STONE-WALLED TIDAL FISH TRAPS: AN ARCHAEOLOGICAL AND ARCHIVAL INVESTIGATION

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Abstract

This thesis investigates whether or not there is an association between Holocene Later Stone Age shell middens and stone-walled tidal fish traps between Cape Agulhas and Still Bay, on the south coast of the Western Cape. These features are known to have a wide distribution but are particularly densely distributed on the south coast, mainly close to historic settlements. Previous research based on the presence of small species of fish from one archaeological site and sea level data have suggested that stone fish traps could be as old as ca. 5 000 B.P. In this thesis, I investigated the antiquity of fish traps by excavating four shell middens located adjacent to fish traps at Cape Agulhas and analysing the contents of these, and of two previously excavated sites at Still Bay. Furthermore, archival research was conducted to obtain as much information as possible about patterns of use of fish traps in historic times. In addition the reports on fish remains from archaeological sites in the Western Cape have been re-evaluated. The results of the archaeological investigation indicated no association between the LSA middens and fish traps and none of the archaeological sites in the literature suggest fishing on the scale normally associated with fish trapping. In contrast, there was a strong link between the building and use of fish traps amongst historic communities along the south coast. Based on the current evidence a pre-colonial age for the practice of fishing with stone-walled tidal fish traps can no longer be entertained.

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CHAPTER 1

Introduction

1.1 Introduction

Stone-walled tidal fish traps (hereafter refered to as fish traps) are a well known feature of the Western Cape coast, especially the south or Indian Ocean coastline (Figs 1.1 and 1.2). Some of these traps are still in use today, but they are generally believed to be of considerable antiquity, some speculating that they could have been in use as early as the mid-Holocene, ca. 5 000 radiocarbon years before present (Poggenpoel 1996). There is, however, little reliable evidence on which to base such claims. The primary aim of this thesis is to examine these features and to evaluate their antiquity in the archaeological record of the Western Cape. The general approach taken in this project is based on Goodwin's (1946: 134) proposal:

> Our only certain method of dating these *vywers* will be the excavation of stratified middens or cave deposits in close association with these traps, and the correlation of stratification with the traps.

At the most recent end of the timescale, the south coast was intensively settled during the latter part of the 19th and early 20th century. Wheat farming and fishing is still the major economic industries. Most people living along the south coast had limited economic resources at their disposal, and fish traps were of considerable importance as a means of feeding themselves and their families. This practice persists, in some areas to this day. This thesis will also investigate the significance of fish traps during the historic period.

Previous research on fish traps has been sporadic and limited to mapping their distribution on the landscape, recording fish catches and assessing living invertebrate populations (Goodwin 1946; Avery 1975, 1976; Gribble 2005; Kemp 2006). The current project focuses specifically on the antiquity of these features. To achieve this goal, several open station shell middens along the south coast in close spatial proximity to fish traps were excavated. The aim was to investigate the depositional history of shell middens close to fish traps, with particular emphasis on the identification and vertical distribution of fish remains. The identification and dating species more likely to have been caught in fish traps than by other means, should give us an indication of the antiquity of the traps.

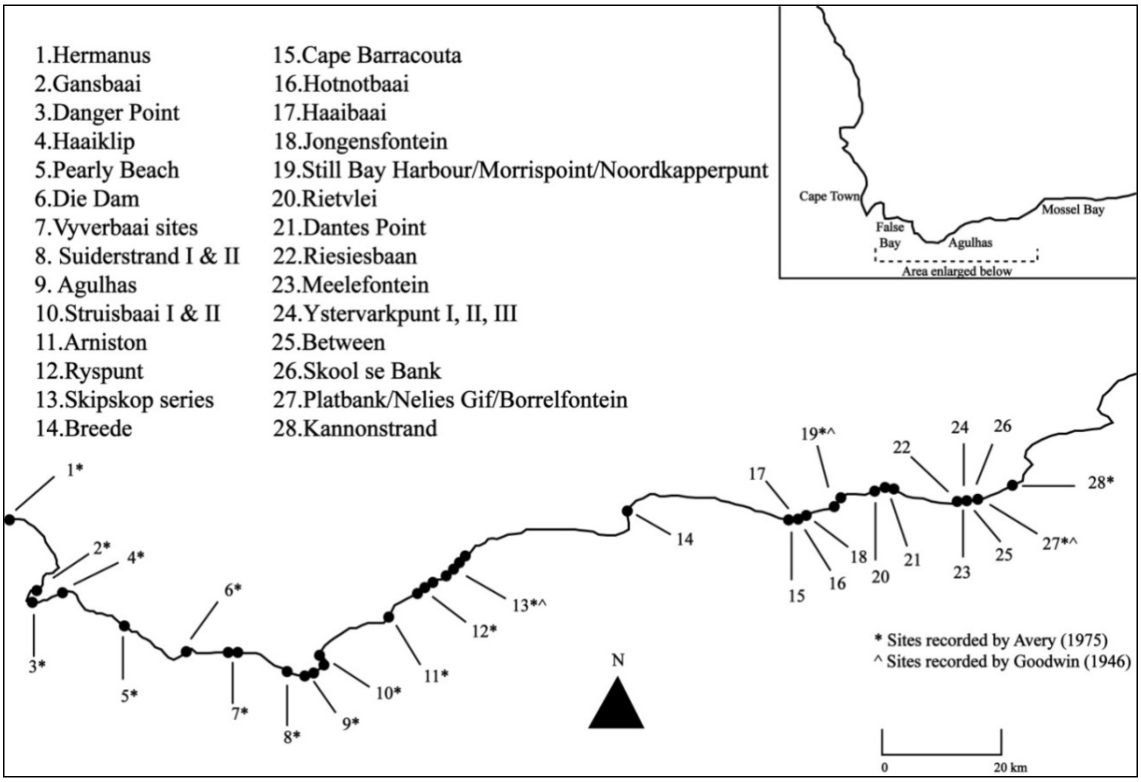


Figure 1.1. Map showing the distribution of stone-walled tidal fish traps along the south coast, adapted from Kemp (2006).

