serranidae	precaudal vertebra	A	>12.5mm
1	8	3	Unknown	caudal vertebra	A	>12.5mm
2	8	3	Unknown	thoracic vertebra	A	>12.5mm
3	8	4	Balistidae	spine	A	
3	8	4	Balistidae	premaxilla	L	
1	8	4	Balistidae	premaxilla	R	
1	8	4	Balistidae	tooth		broken into 2 fragments
4	8	4	Balistidae	unidentified element		
1	8	4	Balistidae	preopercle		fragmented
1	8	4	Balistidae	branchial fragment		fragmented

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
2	8	4	Carangidae	maxilla	R	
1	8	4	Carangidae	maxilla	L	
4	8	4	Haemulidae	maxilla	R	
1	8	4	Haemulidae	scapula		
1	8	4	Labridae	maxilla	L	
2	8	4	Labridae	dentary		fragmented, teeth present
1	8	4	Labridae	dentary	R	
3	8	4	Labridae	premaxilla	L	fragmented, front teeth present
1	8	4	Labridae	pharyngeal plate	A	
1	8	4	Labridae	premaxilla		fragmented
1	8	4	Labridae	dentition fragment		fragmented
1	8	4	Labridae	lower pharyngeal plate		
1	8	4	Unknown	premaxilla	L	
2	8	4	Scaridae	premaxilla		fragmented, teeth present
1	8	4	Scaridae	dentition fragment		fragmented
1	8	4	Scombridae	angular	R	
1	8	4	Scombridae	quadrate	R	
3	8	4	Serranidae	maxilla	R	
11	8	4	Serranidae	maxilla	L	
2	8	4	Serranidae	postemporal	L	
3	8	4	Serranidae	palatine	L	
1	8	4	Serranidae	palatine	R	
8	8	4	Serranidae	premaxilla	L	17.6,11.1,11.3,9.7,8,11.2,8.7,8.4 mm
8	8	4	Serranidae	premaxilla	R	16,15,11.3,12.4,11.3,8.6,8 mm
8	8	4	Serranidae	dentary	R	all fragmented, hinge present
11	8	4	Serranidae	dentary	L	all fragmented, hinge present
12	8	4	Serranidae	quadrate	R	
13	8	4	Serranidae	quadrate	L	
2	8	4	Serranidae	vomer	A	
6	8	4	Serranidae	angular	R	
4	8	4	Serranidae	angular	L	
3	8	4	Serranidae	hyomandibular	R	
4	8	4	Serranidae	quadrate	R	

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	8	4	Serranidae	supracleithrum	L	
2	8	4	Serranidae	postemporal	R	
2	8	4	Serranidae	palatine	L	
1	8	4	Serranidae	palatine	R	
1	8	4	Serranidae	scapula		fragmented
1	8	4	Sparidae	premaxilla	L	
1	8	4	Unknown	ultimate	A	
3	8	4	Unknown	dentary		fragmented
1	8	4	Unknown	quadrate		fragmented
5	8	4	Unknown	maxilla		fragmented
4	8	4	Unknown	premaxilla	L	
3	8	4	Unknown	maxilla		fragmented, small
4	8	4	Unknown	angular	R	
2	8	4	Unknown	angular	L	
2	8	4	Unknown	scapula		
3	8	4	Unknown	hyomandibular	R	
2	8	4	Unknown	hyomandibular	L	
3	8	4	Unknown	quadrate		fragmented
4	8	4	Unknown	pharyngeal plate		2 fragmented
1	8	4	Unknown	dentary	R	fragmented
1	8	4	Unknown	preopercle	L	
1	8	4	Unknown	preopercle	R	
2	8	4	Unknown	cleithrum		fragmented
2	8	4	Unknown	parasphenoid	A	fragmented
2	8	4	Unknown	hyomandibular		fragmented
2	8	4	Unknown	interhyal	R	fragmented
2	8	4	Unknown	interhyal	L	fragmented
1	8	4	Unknown	premaxilla		fragmented
2	8	4	Unknown	basipterygium		fragmented
1	8	4	Unknown	angular	R	
1	8	4	Unknown	epihyal	R	
1	8	4	Unknown	epihyal	L	
2	8	4	Unknown	dentition fragment		