It has been noted that fish are well represented in coastal Holocene sequences of the Western Cape (Hall 1997); yet we know very little about the role they played in prehistoric economies (Poggenpoel 1996; Inskeep 2001; van Niekerk 2004). Material cultural remains relating to fishing are not well represented in southern African archaeological assemblages, and stone sinkers and fish gorges are known from only a few sites (H. J. Deacon 1970; Parkington 1977; Schweitzer & Wilson 1982; Poggenpoel & Robertshaw 1981; Inskeep 1987). It has been postulated that the fish traps along the south coast constitute a prehistoric fishing method of considerable time-depth. The proposed dates ca. 3 000-2 000 B.P (Avery 1975), and 5 000 B.P (Poggenpoel 1996), have wider implications for the understanding of mid-to-late Holocene hunter-gatherers and herders along the south coast. Hunter-gatherers, in particular,

Figure 1.2. Aerial view of fish traps at Noordkapperpunt, Still Bay.

were undergoing fundamental social and economic restructuring during this period. Expressions of this can be seen in the evidence for the practising of delayed return systems; the storage of plant foods in the south eastern Cape (H. J. Deacon 1976; Hall 1990), processing and preservation of shellfish along the west coast (Jerardino 1996), complex ritual behaviour (Hall & Binnerman 1987; Hall 1990, 2000), and increased sedentism and territoriality (Sealy 2006), along the south and south eastern Cape coast. A second important observation is the appearance of pastoralists in the south western Cape ca. 2 000 B.P. If these features date within the last 2 000 years, it is possible that that their appearance might be related to the presence of herders on the landscape, either as a hunter-gatherer response to incoming groups, or a strategy employed by pastoralists.

Fish traps are principally geared towards the exploitation of shoaling species. The species most commonly caught, belong to the *Mugilidae* family (especially *Liza richardsonii* and *Mugil cephalus*), which favour inshore shallows and estuaries and are rarely caught with line and hook (van der Elst 1993). Recent research has shown that up to 100% of catches in fish traps can comprise the southern mullet *Liza richardsonii* (Kemp 2006), although catches of other species have also been recorded, most notably *Coracinus capensis, Sparodon durbanensis, Sarpa salpa* and *Pomatomus saltatrix* (Avery 1975; Kemp 2006). Species of fish reported to have been caught in fish traps are listed in Table 1.1. A wide range of species are present. Previous researchers have suggested that this diversity should be reflected in archaeological assemblages (van Niekerk 2004).

Table 1.1. Species of fish commonly caught in stone fish traps (Avery 1975, 1976; van Niekerk 2004; Kemp 2006).

Mugilidae	**Common name**
Liza richardsonii	Southern Mullet
Mugil cephalus	Flathead Mullet
Sparidae	
Boopsoidea inornata	Fransmadam
Cymatoceps nasutus	Black Musselcracker
Diplodus cervinus hottentotus	Zebra
Diplodus sargus capensis	Blacktail
Lithognathus lithognathus	White Steenbras
Lithognathus mormyrus	Sand Steenbras
Pachymetopon aeneum	Blue Hottentot
Pachymetopon blochii	Hottentot
Rhabdosargus holubi	Cape Stumpnose
Sarpa salpa	Streepie
Sparodon durbanensis	White Musselcracker
Other	
Argyrosomus inordorus/japonicus	Kabeljou
Dichisius capensis	Galjoen
Galeichthys feliceps	White Seacatfish
Pomadasys comersonni	Spotted Grunter
Pomatomus saltatrix	Elf
Seriola lalandi	Cape Yellowtail
Umbrina robeinsoni	Baardman
Sharks and rays	

Since it has been demonstrated that *Liza richardsonii* are most commonly caught in significant quantities, I propose archaeological assemblages do not necessarily need to reflect this diversity. It is postulated here, that assemblages related to fish trapping events should contain large amounts of *Mugilidae spp.,* in particular the southern mullet. Historically, up to 8 000 mullet have been reported from a single trapping event (Haddad 2003) While it is possible that a certain amount of fish may have been preserved on site (such as the modern day drying of mullets, known locally as *bokkoms*) with the intent of transporting them to other locations, evidence of transportation should be visible in the archaeological record. The process of making *bokkoms* can take up to two weeks (Anon 2005), while the minimum period for sun and wind drying fish in this region is 4-5 days, under good weather conditions (Tothill 1899 in lit.). It is expected that processing took place at the coast where the fish were trapped, to prevent spoilage, and that at least some remains of fish should be present in middens as a result of meals during the processing period.

Mullet bone is generally more fragile and prone to deletion from post-depositional processes than larger bodied species. However, considering the large amounts of mullet caught in fish traps in operation today, we can safely assume that if similar quantities were caught in prehistoric times, taphonomic processes ought not to have deleted the presence of this species of fish in archaeological assemblages. A recent study (Nagaoka 2005) demonstrated that the use of 3 mm mesh screens is adequate to ensure recovery of mullet remains from archaeological deposits. All controlled archaeological excavations along the Cape coast, at least during the last forty years, have used 3 mm mesh sieves or smaller. This means that archaeological assemblages recovered during this time can be used to assess the importance of mullet in the faunal remains.

1.2 Previous Research

As mentioned earlier, previous research on fish traps focussed on identifying and mapping their location along the south coast. The first systematic investigation into these features was conducted by A. J. H. Goodwin (1946) in his paper *Prehistoric fishing methods in South Africa.* The stimulus for his paper was rooted in a site he had excavated on the south eastern Cape coast, Oakhurst Shelter (Goodwin 1938), located about 14 km from the coast. In this site there was a marked increase in the frequency of vertebrate fish remains in the Wilton and post-classic Wilton levels (i.e. mid and late Holocene), compared with older layers. Goodwin (1946: 136) writes:

> …coinciding with the normal Wilton and covering the whole local period of the developed and final Wilton, the inhabitants found means of catching fish in quantity and with great regularity.
>
> Vertebrate fish...become an integral and regular part of the diet of these people. Search was made for some form of net-sinker or for a primitive fish-hook, but neither was

> found, nor was there any unusual element found that might conceivably have been used for fishing.