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
6	8	4	Unknown	palatine		fragmented
6	8	4	Belonidae	caudal vertebra	A	<4mm
27	8	4	Carangidae	caudal vertebra	A	<4mm
35	8	4	Unknown	precaudal vertebra	A	<4mm
5	8	4	Serranidae	caudal vertebra	A	<4mm
2	8	4	Serranidae	precaudal vertebra	A	<4mm
12	8	4	Unknown	atlas	A	<4mm
472	8	4	Unknown	caudal vertebra	A	<4mm
13	8	4	Belonidae	caudal vertebra	A	4-4.75mm
39	8	4	Carangidae	caudal vertebra	A	4-4.75mm
20	8	4	Unknown	precaudal vertebra	A	4-4.75mm
3	8	4	Serranidae	thoracic vertebra	A	4-4.75mm
1	8	4	Serranidae	precaudal vertebra	A	4-4.75mm
9	8	4	Serranidae	caudal vertebra	A	4-4.75mm
10	8	4	Unknown	atlas	A	4-4.75mm
314	8	4	Unknown	caudal vertebra	A	4-4.75mm
66	8	4	Belonidae	caudal vertebra	A	4.75-6.3mm
53	8	4	Carangidae	caudal vertebra	A	4.75-6.3mm
8	8	4	Unknown	precaudal vertebra	A	4.75-6.3mm
5	8	4	Serranidae	thoracic vertebra	A	4.75-6.3mm
12	8	4	Serranidae	caudal vertebra	A	4.75-6.3mm
7	8	4	Serranidae	precaudal vertebra	A	4.75-6.3mm
17	8	4	Sphyraenidae	caudal vertebra	A	4.75-6.3mm
5	8	4	Unknown	atlas	A	4.75-6.3mm
361	8	4	Unknown	caudal vertebra	A	4.75-6.3mm
38	8	4	Belonidae	caudal vertebra	A	6.3-8mm
23	8	4	Carangidae	caudal vertebra	A	6.3-8mm, 3 show signs of burning
3	8	4	Unknown	precaudal vertebra	A	6.3-8mm
1	8	4	Scombridae	caudal vertebra	A	6.3-8mm, burnt
3	8	4	Serranidae	thoracic vertebra	A	6.3-8mm
1	8	4	Serranidae	atlas	A	6.3-8mm
17	8	4	Serranidae	caudal vertebra	A	6.3-8mm
10	8	4	Serranidae	precaudal vertebra	A	6.3-8mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
3	8	4	Unknown	atlas	A	6.3-8mm
128	8	4	Unknown	vertebra	A	6.3-8mm
4	8	4	Balistidae	precaudal vertebra	A	8-9.5mm
1	8	4	Balistidae	caudal vertebra	A	8-9.5mm
1	8	4	Balistidae	atlas	A	8-9.5mm
6	8	4	Belonidae	precaudal vertebra	A	8-9.5mm
3	8	4	Belonidae	caudal vertebra	A	8-9.5mm
2	8	4	Carangidae	caudal vertebra	A	8-9.5mm
4	8	4	Haemulidae	caudal vertebra	A	8-9.5mm
2	8	4	Unknown	precaudal vertebra	A	8-9.5mm
2	8	4	Unknown	caudal vertebra	A	8-9.5mm
1	8	4	Scombridae	precaudal vertebra	A	8-9.5mm
4	8	4	Scombridae	caudal vertebra	A	8-9.5mm
6	8	4	Scombridae	thoracic vertebra	A	8-9.5mm
2	8	4	Serranidae	thoracic vertebra	A	8-9.5mm
3	8	4	Serranidae	precaudal vertebra	A	8-9.5mm
12	8	4	Serranidae	caudal vertebra	A	8-9.5mm
2	8	4	Sparidae	precaudal vertebra	A	8-9.5mm
18	8	4	Unknown	caudal vertebra	A	8-9.5mm
1	8	4	Unknown	precaudal vertebra	A	8-9.5mm
1	8	4	Unknown	thoracic vertebra	A	8-9.5mm
1	8	4	Unknown	atlas	A	8-9.5mm
2	8	4	Acanthuridae	caudal vertebra	A	9.5-12.5mm
4	8	4	Balistidae	thoracic vertebra	A	9.5-12.5mm
3	8	4	Balistidae	precaudal vertebra	A	9.5-12.5mm
1	8	4	Balistidae	caudal vertebra	A	9.5-12.5mm
1	8	4	Carangidae	caudal vertebra	A	9.5-12.5mm
5	8	4	Scombridae	caudal vertebra	A	9.5-12.5mm
3	8	4	Serranidae	thoracic vertebra	A	9.5-12.5mm
1	8	4	Serranidae	atlas	A	9.5-12.5mm
2	8	4	Serranidae	precaudal vertebra	A	9.5-12.5mm
1	8	4	Serranidae	caudal vertebra	A	9.5-12.5mm
8	8	4	Unknown	caudal vertebra	A	9.5-12.5mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
2	8	4	Unknown	precaudal vertebra	A	9.5-12.5mm
1	8	4	Balistidae	precaudal vertebra	A	>12.5mm
1	8	4	Serranidae	caudal vertebra	A	>12.5mm
1	8	4	Unknown	thoracic vertebra	A	>12.5mm
1	8	5	Scaridae	premaxilla		
1	8	5	Acanthuridae	caudal vertebra	A	4.75-6.3mm
1	8	5	Unknown	precaudal vertebra	A	4.75-6.3mm
1	8	5	Unknown	vertebra	A	4.75-6.3mm
1	8	5	Unknown	vertebra	A	8-9.5mm
1	8	5	Carangidae	vertebra	A	9.5-12.5mm
2	13	1A	Acanthuridae	caudal vertebra	A	<4mm
1	13	1A	Belonidae	caudal vertebra	A	<4mm
1	13	1A	Belonidae	precaudal vertebra	A	<4mm
3	13	1A	Carangidae	caudal vertebra	A	<4mm
1	13	1A	Carangidae	caudal vertebra	A	<4mm
5	13	1A	Haemulidae	caudal vertebra	A	<4mm
1	13	1A	Haemulidae	precaudal vertebra	A	<4mm
2	13	1A	Labridae	caudal vertebra	A	<4mm
3	13	1A	Unknown	caudal vertebra	A	<4mm
2	13	1A	Serranidae	atlas	A	<4mm
4	13	1A	Serranidae	caudal vertebra	A	<4mm
1	13	1A	Serranidae	thoracic vertebra	A	<4mm
5	13	1A	Sparidae	caudal vertebra	A	<4mm
4	13	1A	Unknown	atlas	A	<4mm
11	13	1A	Unknown	thoracic vertebra	A	<4mm
29	13	1A	Unknown	caudal vertebra	A	<4mm
3	13	1A	Belonidae	caudal vertebra	A	4-4.75mm
1	13	1A	Haemulidae	precaudal vertebra	A	4-4.75mm
3	13	1A	Unknown	caudal vertebra	A	4-4.75mm
2	13	1A	Serranidae	caudal vertebra	A	4-4.75mm
1	13	1A	Serranidae	precaudal vertebra	A	4-4.75mm
20	13	1A	Unknown	precaudal vertebra	A	4-4.75mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	13	1A	Unknown	atlas	A	4-4.75mm
1	13	1A	Acanthuridae	caudal vertebra	A	4.75-6.3mm
2	13	1A	Labridae	caudal vertebra	A	4.75-6.3mm
1	13	1A	Unknown	caudal vertebra	A	4.75-6.3mm
3	13	1A	Scaridae	caudal vertebra	A	4.75-6.3mm
1	13	1A	Serranidae	caudal vertebra	A	4.75-6.3mm
3	13	1A	Sparidae	caudal vertebra	A	4.75-6.3mm
4	13	1A	Unknown	thoracic vertebra	A	4.75-6.3mm
1	13	1A	Unknown	atlas	A	4.75-6.3mm
19	13	1A	Unknown	caudal vertebra	A	4.75-6.3mm
2	13	1A	Acanthuridae	precaudal vertebra	A	6.3-8mm
1	13	1A	Haemulidae	precaudal vertebra	A	6.3-8mm
1	13	1A	Labridae	atlas	A	6.3-8mm
1	13	1A	Unknown	caudal vertebra	A	6.3-8mm
1	13	1A	Unknown	thoracic vertebra	A	6.3-8mm
1	13	1A	Serranidae	caudal vertebra	A	6.3-8mm
1	13	1A	Serranidae	thoracic vertebra	A	6.3-8mm
3	13	1A	Unknown	precaudal vertebra	A	6.3-8mm
8	13	1A	Unknown	caudal vertebra	A	6.3-8mm
3	13	1A	Labridae	caudal vertebra	A	8-9.5mm
1	13	1A	Unknown	caudal vertebra	A	8-9.5mm
1	13	1A	Scombridae	caudal vertebra	A	8-9.5mm
2	13	1A	Unknown	caudal vertebra	A	8-9.5mm
2	13	1A	Scombridae	thoracic vertebra	A	9.5-12.5mm
1	13	1A	Scombridae	caudal vertebra	A	9.5-12.5mm
1	13	1A	Serranidae	atlas	A	9.5-12.5mm
2	13	1B1	Acanthuridae	caudal vertebra	A	<4mm
3	13	1B1	Belonidae	caudal vertebra	A	<4mm
2	13	1B1	Carangidae	caudal vertebra	A	<4mm
6	13	1B1	Haemulidae	caudal vertebra	A	<4mm
1	13	1B1	Labridae	caudal vertebra	A	<4mm
2	13	1B1	Unknown	caudal vertebra	A	<4mm
1	13	1B1	Scaridae	caudal vertebra	A	<4mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	13	1B1	Serranidae	caudal vertebra	A	<4mm
5	13	1B1	Sparidae	caudal vertebra	A	<4mm
1	13	1B1	Sparidae	precaudal vertebra	A	<4mm
3	13	1B1	Unknown	atlas	A	<4mm
2	13	1B1	Unknown	precaudal vertebra	A	<4mm
8	13	1B1	Unknown	thoracic vertebra	A	<4mm
30	13	1B1	Unknown	caudal vertebra	A	<4mm
2	13	1B1	Acanthuridae	precaudal vertebra	A	4-4.75mm
1	13	1B1	Acanthuridae	caudal vertebra	A	4-4.75mm
2	13	1B1	Acanthuridae	thoracic vertebra	A	4-4.75mm
2	13	1B1	Belonidae	caudal vertebra	A	4-4.75mm
1	13	1B1	Carangidae	caudal vertebra	A	4-4.75mm
2	13	1B1	Unknown	caudal vertebra	A	4-4.75mm
2	13	1B1	Serranidae	caudal vertebra	A	4-4.75mm
5	13	1B1	Unknown	thoracic vertebra	A	4-4.75mm
1	13	1B1	Unknown	atlas	A	4-4.75mm
21	13	1B1	Unknown	caudal vertebra	A	4-4.75mm
2	13	1B1	Acanthuridae	precaudal vertebra	A	4.75-6.3mm
2	13	1B1	Acanthuridae	precaudal vertebra	A	4.75-6.3mm
5	13	1B1	Acanthuridae	caudal vertebra	A	4.75-6.3mm
1	13	1B1	Acanthuridae	precaudal vertebra	A	4.75-6.3mm
4	13	1B1	Belonidae	caudal vertebra	A	4.75-6.3mm
3	13	1B1	Belonidae	precaudal vertebra	A	4.75-6.3mm
1	13	1B1	Carangidae	caudal vertebra	A	4.75-6.3mm
1	13	1B1	Haemulidae	caudal vertebra	A	4.75-6.3mm
1	13	1B1	Labridae	caudal vertebra	A	4.75-6.3mm
1	13	1B1	Labridae	thoracic vertebra	A	4.75-6.3mm
2	13	1B1	Unknown	caudal vertebra	A	4.75-6.3mm
1	13	1B1	Unknown	caudal vertebra	A	4.75-6.3mm
1	13	1B1	Unknown	thoracic vertebra	A	4.75-6.3mm
1	13	1B1	Scaridae	caudal vertebra	A	4.75-6.3mm
1	13	1B1	Scaridae	caudal vertebra	A	4.75-6.3mm
1	13	1B1	Scaridae	precaudal vertebra	A	4.75-6.3mm

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
2	13	1B1	Scombridae	caudal vertebra	A	4.75-6.3mm
2	13	1B1	Serranidae	caudal vertebra	A	4.75-6.3mm
6	13	1B1	Serranidae	caudal vertebra	A	4.75-6.3mm
1	13	1B1	Serranidae	atlas	A	4.75-6.3mm
2	13	1B1	Sparidae	precaudal vertebra	A	4.75-6.3mm
1	13	1B1	Sparidae	caudal vertebra	A	4.75-6.3mm
4	13	1B1	Unknown	thoracic vertebra	A	4.75-6.3mm
1	13	1B1	Unknown	atlas	A	4.75-6.3mm
4	13	1B1	Unknown	precaudal vertebra	A	4.75-6.3mm
13	13	1B1	Unknown	caudal vertebra	A	4.75-6.3mm
18	13	1B1	Unknown	caudal vertebra	A	4.75-6.3mm
1	13	1B1	Unknown	precaudal vertebra	A	4.75-6.3mm
1	13	1B1	Unknown	thoracic vertebra	A	4.75-6.3mm
1	13	1B1	Unknown	atlas	A	4.75-6.3mm
1	13	1B1	Acanthuridae	precaudal vertebra	A	6.3-8mm
1	13	1B1	Balistidae	thoracic vertebra	A	6.3-8mm
1	13	1B1	Haemulidae	atlas	A	6.3-8mm
3	13	1B1	Haemulidae	caudal vertebra	A	6.3-8mm
2	13	1B1	Scaridae	caudal vertebra	A	6.3-8mm
1	13	1B1	Scombridae	caudal vertebra	A	6.3-8mm
1	13	1B1	Unknown	caudal vertebra	A	6.3-8mm
1	13	1B1	Unknown	thoracic vertebra	A	6.3-8mm
1	13	1B1	Carangidae	precaudal vertebra	A	8-9.5mm
1	13	1B1	Labridae	thoracic vertebra	A	8-9.5mm
1	13	1B1	Labridae	caudal vertebra	A	8-9.5mm
1	13	1B1	Scombridae	caudal vertebra	A	8-9.5mm
1	13	1B1	Serranidae	thoracic vertebra	A	8-9.5mm
2	13	1B1	Unknown	caudal vertebra	A	8-9.5mm
1	13	1B1	Haemulidae	caudal vertebra	A	9.5-12.5mm
1	13	1B1	Haemulidae	thoracic vertebra	A	9.5-12.5mm
1	13	1B1	Unknown	caudal vertebra	A	9.5-12.5mm
4	13	1B1	Scombridae	caudal vertebra	A	9.5-12.5mm, 2 are burned
1	13	1B1	Scombridae	caudal vertebra	A	>12.5mm

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	13	1B1	Sphyraenidae	caudal vertebra	A	>12.5mm
1	13	1B1	Unknown	thoracic vertebra	A	>12.5mm
11	13	1B2	Acanthuridae	spine	A	
3	13	1B2	Acanthuridae	scapula		fragmented
2	13	1B2	Balistidae	tooth		
3	13	1B2	Balistidae	spine	A	
1	13	1B2	Balistidae	premaxilla	R	
1	13	1B2	Balistidae	premaxilla	L	
1	13	1B2	Balistidae	quadrate	L	
1	13	1B2	Carangidae	quadrate	R	
1	13	1B2	Carangidae	scapula		fragmented
1	13	1B2	Carangidae	maxilla	L	
2	13	1B2	Diodontidae	spine	A	
1	13	1B2	Haemulidae	premaxilla	R	
1	13	1B2	Haemulidae	premaxilla	L	
2	13	1B2	Haemulidae	premaxilla	R	
4	13	1B2	Haemulidae	premaxilla	L	
1	13	1B2	Haemulidae	premaxilla		fragmented
3	13	1B2	Haemulidae	maxilla	L	
1	13	1B2	Haemulidae	maxilla	R	
1	13	1B2	Haemulidae	quadrate	L	
2	13	1B2	Kyphosidae	dentary		
1	13	1B2	Labridae	lower pharyngeal plate	A	
6	13	1B2	Labridae	ultimate	A	
1	13	1B2	Labridae	hyomandibular		
1	13	1B2	Labridae	upper pharyngeal plate		
1	13	1B2	Labridae	hyomandibular	R	
1	13	1B2	Labridae	scapula		fragmented
1	13	1B2	Unknown	hyomandibular	R	
1	13	1B2	Unknown	hyomandibular	L	
1	13	1B2	Unknown	ceratohyal	R	
2	13	1B2	Lutjanidae	premaxilla	L	
4	13	1B2	Lutjanidae	premaxilla	R	

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
2	13	1B2	Lutjanidae	maxilla	L	
1	13	1B2	Lutjanidae	dentary	R	
1	13	1B2	Lutjanidae	angular	R	
5	13	1B2	Scaridae	premaxilla	L	
7	13	1B2	Scaridae	premaxilla	R	
7	13	1B2	Scaridae	premaxilla		fragmented
1	13	1B2	Scaridae	scapula		fragmented
2	13	1B2	Scaridae	ultimate	A	
2	13	1B2	Scaridae	hyomandibular	R	
1	13	1B2	Scaridae	scapula		fragmented
1	13	1B2	Scaridae	quadrate	R	
1	13	1B2	Scaridae	quadrate	L	
7	13	1B2	Scaridae (scarus)	upper pharyngeal plate		fragmented
6	13	1B2	Scaridae (sparisoma)	lower pharyngeal plate	A	one fragmented
2	13	1B2	Scaridae (sparisoma)	upper pharyngeal plate	L	
6	13	1B2	Scaridae (sparisoma)	upper pharyngeal plate	R	
13	13	1B2	Scaridae (sparisoma)	upper pharyngeal plate		fragmented
1	13	1B2	Scombridae	maxilla	R	
4	13	1B2	Serranidae	dentary	R	
4	13	1B2	Serranidae	dentary	L	
4	13	1B2	Serranidae	maxilla	L	
9	13	1B2	Serranidae	maxilla	R	
2	13	1B2	Serranidae	premaxilla	L	8.1, 9
1	13	1B2	Serranidae	ceratohyal	R	
1	13	1B2	Serranidae	epihyal	L	
2	13	1B2	Serranidae	angular	L	
3	13	1B2	Serranidae	angular	R	
1	13	1B2	Serranidae	quadrate	L	
3	13	1B2	Serranidae	quadrate	R	
1	13	1B2	Serranidae	scapula		fragmented
3	13	1B2	Serranidae	vomer	A	
1	13	1B2	Serranidae	hyomandibular	R	
1	13	1B2	Serranidae	palatine	R	

Appendix A-Fish Catalouge

Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
2	13	1B2	Serranidae	palatine	L	
1	13	1B2	Serranidae	epihyal	R	
1	13	1B2	Serranidae	epihyal	L	
1	13	1B2	Sparidae	dentary	L	
1	13	1B2	Unknown	preopercle		fragmented
6	13	1B2	Unknown	scapula		
9	13	1B2	Unknown	ultimate	A	
3	13	1B2	Unknown	maxilla	L	
1	13	1B2	Unknown	maxilla	R	
2	13	1B2	Unknown	angular	R	
5	13	1B2	Unknown	scapula		fragmented
2	13	1B2	Unknown	hyomandibular	R	
1	13	1B2	Unknown	hyomandibular	L	
14	13	1B2	Unknown	hyomandibular		fragmented
2	13	1B2	Unknown	vomer	A	
2	13	1B2	Unknown	palatine	L	
1	13	1B2	Unknown	palatine	R	
2	13	1B2	Unknown	supracleithrum		
1	13	1B2	Unknown	postemporal		
2	13	1B2	Unknown	premaxilla	R	fragmented
1	13	1B2	Unknown	premaxilla	L	fragmented
2	13	1B2	Unknown	otoliths		
2	13	1B2	Unknown	dentary	R	
54	13	1B2	Unknown	dentition fragment		
2	13	1B2	Unknown	epihyal		
14	13	1B2	Unknown	quadrate		
1	13	1B2	Unknown	parasphenoid	A	
11	13	1B2	Unknown	opercle		fragmented
1	13	1B2	Unknown	ceratohyal	L	
8	13	1B2	Acanthuridae	precaudal vertebra	A	<4mm
34	13	1B2	Acanthuridae	caudal vertebra	A	<4mm
6	13	1B2	Belonidae	caudal vertebra	A	<4mm
13	13	1B2	Carangidae	caudal vertebra	A	<4mm

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	13	1B2	Haemulidae	caudal vertebra	A	<4mm
36	13	1B2	Unknown	caudal vertebra	A	<4mm
4	13	1B2	Scaridae	caudal vertebra	A	<4mm
14	13	1B2	Serranidae	caudal vertebra	A	<4mm
15	13	1B2	Sparidae	caudal vertebra	A	<4mm
2	13	1B2	Sphyraenidae	caudal vertebra	A	<4mm
1	13	1B2	Unknown	thoracic vertebra	A	<4mm
103	13	1B2	Unknown	caudal vertebra	A	<4mm
6	13	1B2	Unknown	atlas	A	<4mm
18	13	1B2	Acanthuridae	caudal vertebra	A	4-4.75mm
7	13	1B2	Acanthuridae	precaudal vertebra	A	4-4.75mm
10	13	1B2	Belonidae	caudal vertebra	A	4-4.75mm
2	13	1B2	Belonidae	precaudal vertebra	A	4-4.75mm
1	13	1B2	Belonidae	thoracic vertebra	A	4-4.75mm
3	13	1B2	Haemulidae	caudal vertebra	A	4-4.75mm
1	13	1B2	Labridae	caudal vertebra	A	4-4.75mm
6	13	1B2	Unknown	caudal vertebra	A	4-4.75mm
2	13	1B2	Unknown	thoracic vertebra	A	4-4.75mm
3	13	1B2	Lutjanidae	precaudal vertebra	A	4-4.75mm
3	13	1B2	Lutjanidae	thoracic vertebra	A	4-4.75mm
3	13	1B2	Scombridae	thoracic vertebra	A	4-4.75mm
1	13	1B2	Scombridae	caudal vertebra	A	4-4.75mm
3	13	1B2	Serranidae	thoracic vertebra	A	4-4.75mm
2	13	1B2	Serranidae	precaudal vertebra	A	4-4.75mm
14	13	1B2	Serranidae	caudal vertebra	A	4-4.75mm
1	13	1B2	Serranidae	atlas	A	4-4.75mm
2	13	1B2	Unknown	thoracic vertebra	A	4-4.75mm
4	13	1B2	Unknown	atlas	A	4-4.75mm
1	13	1B2	Unknown	precaudal vertebra	A	4-4.75mm
48	13	1B2	Unknown	caudal vertebra	A	4-4.75mm
7	13	1B2	Acanthuridae	precaudal vertebra	A	4.75-6.3mm
26	13	1B2	Acanthuridae	caudal vertebra	A	4.75-6.3mm
1	13	1B2	Belonidae	caudal vertebra	A	4.75-6.3mm