Unfortunately, the fish remains received limited attention in the Oakhurst report, so it is difficult to estimate species diversity and abundance at this site. However, increased reliance on fish during the mid-Holocene at Oakhurst fits well into existing notions that hunter-gatherer groups were undergoing economic restructuring at this time, widening their diet-breadth practices and emphasising small package food items (Hall 1990).

Thirty years later, Graham Avery (1975) published his work on fish traps between Kleinmond and Cape Agulhas. Like Goodwin's earlier work, the focus was also on location and mapping. However, Avery provided important logistical information on the operation and function of the traps. Local informants provided valuable statistics on the species and numbers of fish caught. More contentious was his extrapolation of the seasonal movements of his informants and projection of this data into prehistoric times. Using what was then known about sea-level change, Avery suggested a likely age for fish traps sometime between 3 000-2 000 B.P., when sea levels returned to approximately their present level after the mid-Holocene high.

Another thirty years passed before further work was done on these features. The South African Heritage Resources Agency undertook an extensive mapping and surveying project of fish traps between Mossel Bay and False Bay. One aim of the National Survey of Underwater Heritage (NSUH) project was to produce high quality digital orthophoto-maps showing the location of fish traps and to check these by means of ground surveys (Gribble 2005). Unfornatley, Gribble left SAHRA before the project was completed, and SAHRA has not produced a report. Much of the work done was, however, described by Kemp (2006) as part of her Masters dissertation. There is now extensive documentation on the location of all surviving fish traps along the south coast, including high quality digital orthophoto maps. Unlike the previous studies, Kemp (2006) focussed on the ecological sensitivity of fish traps. Concerns were raised regarding the possible impact of the fish traps on fish population and intertidal invertebrate communities, as well as about heritage conservation. None of the above mentioned studies provided clarity on the archaeological context of these features, and the best method of doing this is through archaeological excavation. Avery (1975: 109) noted that this approach also has its problems:

> Although the presence of fish species in frequencies suggestive of their being taken in traps, e.g. shoaling types, might serve to relate midden occupations to fish-traps, it provides little information on the effect that such an resource might have had on a large area. People might have been prepared to travel considerable distances from their occupation areas to reap such a rich harvest. Fish might not always have been eaten on the spot and in such cases are not likely to be reflected in local shell middens.

Nonetheless, excavation offers the only secure method of investigating the long-term history of use of these features, including dating. With regard to issues of transportation and trade networks it is important to provide a general knowledge of fish remains in archaeological deposits of the Western Cape so as to minimise the possible biases suggested by Avery.

1.3 Research Area

To achieve the goals discussed above, two localities along the south coast were earmarked for archaeological investigation, Suiderstrand, bordering the property Paapuil Fontein 281, near Cape Agulhas, and Still Bay. These two areas were chosen specifically because the greatest concentrations of fish traps occur here. Secondly, shell middens are situated in close proximity to fish traps, thereby providing the perfect opportunity to investigate their possible association. At Paapkuil Fontein, eleven Later Stone Age shell middens of Holocene age are located on the property. Four of these middens were excavated. These were chosen on the basis of their close proximity to the traps, apparent limited degree of post-depositional disturbance, and in three of the four cases these sites contained a range of archaeological remains other than shellfish. The remaining middens identified at Paapkuil Fontein consisted only of thin scatters of shell, or had been severely disturbed by road-building or other activities.

At Still Bay, two shell midden sites were investigated: Still Bay 1 and 2 (SB 1 & SB 2) located above the harbour. Both sites had been excavated before the start of this project (Rubin 1991), but the contents had been assessed in only a preliminary way; a full analysis has been carried out for the purpose of this study. In addition, I report below on an unpublished study carried out to mitigate damage to a midden as a result of building activity at Jongensfontein, approximately 5 km west of Still Bay. Like SB 2 this was a substantial site, containing stratified deposits ca. one metre deep. Material excavated from Jongensfontein was unfortunately not available for study, so the results presented below are drawn from the site report (Nilssen 2003).

1.4 Thesis layout

This thesis contains six chapters. Chapter Two is a literature review. It provides a background to archaeological research on coastal hunter-gatherers, with a focus on coastal and aquatic adapted foragers. It outlines the development of Later Stone Age archaeology in South Africa, as a context for the work described in subsequent chapters.

Chapter Three reports the results of excavations at Paapkuil Fontein 281, and explores whether or not there is an association between the excavated middens and the fish traps.

Chapter Four described the materials from Still Bay 1 and 2 and summarises the finds from Jongensfontein as reported by Nilssen (2003).

Chapter Five presents the results of original archival research on fish traps conducted at the Cape Archives. There is a surprising wealth of information, much of which concerns legislative issues and applications to construct traps. Because traps were considered to impact negatively of fish populations, there has been tight control over their construction and use over the last hundred years.

Chapter Six is the last chapter of this thesis. The archaeological and historical evidence is discussed and summarised. It is concluded that the archaeological evidence for a prehistoric age of the fish traps along the south coast has been overstated and that the origins of most of the fish traps can be traced to the late nineteenth and early twentieth centuries.

CHAPTER 2

Literature Review

2.1 Introduction

Over the past few decades, a number of archaeologists have viewed intensive harvesting of marine resources as a uniquely Holocene occurrence, thought to have been the result of environmental, demographic and cultural stresses (Cohen 1977; Osborn 1977; Binford 1991). From an optimal foraging and ecological perspective, marine habitats were regarded as marginal in comparison to their terrestrial counterparts, despite the perceived importance of resources such as fish in the development of complex coastal societies (Mosely & Feldman 1989; Moss *et al.* 1990, Erlandson 2001; Inskeep 2001; Whitridge 2001). High technological and labour investment is seen as one reason for the supposed late development of complex coastal economies (Osborn 1977). With regards to the exploitation of fish, Kelly (1996: 209) writes:

> ...fish are different. Some species, especially surface feeders, will give away their presence, but not bottom feeders. And fish cannot be tracked-this is a particular problem in exploiting oceanic fish. The forager can only go to the likely place to find fish, then begin searching randomly. If there are no fish there, the forager could waste quite a bit of time before accepting this as likely.