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
5	13	1B2	Carangidae	caudal vertebra	A	4.75-6.3mm
4	13	1B2	Haemulidae	caudal vertebra	A	4.75-6.3mm
1	13	1B2	Haemulidae	thoracic vertebra	A	4.75-6.3mm
1	13	1B2	Haemulidae	atlas	A	4.75-6.3mm
2	13	1B2	Labridae	precaudal vertebra	A	4.75-6.3mm
4	13	1B2	Labridae	caudal vertebra	A	4.75-6.3mm
1	13	1B2	Labridae	thoracic vertebra	A	4.75-6.3mm
9	13	1B2	Unknown	caudal vertebra	A	4.75-6.3mm
6	13	1B2	Scaridae	caudal vertebra	A	4.75-6.3mm
1	13	1B2	Scombridae	caudal vertebra	A	4.75-6.3mm
1	13	1B2	Scombridae	thoracic vertebra	A	4.75-6.3mm
11	13	1B2	Serranidae	caudal vertebra	A	4.75-6.3mm
1	13	1B2	Serranidae	thoracic vertebra	A	4.75-6.3mm
1	13	1B2	Serranidae	precaudal vertebra	A	4.75-6.3mm
10	13	1B2	Sparidae	caudal vertebra	A	4.75-6.3mm
1	13	1B2	Sparidae	precaudal vertebra	A	4.75-6.3mm
1	13	1B2	Sphyranidae	caudal vertebra	A	4.75-6.3mm
1	13	1B2	Unknown	atlas	A	4.75-6.3mm
12	13	1B2	Unknown	thoracic vertebra	A	4.75-6.3mm
19	13	1B2	Unknown	precaudal vertebra	A	4.75-6.3mm
60	13	1B2	Unknown	caudal vertebra	A	4.75-6.3mm
5	13	1B2	Acanthuridae	precaudal vertebra	A	6.3-8mm
35	13	1B2	Acanthuridae	caudal vertebra	A	6.3-8mm
3	13	1B2	Balistidae	thoracic vertebra	A	6.3-8mm
5	13	1B2	Balistidae	caudal vertebra	A	6.3-8mm
1	13	1B2	Balistidae	thoracic vertebra	A	6.3-8mm
2	13	1B2	Belonidae	caudal vertebra	A	6.3-8mm
1	13	1B2	Belonidae	thoracic vertebra	A	6.3-8mm
1	13	1B2	Carangidae	caudal vertebra	A	6.3-8mm
6	13	1B2	Carangidae	caudal vertebra	A	6.3-8mm
12	13	1B2	Haemulidae	caudal vertebra	A	6.3-8mm
1	13	1B2	Haemulidae	thoracic vertebra	A	6.3-8mm
16	13	1B2	Unknown	caudal vertebra	A	6.3-8mm

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	13	1B2	Lutjanidae	thoracic vertebra	A	6.3-8mm
19	13	1B2	Serranidae	caudal vertebra	A	6.3-8mm
19	13	1B2	Unknown	caudal vertebra	A	6.3-8mm
8	13	1B2	Unknown	atlas	A	6.3-8mm
1	13	1B2	Unknown	thoracic vertebra	A	6.3-8mm
3	13	1B2	Acanthuridae	caudal vertebra	A	8-9.5mm
3	13	1B2	Balistidae	thoracic vertebra	A	8-9.5mm
1	13	1B2	Balistidae	caudal vertebra	A	8-9.5mm
1	13	1B2	Balistidae	precaudal vertebra	A	8-9.5mm
3	13	1B2	Carangidae	caudal vertebra	A	8-9.5mm
1	13	1B2	Carangidae	precaudal vertebra	A	8-9.5mm
3	13	1B2	Haemulidae	caudal vertebra	A	8-9.5mm
2	13	1B2	Haemulidae	precaudal vertebra	A	8-9.5mm
5	13	1B2	Labridae	caudal vertebra	A	8-9.5mm
1	13	1B2	Labridae	thoracic vertebra	A	8-9.5mm
1	13	1B2	Labridae	precaudal vertebra	A	8-9.5mm
4	13	1B2	Unknown	caudal vertebra	A	8-9.5mm
1	13	1B2	Unknown	precaudal vertebra	A	8-9.5mm
1	13	1B2	Unknown	thoracic vertebra	A	8-9.5mm
1	13	1B2	Lutjanidae	thoracic vertebra	A	8-9.5mm
3	13	1B2	Scaridae	caudal vertebra	A	8-9.5mm
14	13	1B2	Scombridae	caudal vertebra	A	8-9.5mm
5	13	1B2	Serranidae	caudal vertebra	A	8-9.5mm
1	13	1B2	Serranidae	atlas	A	8-9.5mm
2	13	1B2	Serranidae	thoracic vertebra	A	8-9.5mm
5	13	1B2	Unknown	precaudal vertebra	A	8-9.5mm
18	13	1B2	Unknown	caudal vertebra	A	8-9.5mm
1	13	1B2	Unknown	thoracic vertebra	A	8-9.5mm, burned
2	13	1B2	Balistidae	thoracic vertebra	A	9.5-12.5mm
1	13	1B2	Balistidae	caudal vertebra	A	9.5-12.5mm
1	13	1B2	Belonidae	caudal vertebra	A	9.5-12.5mm
2	13	1B2	Haemulidae	caudal vertebra	A	9.5-12.5mm
1	13	1B2	Haemulidae	thoracic vertebra	A	9.5-12.5mm

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
11	13	1B2	Labridae	caudal vertebra	A	9.5-12.5mm
3	13	1B2	Labridae	precaudal vertebra	A	9.5-12.5mm
1	13	1B2	Unknown	caudal vertebra	A	9.5-12.5mm
1	13	1B2	Unknown	precaudal vertebra	A	9.5-12.5mm
1	13	1B2	Scaridae	caudal vertebra	A	9.5-12.5mm
5	13	1B2	Scombridae	thoracic vertebra	A	9.5-12.5mm
15	13	1B2	Scombridae	caudal vertebra	A	9.5-12.5mm
1	13	1B2	Scombridae	atlas	A	9.5-12.5mm
4	13	1B2	Serranidae	caudal vertebra	A	9.5-12.5mm
1	13	1B2	Serranidae	precaudal vertebra	A	9.5-12.5mm
1	13	1B2	Serranidae	thoracic vertebra	A	9.5-12.5mm
22	13	1B2	Unknown	caudal vertebra	A	9.5-12.5mm, 4 are burned
1	13	1B2	Unknown	thoracic vertebra	A	9.5-12.5mm
1	13	1B2	Unknown	precaudal vertebra	A	9.5-12.5mm
3	13	1B2	*Scombridae	caudal vertebra	A	>12.5mm, *2 are similar, but not exact
1	13	1B2	Carangidae	caudal vertebra	A	>12.5mm
8	13	1B2	Serranidae	caudal vertebra	A	>12.5mm
1	13	1B2	Serranidae	atlas	A	>12.5mm
1	13	1B2	Serranidae	precaudal vertebra	A	>12.5mm
3	13	1B2	Unknown	caudal vertebra	A	>12.5mm
1	13	1B2	Unknown	atlas	A	>12.5mm
1	13	1B2	Unknown	thoracic vertebra	A	>12.5mm
16	13	1C	Acanthuridae	spine		
2	13	1C	Balistidae	tooth		
3	13	1C	Balistidae	spine		
2	13	1C	Balistidae	premaxilla	R	
1	13	1C	Balistidae	premaxilla	L	
2	13	1C	Balistidae	spine		
1	13	1C	Balistidae*	quadrate	L	*most similar to Balistidae
6	13	1C	Balistidae*	quadrate	R	*most similar to Balistidae
1	13	1C	Carangidae	dentary	R	
1	13	1C	Carangidae	scapula		fragmented
1	13	1C	Carangidae	hyomandibular	L	

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	13	1C	Carangidae	maxilla	L	
1	13	1C	Diodontidae	lower pharyngeal plate	A	
1	13	1C	Squalomorphii	tooth		
1	13	1C	Ephippidae	hyomandibular	R	
4	13	1C	Haemulidae	premaxilla	R	
4	13	1C	Haemulidae	premaxilla	L	
4	13	1C	Haemulidae	maxilla	L	
3	13	1C	Haemulidae	ceratohyal	L	
2	13	1C	Haemulidae	ceratohyal	R	
1	13	1C	Haemulidae	maxilla	L	
1	13	1C	Haemulidae	angular	R	
3	13	1C	Haemulidae	angular	L	
1	13	1C	Haemulidae	otolith	L	
1	13	1C	Haemulidae	hyomandibular	R	
1	13	1C	Haemulidae	scapula		fragmented
1	13	1C	Labridae	lower pharyngeal plate	A	
1	13	1C	Labridae	premaxilla	L	
1	13	1C	Labridae	premaxilla	R	
2	13	1C	Labridae	maxilla	L	
1	13	1C	Labridae	ultimate		
1	13	1C	Unknown	epihyal	L	
2	13	1C	Unknown	epihyal	R	
2	13	1C	Lutjanidae	premaxilla	R	
1	13	1C	Lutjanidae	premaxilla	L	
1	13	1C	Lutjanidae	maxilla	R	
2	13	1C	Lutjanidae	maxilla	L	
2	13	1C	Lutjanidae	angular	R	
1	13	1C	Lutjanidae	scapula	R	
1	13	1C	Lutjanidae	dentary	R	
1	13	1C	Lutjanidae	hyomandibular	R	
1	13	1C	Lutjanidae	epihyal	L	
1	13	1C	Lutjanidae	epihyal	R	
8	13	1C	Scaridae	premaxilla	L	

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
6	13	1C	Scaridae	premaxilla	R	
4	13	1C	Scaridae	dentary	R	
2	13	1C	Scaridae	dentary	L	
1	13	1C	Scaridae	dentary		fragmented
1	13	1C	Scaridae	ultimate	A	
4	13	1C	Scaridae	scapula	R	
4	13	1C	Scaridae	scapula	L	
1	13	1C	Scaridae	quadrate	R	
2	13	1C	Scaridae	hyomandibular	R	
1	13	1C	Scaridae	hyomandibular	L	
1	13	1C	Scaridae	ultimate	A	
1	13	1C	Scaridae	scapula	L	
2	13	1C	Scaridae (scarus)	upper pharyngeal plate		fragmented
7	13	1C	Scaridae (sparisoma)	lower pharyngeal plate	A	
6	13	1C	Scaridae (sparisoma)	upper pharyngeal plate	L	
4	13	1C	Scaridae (sparisoma)	upper pharyngeal plate	R	
11	13	1C	Scaridae (sparisoma)	upper pharyngeal plate		fragmented
3	13	1C	Scaridae (sparisoma)	maxilla	L	
2	13	1C	Scaridae (sparisoma)	maxilla	R	
1	13	1C	Scombridae	maxilla	L	
4	13	1C	Serranidae	premaxilla	L	
1	13	1C	Serranidae	premaxilla	R	
5	13	1C	Serranidae	maxilla	L	
6	13	1C	Serranidae	maxilla	R	
1	13	1C	Serranidae	premaxilla	L	
5	13	1C	Serranidae	dentary	L	
2	13	1C	Serranidae	dentary	R	
3	13	1C	Serranidae	palatine	L	
2	13	1C	Serranidae	palatine	R	
2	13	1C	Serranidae	postemporal	R	
2	13	1C	Serranidae	hyomandibular	R	
2	13	1C	Serranidae	hyomandibular	L	
1	13	1C	Serranidae	scapula	R	

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	13	1C	Serranidae	epihyal	R	
1	13	1C	Serranidae	epihyal	L	
3	13	1C	Serranidae	angular	R	
6	13	1C	Serranidae	angular	L	
1	13	1C	Serranidae	quadrate	L	
7	13	1C	Serranidae	quadrate	R	
1	13	1C	Serranidae	epihyal	R	
1	13	1C	Serranidae	spine	A	
1	13	1C	Unknown	opercle	R	
2	13	1C	Unknown	maxilla	L	
1	13	1C	Unknown	maxilla	R	
1	13	1C	Unknown	parasphenoid	A	
11	13	1C	Unknown	opercle		fragmented
4	13	1C	Unknown	opercle		fragmented
8	13	1C	Unknown	hyomandibular		fragmented
2	13	1C	Unknown	hyomandibular	L	
1	13	1C	Unknown	hyomandibular	R	
1	13	1C	Unknown	hyomandibular		highly fragmented
22	13	1C	Unknown	dentition fragment		
4	13	1C	Unknown	ultimate	A	
1	13	1C	Unknown	otolith		
1	13	1C	Unknown	postemporal	R	
1	13	1C	Unknown	postemporal	L	
1	13	1C	Unknown	dentary	L	
2	13	1C	Unknown	dentary	R	
2	13	1C	Unknown	quadrate	R	
4	13	1C	Unknown	quadrate	L	
1	13	1C	Unknown	scapula	L	
4	13	1C	Unknown	scapula	R	
1	13	1C	Unknown	palatine	L	
3	13	1C	Unknown	palatine	R	
10	13	1C	Acanthuridae	caudal vertebra	A	<4mm
4	13	1C	Acanthuridae	precaudal vertebra	A	<4mm

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
2	13	1C	Belonidae	precaudal vertebra	A	<4mm
1	13	1C	Belonidae	caudal vertebra	A	<4mm
7	13	1C	Carangidae	caudal vertebra	A	<4mm
3	13	1C	Carangidae	caudal vertebra	A	<4mm
11	13	1C	Haemulidae	caudal vertebra	A	<4mm
3	13	1C	Haemulidae	precaudal vertebra	A	<4mm
13	13	1C	Unknown	caudal vertebra	A	<4mm
12	13	1C	Serranidae	caudal vertebra	A	<4mm
3	13	1C	Serranidae	thoracic vertebra	A	<4mm
1	13	1C	Serranidae	atlas	A	<4mm
22	13	1C	Sparidae	caudal vertebra	A	<4mm
2	13	1C	Sparidae	precaudal vertebra	A	<4mm
1	13	1C	Sphyranidae	caudal vertebra	A	<4mm
1	13	1C	Unknown	atlas	A	<4mm
26	13	1C	Unknown	caudal vertebra	A	<4mm
22	13	1C	Unknown	precaudal vertebra	A	<4mm
9	13	1C	Unknown	thoracic vertebra	A	<4mm
4	13	1C	Acanthuridae	precaudal vertebra	A	4-4.75mm
42	13	1C	Acanthuridae	caudal vertebra	A	4-4.75mm
1	13	1C	Carangidae	caudal vertebra	A	4-4.75mm
4	13	1C	Haemulidae	caudal vertebra	A	4-4.75mm
16	13	1C	Unknown	caudal vertebra	A	4-4.75mm
1	13	1C	Lutjanidae	thoracic vertebra	A	4-4.75mm
1	13	1C	Serranidae	thoracic vertebra	A	4-4.75mm
4	13	1C	Serranidae	precaudal vertebra	A	4-4.75mm
13	13	1C	Serranidae	caudal vertebra	A	4-4.75mm
3	13	1C	Sphyraenidae	caudal vertebra	A	4-4.75mm
14	13	1C	Unknown	caudal vertebra	A	4-4.75mm
2	13	1C	Unknown	precaudal vertebra	A	4-4.75mm
12	13	1C	Unknown	thoracic vertebra	A	4-4.75mm
23	13	1C	Acanthuridae	caudal vertebra	A	4.75-6.3mm
3	13	1C	Acanthuridae	precaudal vertebra	A	4.75-6.3mm
1	13	1C	Balistidae	thoracic vertebra	A	4.75-6.3mm

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
3	13	1C	Belonidae	caudal vertebra	A	4.75-6.3mm
1	13	1C	Belonidae	thoracic vertebra	A	4.75-6.3mm
2	13	1C	Carangidae	caudal vertebra	A	4.75-6.3mm
5	13	1C	Haemulidae	caudal vertebra	A	4.75-6.3mm
1	13	1C	Haemulidae	precaudal vertebra	A	4.75-6.3mm
1	13	1C	Haemulidae	atlas	A	4.75-6.3mm
29	13	1C	Unknown	caudal vertebra	A	4.75-6.3mm
1	13	1C	Unknown	thoracic vertebra	A	4.75-6.3mm
2	13	1C	Scaridae	caudal vertebra	A	4.75-6.3mm
13	13	1C	Serranidae	caudal vertebra	A	4.75-6.3mm
4	13	1C	Serranidae	precaudal vertebra	A	4.75-6.3mm
4	13	1C	Serranidae	thoracic vertebra	A	4.75-6.3mm
3	13	1C	Sparidae	caudal vertebra	A	4.75-6.3mm
3	13	1C	Unknown	thoracic vertebra	A	4.75-6.3mm
2	13	1C	Unknown	precaudal vertebra	A	4.75-6.3mm
2	13	1C	Unknown	atlas	A	4.75-6.3mm
77	13	1C	Unknown	caudal vertebra	A	4.75-6.3mm
12	13	1C	Acanthuridae	caudal vertebra	A	6.3-8mm
1	13	1C	Acanthuridae	thoracic vertebra	A	6.3-8mm
2	13	1C	Acanthuridae	precaudal vertebra	A	6.3-8mm
1	13	1C	Balistidae	caudal vertebra	A	6.3-8mm
2	13	1C	Balistidae	thoracic vertebra	A	6.3-8mm, fused together
1	13	1C	Belonidae	caudal vertebra	A	6.3-8mm
3	13	1C	Carangidae	caudal vertebra	A	6.3-8mm
1	13	1C	Carangidae	caudal vertebra	A	6.3-8mm
1	13	1C	Diodontidae	caudal vertebra	A	6.3-8mm
1	13	1C	Haemulidae	caudal vertebra	A	6.3-8mm
1	13	1C	Haemulidae	atlas	A	6.3-8mm
12	13	1C	Unknown	caudal vertebra	A	6.3-8mm
9	13	1C	Unknown	caudal vertebra	A	6.3-8mm
1	13	1C	Unknown	thoracic vertebra	A	6.3-8mm
4	13	1C	Scaridae	caudal vertebra	A	6.3-8mm
1	13	1C	Scombridae	caudal vertebra	A	6.3-8mm