Earlier models of coastal ‘intensification’ often sought to explain the recent development of coastal economies through effects of post-glacial population increase and saturation (Cohen 1977; Osborn 1977). Yesner (1987:285 in Erlandson 2001:288) states that a “real commitment to maritime lifeways did not precede late Upper Paleolithic times”, although he noted that such models were generally ‘out of step’ with the archaeological and historical data which suggest that coastal hunter-gatherers were more populous, sedentary and culturally complex than their terrestrial counterparts (Erlandson 2001:289). The major trajectory in global thought, post-1960s, explicitly emphasised the supposed unproductive nature of aquatic habitats versus terrestrial ones (Cohen 1977; Osborn 1977; Bailey 1978; Gamble 1986). Yesner argued that an aquatic adaption during the post-Pleistocene was the result of a combination of megafaunal extinctions, climate ameliorations, and sea level stabilization. Similarly, Holl (2005) argued for the possibility that hunter-gatherers globally, came up with similar solutions for similar problems.

Erlandson (2001: 292) recently, reviewed Yesner's model. He finds "variation in the patterns of and timing of megafaunal extinctions or survival, the considerable evidence of aquatic adaptations prior to such widespread extinctions, and little evidence that marine and other aquatic resources were relatively unproductive prior to sea level stabilization". One of the problems of the earlier model is the selectivity of the datasets used. Binford's (1991) model was Eurocentric and failed to adequately account for the effects of marine transgressions and the impact this had on the archaeological visibility of earlier sites (Rowley-Conwy 2001).

In South Africa, there are a number of sites dating to the Middle Stone Age (MSA) which show effective marine exploitation; these sites include Herolds Bay (Brink & Deacon 1982), Klasies River Main Site (Thackeray 1988; H.J. Deacon 1989, 1992, 1998), Sea Harvest (Volman 1978), Blombos Cave (Henshilwood *et al*. 2001), and Yzerfontein 1 (Halkett *et al.* 2003; Klein *et al.* 2004). At Blombos Cave, densities of shellfish were higher in the MSA levels than in the LSA, especially in the BBC 3 phase. Fish were also present but the densities were lower than in the LSA. Henshilwood *et al.* (2001) indicated that variations in soil acidity and moisture in different sections of the cave may have caused the deletion of some fish bone from the assemblage. Black musselcracker (*Cymatoceps nasutus*) are the most abundant species in the MSA at Blombos Cave. This is a shy and solitary species and occurs on rocky reefs (van der Elst 1993). The similarities between Middle Stone Age and Later Stone Age sites in the Cape are summarised by H.J. Deacon (1989: 557-559):

> The distribution of Middle Stone Age sites in the southern Cape is the same as that for the Later Stone Age and departs markedly from that of the Acheulian.
>
> The view offered here is that the Middle Stone Age groups in the southern Cape had essentially the same perception of their environment as their Holocene successors. In their subsistence behaviour they show the same reliance on carbohydrate-rich plant

> foods, supplemented by animal protein and the use of shellfish as a source of nutrients, as found in the Later Stone Age. The implication of this review of Middle Stone Age subsistence is that in this respect behaviour and the ability to solve problems relating to resources was modern.

This situation is not unique to South Africa and similar evidence is present elsewhere in the world (Rowley-Conwy 2001), and has been reviewed in detail by Erlandson (2001). The evidence now available suggests that marine resources acted as a long term dietary staple (Erlandson 2001). Similarly, it has been argued (Rick *et al*. 2001) that intensive harvesting of marine foods such as fish, developed independently of population pressure and saturation.

In North America, open midden sites on the California coast provide evidence for sophisticated and efficient fish harvesting strategies during the early Holocene. This is significant in that it shows that people clearly had the technological capability to utilise a range of fish species much earlier than suggested, and that this may have been unrelated to pressures of intensification (Rick & Erlandson 2000). Similar evidence that intensive and varied fishing strategies were employed between 11 500-8 500 B.P. comes from Daisy Cave along the Pacific Coast of California (Rick *et al*. 2001), and from coastal Peru (Sandweiss *et al.* 1998). Salmon harvesting was a major endeavour during the Jomon period in Japan, involving logistical and storage strategies (Matsui 1996). Salmon exploitation was also believed to have played a significant role in the complexity of many Northwest Coast groups of North America (Moss *et al.* 1990). In South Africa, Elands Bay Cave (Parkington 1977) and Nelson Bay Cave (Inskeep 1987) provide the best evidence for early Holocene fishing strategies

Quantifying the contribution of fish to prehistoric diets is often difficult. A host of problems quite unique to the study of ichthyology inhibit detailed interpretive models. Some of these include differential bone preservation (Nagaoka 2005), selective processing methods which may be species specific or culturally derived, such as boiling of heads and filleting (Whitridge 2001; Zohar & Dayan 2001) deletion of fish bone through external sources such as scavenging by carnivores (Whitridge 2001), and difficulty in identifying fish bone to species level (Gobalet 2005). Furthermore, poor recovery methods such as the use of large mesh sizes (>3 mm) in earlier excavations resulted in poor representation of fish bone in many coastal assemblages (Whitridge 2001), particularly small species. While some of these issues can be remedied through re-excavation and the use of smaller mesh sizes (Nagaoka 2005), and consulting a wide reference collection to increase species diversity and minimum number of individuals (Gobalet 2005); many of the taphonomic issues outlined above are beyond the control of the archaeologist.