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
9	13	1C	Serranidae	caudal vertebra	A	6.3-8mm
1	13	1C	Serranidae	atlas	A	6.3-8mm
1	13	1C	Serranidae	precaudal vertebra	A	6.3-8mm
10	13	1C	Sparidae	caudal vertebra	A	6.3-8mm
3	13	1C	Sphyraenidae	caudal vertebra	A	6.3-8mm
4	13	1C	Unknown	precaudal vertebra	A	6.3-8mm
11	13	1C	Unknown	thoracic vertebra	A	6.3-8mm
39	13	1C	Unknown	caudal vertebra	A	6.3-8mm
2	13	1C	Acanthuridae	precaudal vertebra	A	8-9.5mm
2	13	1C	Acanthuridae	caudal vertebra	A	8-9.5mm
1	13	1C	Haemulidae	precaudal vertebra	A	8-9.5mm
8	13	1C	Labridae	caudal vertebra	A	8-9.5mm
2	13	1C	Scaridae	caudal vertebra	A	8-9.5mm
2	13	1C	Scombridae	caudal vertebra	A	8-9.5mm
1	13	1C	Scombridae	thoracic vertebra	A	8-9.5mm
3	13	1C	Serranidae	caudal vertebra	A	8-9.5mm
1	13	1C	Serranidae	thoracic vertebra	A	8-9.5mm
5	13	1C	Sparidae	caudal vertebra	A	8-9.5mm
3	13	1C	Sparidae	precaudal vertebra	A	8-9.5mm
26	13	1C	Unknown	caudal vertebra	A	8-9.5mm, 4 are burned
2	13	1C	Belonidae	caudal vertebra	A	9.5-12.5mm
2	13	1C	Carangidae	caudal vertebra	A	9.5-12.5mm
1	13	1C	Diodontidae	caudal vertebra	A	9.5-12.5mm
1	13	1C	Haemulidae	caudal vertebra	A	9.5-12.5mm
1	13	1C	Labridae	thoracic vertebra	A	9.5-12.5mm
3	13	1C	Labridae	thoracic vertebra	A	9.5-12.5mm
1	13	1C	Labridae	precaudal vertebra	A	9.5-12.5mm
17	13	1C	Labridae	caudal vertebra	A	9.5-12.5mm
9	13	1C	Scombridae	caudal vertebra	A	9.5-12.5mm
7	13	1C	Serranidae	caudal vertebra	A	9.5-12.5mm
1	13	1C	Serranidae	precaudal vertebra	A	9.5-12.5mm
1	13	1C	Serranidae	thoracic vertebra	A	9.5-12.5mm
4	13	1C	Unknown	caudal vertebra	A	9.5-12.5mm

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
3	13	1C	Unknown	caudal vertebra	A	>12.5mm
7	13	1C	Serranidae	caudal vertebra	A	>12.5mm
2	13	1C	Serranidae	precaudal vertebra	A	>12.5mm
1	13	1C	Serranidae	thoracic vertebra	A	>12.5mm
4	13	1C	Unknown	caudal vertebra	A	>12.5mm
2	13	2	Acanthuridae	spine	A	
1	13	2	Balistidae*	quadrate	L	*most similar to Balistidae
1	13	2	Balistidae*	quadrate	R	*most similar to Balistidae
1	13	2	Carangidae	dentary	R	
1	13	2	Carangidae	dentary	L	
2	13	2	Haemulidae	premaxilla	L	
1	13	2	Haemulidae	premaxilla	R	
1	13	2	Haemulidae	otolith	R	
1	13	2	Labridae	lower pharyngeal plate	A	
1	13	2	Labridae	dentary		fragmented
1	13	2	Unknown	epihyal	L	
1	13	2	Lutjanidae	premaxilla	L	
3	13	2	Scaridae	upper pharyngeal plate	R	
1	13	2	Scaridae	upper pharyngeal plate		fragmented
1	13	2	Scaridae (scarus)	premaxilla	R	
1	13	2	Scaridae (scarus)	premaxilla	L	
3	13	2	Scaridae (sparisoma)	lower pharyngeal plate	A	
2	13	2	Scaridae (sparisoma)	maxilla	R	
3	13	2	Serranidae	dentary	R	
1	13	2	Serranidae	dentary	L	
3	13	2	Serranidae	quadrate	L	
1	13	2	Serranidae	angular	L	
1	13	2	Serranidae	angular	R	
2	13	2	Serranidae	ceratohyal	R	
2	13	2	Serranidae	ceratohyal	L	
1	13	2	Serranidae	hyomandibular	R	
1	13	2	Serranidae	postemporal	L	
1	13	2	Sparidae	premaxilla	L	

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	13	2	Unknown	preopercle		fragmented
4	13	2	Unknown	ultimate	A	highly fragmented
2	13	2	Unknown	hyomandibular	L	
1	13	2	Unknown	maxilla	R	highly fragmented
7	13	2	Unknown	dentition fragment		
1	13	2	Unknown	postemporal	R	
1	13	2	Unknown	opercle		
1	13	2	Unknown	supracleithrum		
1	13	2	Unknown	epihyal		fragmented
1	13	2	Unknown	angular	R	degradated
3	13	2	Unknown	palatine	L	
2	13	2	Unknown	quadrate	L	
1	13	2	Acanthuridae	caudal vertebra	A	<4mm
1	13	2	Haemulidae	caudal vertebra	A	<4mm
1	13	2	Sphyraenidae	caudal vertebra	A	<4mm
9	13	2	Unknown	caudal vertebra	A	<4mm
1	13	2	Unknown	thoracic vertebra	A	<4mm
1	13	2	Acanthuridae	caudal vertebra	A	4-4.75mm
3	13	2	Carangidae	caudal vertebra	A	4-4.75mm
1	13	2	Unknown	caudal vertebra	A	4-4.75mm
2	13	2	Serranidae	caudal vertebra	A	4-4.75mm
1	13	2	Acanthuridae	caudal vertebra	A	4.75-6.3mm
1	13	2	Acanthuridae	precaudal vertebra	A	4.75-6.3mm
1	13	2	Balistidae	thoracic vertebra	A	4.75-6.3mm
1	13	2	Belonidae	caudal vertebra	A	4.75-6.3mm
1	13	2	Belonidae	precaudal vertebra	A	4.75-6.3mm
2	13	2	Unknown	caudal vertebra	A	4.75-6.3mm
3	13	2	Scaridae	caudal vertebra	A	4.75-6.3mm
2	13	2	Scaridae	thoracic vertebra	A	4.75-6.3mm
1	13	2	Serranidae	caudal vertebra	A	4.75-6.3mm
1	13	2	Sparidae	caudal vertebra	A	4.75-6.3mm
1	13	2	Unknown	precaudal vertebra	A	4.75-6.3mm
7	13	2	Unknown	caudal vertebra	A	4.75-6.3mm

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Number	Unit	Level	Family	Element	Side	Notes (measurement, partial element, burning, etc.)
1	13	2	Acanthuridae	caudal vertebra	A	6.3-8mm
1	13	2	Haemulidae	precaudal vertebra	A	6.3-8mm
1	13	2	Labridae	thoracic vertebra	A	6.3-8mm
2	13	2	Unknown	caudal vertebra	A	6.3-8mm
3	13	2	Scombridae	caudal vertebra	A	6.3-8mm
1	13	2	Serranidae	atlas	A	6.3-8mm
1	13	2	Serranidae	thoracic vertebra	A	6.3-8mm
1	13	2	Serranidae	atlas	A	6.3-8mm
3	13	2	Sparidae	caudal vertebra	A	6.3-8mm
2	13	2	Unknown	precaudal vertebra	A	6.3-8mm
6	13	2	Unknown	caudal vertebra	A	6.3-8mm
1	13	2	Scombridae	caudal vertebra	A	8-9.5mm
1	13	2	Serranidae	atlas	A	8-9.5mm
1	13	2	Serranidae	thoracic vertebra	A	8-9.5mm
1	13	2	Sparidae	caudal vertebra	A	8-9.5mm
1	13	2	Unknown	caudal vertebra	A	8-9.5mm
1	13	2	Labridae	caudal vertebra	A	9.5-12.5mm
4	13	2	Scombridae	caudal vertebra	A	9.5-12.5mm
1	13	2	Scombridae	thoracic vertebra	A	9.5-12.5mm
1	13	2	Serranidae	thoracic vertebra	A	9.5-12.5mm
1	13	2	Sparidae	caudal vertebra	A	9.5-12.5mm
2	13	2	Unknown	caudal vertebra	A	9.5-12.5mm
1	13	2	Scombridae	thoracic vertebra	A	>12.5mm