A case in point is the Jomon of Japan. Population density and sedentism, especially in the northeast, was seen as an outgrowth of shellfish exploitation (Koike 1980 in Rowley-Conwy 2001), and seasonally abundant salmon and trout (Matsui 1996). However, there was very little artefactual and faunal evidence to suggest that salmon harvesting played any role in this development. It was only through fine sieving that Matsui (1996) identified four different types of salmon preservation at Jomon sites. The differential preservation of salmon remains, he argued, was the result of different patterns of capture, processing, storage and transport. Notwithstanding these problems, the analysis of ichthyofauna can play a vital role in re-addressing the role of marine foods in forager diets (Renouf 1989), and may also be important in understanding environmental and ecological changes (Andrus & Crowe 2002; Whitfield & Elliot 2002; Reitz 2004).

2.2 The archaeology of coastal groups: changing perspectives

Since the publication of *Man the Hunter* (Lee & DeVore 1968) archaeologists have increasingly become aware of the variability amongst hunter-gatherer communities the world over. Despite considerable ethnographic variability, behavioural ecologists often make four assumptions about hunter-gatherers (Winterhalder 2001: 13), 1) under-production, and a general lack of material accumulation; 2) routine food sharing; 3) egalitarianism; and 4), a division of labour between the foraging of males and females: males hunt while females generally gather.

Despite these generalities, behavioural ecologists have developed a critical awareness of their own discipline and have cautioned against uncritical application of foraging models:

> General models of hunter-gatherer social organization and behaviour are increasingly at odds with evidence of variation among foraging societies (Martin 1974). We thus face an unappealing choice: either to achieve generalizations that fail to explain much of the observed variation, or to give up the task of constructing general models and deal only with specific societies or regions. The first option is normative: diversity is explained away. The second option is particularist: diversity is accounted for in the

> aggregate but is not explained in a theoretically cohesive fashion (Smith & Winterhalder 1981: 4)

> For the present, given the paucity of foraging studies on humans, cautious use of energy currency will be likely to produce extensive and fairly reliable, if ultimately incomplete, insights (Winterhalder 1981: 22).

In South Africa, data emanating from the Kalahari model (Lee 1965) have had a significant impact on the interpretation of Later Stone Age archaeologies. Over the years the power of ethnographically derived datasets such as these from the Kalahari as sources of inspiration has come under critique (Wobst 1978; Hodder 1986). As in other parts of the world, concern has been raised over the pitfalls of projecting the 'ethnographic present' onto the past. While the use of ethnographies from inland foraging groups may not be entirely applicable with respect to coastal groups, the ethnographic record has nonetheless been a powerful tool in understanding some aspects of the sub-Saharan archaeological record, most notably the interpretation of southern African rock art (Lewis-Williams 1981, 1995).

Archaeologists working in coastal areas have often highlighted the potential marine resources hold for supporting large populations, the development of sedentary societies, perhaps having hierarchical social organization (Moseley & Feldman 1989; Renouf 1989; Moss *et al.* 1990; Matsui 1996; Whitridge 2001).

Woodburn (1980) investigated levels of economic organization through the concepts of immediate return versus delayed return systems. Simply put, immediate return systems imply immediate consumption of resources, whereas in delayed return systems storage becomes essential for later consumption, especially in times of scarcity. Moreover, in delayed return systems, time is invested in logistical activities such as the construction of traps, weirs etc. The construction of fish traps is labour intensive, and it is likely that traps and the catch thereof belonged to the individual/s who constructed them. Traps therefore constituted territories and the surplus food may lead to unequal access to wealth. This is in contradiction to immediate return systems.

Storage is not a causal factor for political stratification. There is a spectrum of possibilities that may result in internal stratification. Rowley-Conwy (2001) noted that Inuit groups store food due to seasonal fluctuations and are logistically organised, but that most are not territorial and hierarchical. Similarly, Australian Aborigines do not practise storage but some are highly territorial, in respect to defending water resources. Other forms of 'complexity' include ritual burial and the identification of cemeteries (Pardoe 1988), which have been suggested to relate to increased notions of territory and heightened social identity (Hall 1990).

Environment and ecological factors appear to play a causal link in social organisation and territoriality. To account for these variances, Rowley-Conwy (2001: 42) constructed a four-fold typology of hunter-gatherers, "1) The OAS (Original Affluent Society): groups with little or no logistical movement of resources or food storage. These are mostly found in tropical regions (e.g. the Aborigines and the Kalahari San), although some occur in higher latitude areas where resources are available throughout the year; people can move from one resource to the next, exploiting them in sequence without the need for much storage, 2) logistic groups that do not defend territories, such as most Inuit, 3) logistic groups that do defend territories- many of Woodburn's delayed return groups, and 4) sedentary groups who invariably defend territories and store resources, forming a continuation from type 3". Does long-term marine resource exploitation favour the development of one of these types of organisation rather than the others? Can a maritime revolution provide a demographic threshold and can it act as an 'incipient' phase to or a successful alternative to the adoption of agriculture? These questions are best examined by looking at a few examples.

The economic importance of salmon in the development of North American Northwest Coast groups has long been stressed (Goddard 1945; Krause 1956; Boas 1966). Goddard (1945: 59) also noted the importance of other marine fishes such as halibut, herring, eulochon and smelt. Moss *et al.* (1990) indicated that economic specialization, internal stratification, artistic elaboration, and cultural sophistication are considered outgrowths of the highly productive salmon economy. At the Namu site along the Northwest coast of British Columbia, salmon remains are abundant between 6 000-4 000 B.P., but are particularly so between 4 775 B.P and 3 825 B.P. (Cannon 2000). No faunal remains were preserved in early Holocene layers at this site. It is possible that chemical and mechanical breakdown account for the absence of faunal material in the early layers. Before and after peak periods of salmon exploitation, the focus was on a much more eclectic range of resources, including small package animals such as dogfish, herring, and shellfish, in addition to deer. Herring seem to have been particularly important as a small package item.