Appendix B-Fish Vertebral Data

		>12.5		9.5-12.5		8-9.4		6.3-7.9		4.75-6.2		4-4.74		<4		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Unit 1	Level 1	0	0.0	1	3.8	4	15.4	3	11.5	6	23.1	1	3.8	11	42.3	26	2.3
	Level 2	0	0.0	5	7.6	2	3.0	10	15.2	15	22.7	7	10.6	27	40.9	66	5.7
	Level 3	5	0.8	46	7.1	80	12.4	164	25.5	92	14.3	127	19.7	130	20.2	644	56.0
	Level 4	2	0.5	21	5.6	28	7.5	47	12.5	85	22.7	49	13.1	143	38.1	375	32.6
	Level 5	0	0.0	3	7.9	1	2.6	5	13.2	14	36.8	6	15.8	9	23.7	38	3.3
	Total	7	0.6	76	6.6	115	10.0	229	19.9	212	18.5	190	16.5	320	27.9	1149	100.0
Unit 2	Level 1	0	0.0	1	1.6	1	1.6	8	12.5	15	23.4	9	14.1	30	46.9	64	7.2
	Level 2	0	0.0	7	5.5	3	2.4	11	8.7	34	26.8	28	22.0	44	34.6	127	14.3
	Level 3	5	0.8	20	3.2	35	5.6	97	15.5	142	22.8	123	19.7	202	32.4	624	70.2
	Level 4	0	0.0	3	37.5	0	0.0	3	37.5	1	12.5	1	12.5	0	0.0	8	0.9
	Level 5	2	3.0	3	4.5	13	19.7	6	9.1	15	22.7	12	18.2	15	22.7	66	7.4
	Total	7	0.8	34	3.8	52	5.8	125	14.1	207	23.3	173	19.5	291	32.7	889	100.0
Unit 3	Level 1	0	0.0	0	0.0	1	1.6	4	6.5	5	8.1	20	32.3	32	51.6	62	12.7
	Level 2	2	0.9	11	4.7	12	5.1	31	13.2	67	28.6	28	12.0	83	35.5	234	48.0
	Level 3	4	2.1	22	11.5	25	13.0	39	20.3	42	21.9	25	13.0	35	18.2	192	39.3
	Total	6	1.2	33	6.8	38	7.8	74	15.2	114	23.4	73	15.0	150	30.7	488	100.0
Unit 4	Level 1	1	0.7	6	4.3	4	2.9	23	16.4	55	39.3	27	19.3	24	17.1	140	10.6
	Level 2	8	0.8	40	4.1	61	6.3	90	9.3	153	15.8	182	18.8	435	44.9	969	73.5
	Level 3	3	1.4	14	6.8	14	6.8	47	22.7	56	27.1	34	16.4	39	18.8	207	15.7
	Level 4	0	0.0	0	0.0	0	0.0	0	0.0	1	33.3	0	0.0	2	66.7	3	0.2
	Total	12	0.9	60	4.5	79	6.0	160	12.1	265	20.1	243	18.4	500	37.9	1319	100.0
Unit 5	Level 1	1	1.4	3	4.2	3	4.2	9	12.5	10	13.9	11	15.3	35	48.6	72	11.6
	Level 2	0	0.0	3	0.7	7	1.6	27	6.3	49	11.3	79	18.3	267	61.8	432	69.7
	Level 3	0	0.0	0	0.0	1	14.3	0	0.0	1	14.3	1	14.3	4	57.1	7	1.1
	Level 4	0	0.0	5	4.6	7	6.4	0	0.0	20	18.3	23	21.1	54	49.5	109	17.6
	Total	1	0.2	11	1.8	18	2.9	36	5.8	80	12.9	114	18.4	360	58.1	620	100.0
Unit 6	Level 1	0	0.0	3	9.7	1	3.2	9	29.0	9	29.0	1	3.2	8	25.8	31	13.0
	Level 2	0	0.0	8	10.7	10	13.3	23	30.7	26	34.7	5	6.7	3	4.0	75	31.5
	Level 3	3	2.3	12	9.3	24	18.6	29	22.5	29	22.5	20	15.5	12	9.3	129	54.2
	Level 4	0	0.0	0	0.0	2	66.7	1	33.3	0	0.0	0	0.0	0	0.0	3	1.3
	Total	3	1.3	23	9.7	37	15.5	62	26.1	64	26.9	26	10.9	23	9.7	238	100.0
Unit 7	Level 1	1	2.0	1	2.0	3	6.0	13	26.0	21	42.0	6	12.0	5	10.0	50	16.1
	Level 2	6	5.2	14	12.2	11	9.6	34	29.6	27	23.5	8	7.0	15	13.0	115	37.1
	Level 3	3	2.1	14	9.7	19	13.1	37	25.5	35	24.1	18	12.4	19	13.1	145	46.8
	Total	10	3.2	29	9.4	33	10.6	84	27.1	83	26.8	32	10.3	39	12.6	310	100.0
Unit 8	Level 1	0	0.0	0	0.0	0	0.0	4	16.0	8	32.0	5	20.0	8	32.0	25	1.0
	Level 2	0	0.0	3	2.6	7	6.1	13	11.4	31	27.2	23	20.2	37	32.5	114	4.8
	Level 3	19	4.7	39	9.7	42	10.4	88	21.9	113	28.1	44	10.9	57	14.2	402	16.8
	Level 4	3	0.2	33	1.8	76	4.1	227	12.3	534	29.0	409	22.2	559	30.4	1841	77.1
	Level 5	0	0.0	1	20.0	1	20.0	0	0.0	3	60.0	0	0.0	0	0.0	5	0.2
	Total	22	0.9	76	3.2	126	5.3	332	13.9	689	28.9	481	20.2	661	27.7	2387	100.0
Unit 9	Level 1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Level 2	0	0.0	0	0.0	0	0.0	2	12.5	6	37.5	2	12.5	6	37.5	16	100.0
	Level 3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	0	0.0	0	0.0	0	0.0	2	12.5	6	37.5	2	12.5	6	37.5	16	100.0
Unit 10	Level 1	0	0.0	0	0.0	0	0.0	2	16.7	1	8.3	6	50.0	3	25.0	12	32.4
	Level 2	0	0.0	0	0.0	2	13.3	2	13.3	3	20.0	5	33.3	3	20.0	15	40.5
	Level 3	0	0.0	0	0.0	1	10.0	1	10.0	6	60.0	0	0.0	2	20.0	10	27.0
	Total	0	0.0	0	0.0	3	8.1	5	13.5	10	27.0	11	29.7	8	21.6	37	100.0

Appendix B-Fish Vertebral Data

		>12.5		9.5-12.5		8-9.4		6.3-7.9		4.75-6.2		4-4.74		<4		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Unit 11	Level 1	0	0.0	0	0.0	0	0.0	0	0.0	4	25.0	5	31.3	7	43.8	16	23.2
	Level 2	0	0.0	0	0.0	0	0.0	4	12.9	5	16.1	4	12.9	18	58.1	31	44.9
	Level 3	0	0.0	0	0.0	0	0.0	1	8.3	2	16.7	1	8.3	8	66.7	12	17.4
	Level 4	1	10.0	1	10.0	0	0.0	0	0.0	3	30.0	3	30.0	2	20.0	10	14.5
	Total	1	1.4	1	1.4	0	0.0	5	7.2	14	20.3	13	18.8	35	50.7	69	100.0
Unit 12	Level 1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	20.0	4	80.0	5	7.6
	Level 2	0	0.0	0	0.0	0	0.0	3	18.8	1	6.3	4	25.0	8	50.0	16	24.2
	Level 3	0	0.0	0	0.0	0	0.0	2	6.7	5	16.7	10	33.3	13	43.3	30	45.5
	Level 4	0	0.0	1	6.7	2	13.3	1	6.7	5	33.3	2	13.3	4	26.7	15	22.7
	Total	0	0.0	1	1.5	2	3.0	6	9.1	11	16.7	17	25.8	29	43.9	66	100.0
Unit 13	Level 1A	0	0.0	4	2.3	7	4.1	19	11.1	35	20.5	31	18.1	75	43.9	171	8.3
	Level 1B	3	1.4	7	3.2	7	3.2	11	5.0	85	38.8	39	17.8	67	30.6	219	10.7
	Level 1B	19	2.2	75	8.6	80	9.2	136	15.6	186	21.3	135	15.4	243	27.8	874	42.7
	Level 1C	17	2.4	50	7.1	56	8.0	131	18.6	180	25.6	117	16.6	153	21.7	704	34.4
	Level 2	1	1.3	10	12.5	5	6.3	22	27.5	22	27.5	7	8.8	13	16.3	80	3.9
	Total	40	2.0	146	7.1	155	7.6	319	15.6	508	24.8	329	16.1	551	26.9	2048	100.0
Unit 14	Level 1A	0	0.0	12	5.7	15	7.2	18	8.6	77	36.8	50	23.9	37	17.7	209	20.0
	Level 1B	13	1.9	62	8.9	71	10.2	116	16.6	83	11.9	56	8.0	296	42.5	697	66.6
	Level 1C	3	2.2	9	6.7	13	9.7	28	20.9	37	27.6	22	16.4	22	16.4	134	12.8
	Level 2	0	0.0	0	0.0	0	0.0	0	0.0	4	57.1	0	0.0	3	42.9	7	0.7
	Total	16	1.5	83	7.9	99	9.5	162	15.5	201	19.2	128	12.2	358	34.2	1047	100.0
Unit 15	Level 1	4	1.7	15	6.4	23	9.9	25	10.7	61	26.2	54	23.2	51	21.9	233	66.4
	Level 2	1	1.0	5	4.8	10	9.5	10	9.5	31	29.5	23	21.9	25	23.8	105	29.9
	Level 3A	1	12.5	1	12.5	1	12.5	1	12.5	1	12.5	2	25.0	1	12.5	8	2.3
	Level 3B	0	0.0	0	0.0	0	0.0	0	0.0	3	75.0	1	25.0	0	0.0	4	1.1
	Level 3C	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	1	0.3
	Total	6	1.7	21	6.0	34	9.7	36	10.3	97	27.6	80	22.8	77	21.9	351	100.0
Unit 16	Level 1A	1	0.7	8	5.4	7	4.7	14	9.5	53	35.8	24	16.2	41	27.7	148	22.9
	Level 1B	3	3.4	3	3.4	5	5.7	10	11.4	21	23.9	18	20.5	28	31.8	88	13.6
	Level 2	4	1.4	23	8.1	19	6.7	51	18.0	82	28.9	76	26.8	29	10.2	284	44.0
	Level 3A	1	0.8	3	2.5	9	7.4	9	7.4	23	18.9	27	22.1	50	41.0	122	18.9
	Level 3B	0	0.0	0	0.0	0	0.0	1	50.0	0	0.0	1	50.0	0	0.0	2	0.3
	Level 3C	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Level 3D	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	1	0.2
	Total	9	1.4	37	5.7	40	6.2	85	13.2	180	27.9	146	22.6	148	22.9	645	100.0
Unit 17	Level 1	0	0.0	0	0.0	0	0.0	1	6.3	4	25.0	4	25.0	7	43.8	16	41.0
	Level 2	0	0.0	2	20.0	1	10.0	2	20.0	0	0.0	2	20.0	3	30.0	10	25.6
	Level 3	0	0.0	1	10.0	1	10.0	1	10.0	6	60.0	0	0.0	1	10.0	10	25.6
	Level 4	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0	1	33.3	1	33.3	3	7.7
	Total	0	0.0	3	7.7	3	7.7	4	10.3	10	25.6	7	17.9	12	30.8	39	100.0