Hayden (1981) indicated that intensification of small package items relates to periods of population growth and increased sedentism. Bender (1978) suggested that times of increased production could be associated with social and cultural change. Cannon (2000) suggested that periods of peak salmon exploitation seem to have been associated with periods of social affluence as burials during these periods are the only ones associated with finely crafted artefacts, which may relay notions of social ranking and importance. However, Cannon sees salmon exploitation as a gradual, long-term process culminating in high levels of production supporting dense populations giving rise to complex social organization, but that the importance of the salmon fishing may have been overstated.

The European Mesolithic is often regarded as a demographic threshold which set the stage for a 'social revolution' (Rowley-Conwy 2001). According to Renouf (1989) one of the striking features that separates north coastal European hunter-gatherers is the degree of sedentism practiced, and that there is a distinct correlation between fishing and permanence of residence. Renouf relies here on Murdock (1969) to suggest that fishing is the only alternative to agriculture that can support a settled way of life.

Archaeologists working with north coastal and arctic hunter-gatherers note that some individuals do attain authoritative power due to the nature of large scale communal hunts, particularly whale hunting and the hunting of other large marine mammals that require logistical planning. For example, amongst the Tareumiut, *umealiqs* (or boat owners) are known to attain personal wealth and formed a distinct social sector in an otherwise egalitarian society (Renouf 1989). Internal stratification was not noted for the Beluga whale hunters of the Canadian Arctic, although similar logistical planning is needed (Betts & Friesen 2006). Kroeber (1939) in Renouf (1989: 103) reported high aboriginal population densities for most of North America with densities at the coast being quite high, ranging from .02-0.75 individuals per km^2. Densities for modern inland hunter-gatherers were reported to be much lower, ranging between .001-0.15 individuals per km^2.

Binford (2001: pp. 243-314) has recently explored the relationship between storage, group size, seasonality and complexity (measured in terms of internal differentiation). Below I highlight some of the main points the effect storage has on groups dependent primarily upon aquatic resources: 1) there is a positive correlation between storage and groups living at high latitudes with a strong emphasis on seasonal fluctuation on resources related to a shorter growing season, 2) there is a positive relationship between group size and political stratification and that aquatic adapted groups are usually sedentary and practice storage, 3) amongst delayed return societies noted for high population densities and sedentism, prior investment in facilities such as traps etc. is common, and such tactics represent the effects of processes of intensification, 4) larger group sizes and population density are observed amongst groups exploiting primarily anadromous fish, which are found only in the Northern Hemisphere, 5) a shift towards the exploitation of aquatic resources is the most viable adaptive strategy for groups undergoing intensification, 6) there is a positive relationship between the exploitation of aquatic resources and the degree of internal differentiation, but there is not necessarily a causal link between storage, intensification and the development of complex societies, and, 7) internal differentiation or social stratification arises from the investment in durable facilities, such as fish traps or weirs, to aid extraction of resources from a particular venue. Access to the venue will be restricted to persons contributing their labour to construct the facilities, particularly in cases where resource productive locations are limited.

Intensification and storage can play an important role in population growth and complexity, especially for people dependent upon aquatic resources, but are not necessarily causal factors. Aquatic adapted groups are some of the most complex in terms of labour organisation and political stratification. However, the development of these features is mediated by a subset of environmental factors and is more likely to occur at higher latitudes where storage and the investment in durable facilities are likely to be a necessity. In these areas the need to store food becomes more a necessity than in temperate climates.

In coastal Israel, at the site of Atlit-Yam, Zohar and Dayan (2001), have argued for the importance of grey trigger fish in early Holocene trade networks between the coast and the interior. In South America, some archaeologists have seen the development of complex Andean civilisation along the Peruvian Pacific Coast as an outgrowth of long-term and sustained harvesting of the highly productive anchoveta fishery (Moseley & Feldman 1989), although others have been sceptical (Raymond 1981). It has been argued that the netting of anchoveta and other small schooling fish in near shore conditions promoted coastal sedentism, population growth, large communities and its eventual expression in the monumental constructions of the third and second millennium BC.

Closer to home, one of the significant debates centres on trying to explain the development of the archaeological complex of north tropical Africa and around the Great Lakes region and how it relates to what Sutton (1974) has termed the "Aquatic Civilizations of Middle Africa", as a successful alternative to the adoption of agriculture (Holl 2005). Sutton (1977: 25) says the following about the Aquatic Civilisations of Middle Africa:

> during the early post-Pleistocene there flourished right across the middle belt of the African continent a highly distinctive way of life intimately associated with the great rivers, lakes and marshes. This belt comprises the southern Sahara and the Sahel from the Atlantic to the Nile and there bends up-river to the East African rift valleys and the equator.

While the exact origins of this cultural complex could not be established with certainty, Sutton (1977) hypothesised that its roots lay somewhere in East Africa, with gradual expansion northwards along the Nile Valley, and westwards through the Sahara and Sahel. As Holl (2005) remarked, the 'Aqualithic' discussion is fundamental as it "focuses on the very issue of the transition from foraging to food producing lifeways…variables involved in the debate include climate change and ecosystem dynamics, technological innovation, settlement patterns, and language expansion". Many of these issues have been dealt with in some considerable detail by Haaland (1992), and Yellen (1998), whilst Ehret (2002) provided a detailed map of language expansion. Haaland (1992) viewed sedentism based on intensive utilisation of aquatic resources as a fundamental precondition to the eventual cultivation of crops.

Hunter-gatherer demographic studies suggest that population growth and density are probably governed by a range of factors (Pennington 2001). Periods of increased fertility amongst hunter-gatherers would stimulate growth and the need to increase production, which could be achieved by means of a shift towards aquatic resources. The process from 'simple' to 'complex' is not a linear one. Increased production of a certain set of resources does not necessarily entail a tendency towards increased political complexity. It does, however, provide an opportunity for increased complexity. For groups dependent upon aquatic resources, 'complexity' arises out of the unique set technological requirements to effectively harvest this resource in environments where simple strategies may not yield the desired results. Fish traps and weirs require understanding of lunar cycles and tides, and their construction and maintenance frequently but not always needs logistical cooperation. Such strategies are laborious and time consuming and require considerable investment. The trajectory in such instances would be towards a definition of personal property and the limitation of access to both the structure and its yields. Amongst the agricultural Tembi-Thonga rights to fish kraals and sites are passed from farther to son and rights are jealously guarded. Kraals are regarded the property of the owner, but he also has proprietary rights to the space around them. Nobody is therefore allowed to build any traps nearby that would potentially restrict the access of fish to the kraal (Felgate 1982). The same principles govern the use of fish traps in al#Bahrain (Serjeant 1968). In the Tembi-Thonga case, however, the elder son, who inherits ownership, is obligated under custom to share the goods of his inheritance with his younger brothers and help them in marriage (Felgate 1982). Meehan (1982) noted the use of fish traps amongst the Anbarra in Australia, but does not indicate whether ownership and access was restricted to particular individuals.

The investigation of the fish traps in these terms is obviously important for Holocene economic and social organisation along the south coast of South Africa. Furthermore, a general understanding of where fish traps fit into the archaeological sequence will provide a valuable backdrop to understanding the broader processes driving these changes. In temperate regions where resources are available year-round and the risk of failure is minimal, storage and tight control over a particular resource is not expected. In South Africa, there is a strong seasonal pulse to the exploitation of fish traps. Historically, best catches occur during the winter months between July and August (du Toit 1912 in lit.; Avery 1975; Kemp 2006). To maximise yields from these features there should be effective processing and storage methods to deal with the product, the traces of which should be observed in the assemblages of archaeological sites. However, the development of these practices needs to be weighed against the likelihood that failure to do this will negatively impact on the nutritional status of people dependent upon them. In the relatively temperate climate of the south coast, with year-round availability of many resources, storage is not a necessity, although population growth might have acted as a stimulus that required stored foods or more intensive exploitation of resources.

It is apparent that Winterhalder's (2001) features of hunter-gatherers do not fit neatly when examining groups dependent upon aquatic resources. While there is considerable variability in the range of social and economic organisation demonstrated by aquatic adapted groups, they differ most on point four from traditional hunter-gatherers (Binford 2001). This point states that there is a general division of labour between males and females, that males hunt and females gather. The division of labour for aquatic groups and those dependent upon fish are normally divided along performing different roles while procuring and processing a single resource. Males normally procure while the females are responsible for the processing.

The general purpose of this first section of Chapter 2 was to highlight the possibilities of a variety of types of social organization amongst coastal foragers examined through the concept of intensification. I suggested that population saturation may indeed be the driving force to intensify production and that the best way to increase production is to shift attention to aquatic resources. I would like to emphasise that density and storage do not necessarily entail complexity. Akazawa (1989) demonstrated that marine transgressions during the terminal Jomon resulted in declining population densities, a shift back to terrestrial animals, and perhaps social organization similar to the four generalities proposed by behavioural ecologists, in the southeast of Japan. Groups in the northeast unaffected by marine transgressions continued to be marked by high population densities and storage.

The following section aims to provide a brief overview of archaeological research in the southern and Eastern Cape of South Africa, with particular emphasis on some of the themes discussed above.

2.3 Later Stone Age Holocene Archaeology

The previous section aimed to summarise some aspects of current thinking regarding Holocene coastal hunter-gatherers. The aim of the following discussion is to provide a brief summary of development of Later Stone Age Holocene archaeological research and thinking in South Africa. The discussion hopes to illustrate the movement away from lithocentric and ecological models towards increasing reliance on social theory as a mechanism to explore hunter-gatherer cultural complexity and growth.

The development of Holocene archaeological research in the South Africa can roughly be characterised into three intellectual phases. The first of these ‘phases’ was primary lithocentric with the aim to describe culture-stratigraphy through identifying stone tool ‘traditions’ or ‘industries’ (Goodwin & van Riet Lowe 1929). The second intellectual ‘phase’ saw the emergence of complex ecological and environmental models as a means to explain subsistence and settlement strategies. Within the ecological framework, or what some have termed the man-land model, people were seen as passive agents continually subjected to external environmental forces driving cultural change (Mazel 1987, Parkington 1993). Critics of the ecological model regard it as descriptive, masking variability for sake of generalised patterns. The third phase draws much of its inspiration from social theory which emphasises people-people interaction and the significance of such relations in stimulating cultural growth. Within this model, less emphasis is placed on the environment; settlement, subsistence and raw material choice are seen as socially mediated phenomena fulfilling dual social logistical needs (Mazel 1987, 1989a, 1989b; Wadley 1987, 1989; Hall 1990; Parkington 1993). None of these approaches are without their shortcomings, and critiques of the models are both valid and necessary for the production of knowledge. Nonetheless all three 'phases' have played a vital role in understanding the Holocene Later Stone Age sequence of South Africa (Mitchell 2002).

Chronologically, the three 'phases' can be neatly situated into three time periods, the 1920s-1950s, 1960s-1970s, and 1980s-1990s. Much of the research conducted during the 1990s and currently can be regarded as an extension of the intellectual environment of the 1980s. It has been clearly demonstrated that developments in South Africa drew on similar debates elsewhere (Mazel 1987).

In the decades preceding the 1960s archaeological research in South Africa was concerned with stone tool typologies and culture-stratigraphy (Mazel 1987; Wadley 1989). Although culture-stratigraphy concerns still lingered (see for example Inskeep 1967), and the primary concern of the Burg Wartenstein symposium was the creation of a unified stone tool classificatory scheme (Parkington 1993), archaeological research was re-oriented during the 1960s and 1970s to more environmentally and ecologically focussed research, with regional rather than site focus (Mazel 1987). Ray Inskeep was responsible for implementing a rigorous scientific approach to LSA studies during the 1960s. Many of his students later went on to start major field research that significantly advanced the understanding of the LSA record.