Appendix C
Shellfish Catalogue

Species/Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**Total**
Bivalve																		
Donax denticulatus	15	0	0	0	11	0	0	0	0	0	20	32	793	930	579	439	0	**2819**
Arca zebra	0	1	0	0	0	0	0	0	0	0	40	28	44	118	151	32	1	**415**
"Thick Lucine"	0	1	0	0	5	0	8	2	0	0	0	0	90	12	47	3	3	**171**
Spondylus americanus	11	4	8	18	108	6	35	23	3	0	0	0	6	45	16	21	6	**310**
Phacoides pectinata	0	0	8	0	1	0	0	0	0	0	0	0	4	44	23	0	0	**80**
Chione paphia	0	0	0	1	0	0	2	0	0	0	0	0	18	0	0	48	0	**69**
Codakia orbicularis	0	0	0	0	5	0	0	0	1	4	4	15	14	11	10	1	6	**71**
Pinctada radiata	0	0	0	0	7	0	0	0	0	0	0	0	0	1	60	0	0	**68**
Antigona listeri	0	0	0	0	0	0	0	0	0	0	0	0	1	54	2	3	0	**60**
Anadara notabilis	0	0	0	0	0	0	0	0	0	0	0	5	6	5	0	14	0	**30**
Chama macerophylla	0	0	2	0	1	0	0	0	0	0	0	0	1	8	0	5	0	**17**
Lima scabra	0	0	0	0	0	0	0	0	0	0	0	0	6	1	1	0	0	**8**
Crepidula sp.	0	0	0	0	1	0	0	0	3	0	0	0	0	3	0	0	0	**7**
Lyropecten nodosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	**2**
Andara brazilensis	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Gastropoda																		
Cittarium pica	283	230	266	351	415	131	458	87	93	211	40	129	1018	1513	752	625	467	**7069**
Nerita sp.	14	8	25	4	19	3	10	5	0	2	29	46	90	146	134	150	0	**685**
Strombus gigas	7	3	38	45	35	4	76	0	19	26	0	3	12	42	54	17	23	**404**
Tectarius muricatus	29	27	35	0	33	0	0	4	8	6	0	0	32	30	17	17	10	**248**
Landsnails	15	116	21	0	0	0	0	12	11	0	0	0	0	0	0	59	0	**234**

Appendix C
Shellfish Catalogue

Species/Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**Total**
Limpets	7	13	2	1	6	0	3	3	0	1	0	1	5	9	1	5	1	**58**
Astrea caelata	3	3	3	0	3	0	8	0	2	0	0	4	3	2	0	6	2	**39**
Olivia sp.	4	10	1	0	3	2	0	7	0	0	1	1	5	2	4	1	0	**41**
Columbella mercatoria	11	6	13	6	9	5	14	0	0	0	0	2	6	0	1	0	0	**73**
Natica canrena	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	4	0	**8**
Cypraecassis testiculus	0	0	0	0	0	0	0	0	0	0	0	0	1	0	6	0	0	**7**
Cymatium pileare	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	2	**7**
Murex brevifrons	0	1	2	3	0	0	5	4	0	0	0	0	0	1	0	2	2	**20**
Strombus pugilis	0	6	2	0	2	6	5	2	0	0	0	0	3	0	1	0	0	**27**
Cassias sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	**3**
Conus sp.	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	**2**
Chyphoma gibbosum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	**2**
Echinoderm																		
Sea Urchin	0	0	0	0	0	0	0	0	0	0	0	4	0	88	39	128	0	**259**
Polyplacophora																		
Chiton sp.	13	0	0	6	5	0	8	0	0	1	6	4	46	93	86	50	1	**319**
Coral	10	0	0	0	20	0	0	0	14	5	29	37	98	77	30	26	67	**413**
Unknown	77	185	7	6	373	0	13	342	20	176	162	284	1679	1038	783	360	307	**5812**
Total	**499**	**651**	**434**	**472**	**1067**	**159**	**673**	**524**	**183**	**443**	**342**	**607**	**3996**	**4290**	**2820**	**2035**	**916**	**20111**

Appendix D-Crab Catalouge

Unit	Level	Gearcinidae				Coenobitidae		Weight	Total
#	#	claw	claw tips	carapace frag	walking leg	claw	pincer	(g)	#
1	1	4	2	0	0	0	0	4.6	6
1	2	2	0	3	0	0	1	4.2	5
1	3	764	266	644	5	3	7	1814	1689
1	4	441	131	701	0	2	2	1021	1277
1	5	35	39	80	0	2	0	113.4	156
2	1	0	3	2	0	0	0	2.9	5
2	2	7	1	0	0	0	0	4.5	8
2	3	154	43	218	0	4	1	620	420
2	4	937	209	843	4	4	2	2268	1999
2	5	93	35	29	1	3	1	250	162
3	1	46	17	8	0	4	0	74.3	75
3	2	189	80	75	0	4	0	340.2	348
3	3	282	73	84	0	7	1	453.6	447
3	4	2	1	0	0	0	0	3.7	3
4	1	471	74	303	0	6	1	340.2	855
4	2	963	412	480	0	23	4	1588	1882
4	3	529	186	171	0	17	2	997.9	905
4	4	18	5	11	0	1	0	27.5	35
5	1	2	0	0	0	0	0	1.2	2
5	2	26	2	17	0	0	0	21.8	45
5	3	1057	229	1473	4	25	3	1928	2791
5	4	143	56	251	0	7	1	340.2	458
6	1	56	54	4	0	4	0	162.6	118
6	2	211	123	66	0	4	0	567	404
6	3	333	97	9	0	4	0	567	443
7	1	181	50	84	0	0	1	226.8	316
7	2	457	101	216	0	5	1	567	780
7	3	576	149	434	0	13	0	907.2	1172
8	1	0	1	4	0	0	1	2.3	6
8	3	679	234	390	0	3	2	2164.4	1308
8	4	1250	324	2432	1	17	2	2297	4026
8	5	4	2	4	0	0	0	8.1	10
10	2	6	5	0	0	0	0	8.2	11
10	3	4	7	6	0	3	0	12.8	20
11	4A	0	3	2	0	0	0	7.2	5
11	4B	3	5	0	0	0	0	5.88	3
12	1	1	0	0	0	0	0	2.2	1
12	2	0	3	0	0	0	0	2.9	3
12	3	1	0	1	0	3	0	3.4	4
12	4A	1	0	0	0	5	1	2.6	7
12	4B	0	0	1	0	2	0	1.8	3
13	1A	160	15	9	0	2	6	90.4	192
13	1B1	151	23	11	0	6	8	106.6	199
13	1B2	720	232	128	3	10	17	793.8	1110
13	1C	456	163	322	4	9	20	682.3	974
13	2	12	14	140	0	7	1	48	174
14	1A	174	61	620	0	22	3	181.2	880
14	1B	1163	263	882	4	23	38	1134	2373
14	1C	62	57	214	0	5	5	146.6	343
14	2	6	2	16	0	0	0	11	24

Appendix D-Crab Catalouge

Unit	Level	Gearcinidae				Coenobitidae		Weight	Total
#	#	claw	claw tips	carapace frag	walking leg	claw	pincer	(g)	#
15	1	440	54	369	0	18	5	204.1	886
15	2	290	63	162	0	11	5	204.1	531
15	3	30	9	22	0	0	0	19.7	61
15	3B	7	1	6	0	2	2	6.4	18
15	3C	4	0	3	0	1	1	4.6	9
15	3E	1	0	0	0	0	0	0.74	1
16	1	107	39	180	0	6	4	96.8	336
16	2	201	89	340	0	21	6	188.1	657
16	1B	76	25	64	0	3	0	70.6	168
16	3	79	37	80	0	1	5	74.13	202
16	3B	0	0	6	0	0	0	1.4	6
17	1	2	4	9	0	1	0	9	16
17	2	10	6	0	0	0	1	10.3	17
17	3	15	4	10	0	2	3	10.6	34
17	4	9	5	6	0	1	0	17	21
					SITE TOTAL			**23847.05**	**31445**

*Gecarcinidae-land crab

**Coenobitidae-land hermit crab