Two of his students, Hilary and Janette Deacon, played a significant role in the development of archaeological research, particularly in the Eastern Cape. An important facet of LSA studies during this period was the multi-disciplinary approach, with clear influences from ecology. In the mid-1960s H. J. Deacon started his 'Prehistory of the Eastern Cape project' with the explicit aim of understanding the relationship between man and environment during the post-Pleistocene by re-examining previously excavated sites in the Eastern Cape and excavating new ones. A synthesis of this approach was published in 1976, entitled *Where Hunters Gathered*. H. J. Deacon (1976) described the project as strictly ecological in its views of the post-Pleistocene, emphasising the relationship between environments, subsistence and demography at one level, and the adaptations between man and specific plants and animals in particular. He argued for stable Holocene populations with equilibrium in man-land relations. Populations had flexible behavioural responses which were adaptive in their environmental context.

Coinciding with H. J. Deacon's ecological work was J. Deacon's classic re-assessment of the Wilton artefact tradition from Wilton Large Rock Shelter (J. Deacon 1972) as well as a refining of the classification of Later Stone Age stone artefact traditions (J. Deacon 1984). Deacon explained the development of the Wilton from the Large Rock Shelter through a cultural systems ontogeny framework, imported into archaeology by Clarke (1968), borrowed from developmental biology. The system proposes a five phase process of development, birth-growth-maturity-decline-death. For J. Deacon, cultural systems ontogeny provided a "logical framework in which to describe the changes within the Wilton site local sequence through time" (J. Deacon 1972: 38). Significantly, the maturity phase of the Wilton was seen to reflect a period of equilibrium between people and their environment. Key to this concept is the notion of 'adaptation' to external stimuli, in this case environment, which fits well into H. J. Deacon's man-land framework.

While the work conducted by Hilary and Janette Deacon during the 1960s and 1970s provided new insights into man-land relations during the Holocene in the Eastern Cape, John Parkington's interest focussed on the LSA of the south western Cape. Like the Deacons, Parkington's research was influenced by the ecological approach. The publication of the De Hangen site report (Parkington & Poggenpoel 1971), marked an important development for LSA studies in the south western Cape. It was this paper more than anything else that led to the birth of the 'seasonal mobility' hypothesis, which has been outlined in subsequent publications (Parkington 1972, 1976, 1977). In a nutshell the hypothesis proposed a seasonal movement of LSA people between the coast and interior of the south western Cape, with summer occupation postulated for the mountain areas represented by De Hangen and winter occupation for the coast represented by Elands Bay Cave.

The focus of the research was to examine "man-land relations" (Parkington 1972: 223), and was "phrased in ecological terms" (Parkington 2001: 2). Parkington (1972, 1976, 2001), employed the concepts of 'time' and 'place' as a means to "re-enact the lives of real people at particular places and times" (Parkington 2001: 1). As such he was very reliant on the Kalahari ethnographies, in particular the work done by Lee (1965), as a model to understand seasonal exploitation of food resources. Conceptually, this hinged on the idea that the underlying social and economic structures of prehistoric south western Cape groups were broadly similar to the ones governing extant Kalahari groups.

While the ecologically derived models developed for the eastern and south western Cape since the 1960s have had a lasting impact on understanding of the Later Stone Age, the 1980s marked a turning point in Later Stone Age research. The application of social theory and the prospect of investigating people-people relations began to find favour with many young researches from the mid-1980s onwards (Mitchell 2005).

An important publication was Parkington's (1980) paper *Time and place: some observations on spatial and temporal patterning in the Later Stone Age sequence in southern Africa.* Parkington developed a well structured critique of the Deacons' 'Prehistory of the eastern Cape' project. Essentially his critique was confined to the implications of Hilary and Janette Deacons' 'homeostatic plateaux' and 'cultural systems ontogeny' which implied stable and behaviourally flexible terminal and post-Pleistocene populations. He regarded these models as masking variability and while useful to describe change through time "its inflexibility hinders an understanding of the processes involved" (Parkington 1980: 83).

While this paper highlighted some of the pitfalls of ecologically derived models, it in fact did very little to change the course of mainstream Later Stone Age research. In South Africa, it was the study of rock art that really illustrated the importance of social theory in understanding people-people interaction (Lewis-Williams 1993; Mitchell 2005). Patricia Vinnicombe's *People of the Eland* (1976), provided the initial impetus and eventually led to Lewis-Williams' (1981) book *Believing and seeing.*

It was not, however, until the mid-1980s that social theory became an attractive tool for interpreting the past. Later Stone Age archaeologists became increasingly influenced by historical materialist approach, in particular the writings of Hodder (1979, 1985), Sackett

(1986), Bender (1978, 1981, 1985), and Lourandos (1983, 1985). In addition, Wiessner's (1982, 1983) work on *xaro* gift networks among residual forager groups became a powerful interpretive tool and influenced amongst others, the work of Wadley (1987, 1989), Mazel (1989a, 1989b) and Barham (1989).

The three most important mainstream LSA research projects of this period were Wadley's (1987, 1989) aggregation and dispersal model in the Transvaal, Mazel's (1987, 1989a, 1989b) research into hunter-gatherer groups in the Thukela Basin and Hall's (1990) work in the south eastern Cape. The influence of social theory resulted in greater theorizing about social organisation, settlement and subsistence strategies during the Wilton in different ecological settings, with people-people interaction being the driving force.

Mazel's work, more than others, seems to have undergone a radical transformation. His project, initiated in 1981 had a "strong human ecology orientation" in which he sought to understand the relationship between subsistence strategies, artefact distributions and the environment (Mazel 1989a: 33). Later he hoped to reconstruct a regional social history informed by social theory for the Thukela Basin with the ecological approach viewed through the concept of adaptation as a deterministic explanatory mechanism.

Historical materialism was seen as an important new approach that tried to redirect attention "to the totality of human behaviour and avoids the reductionism inherit in both approaches, which have seen a determinate role in the environment and those which have given primacy to the 'cognitive system'" (M. Hall quoted in Mazel 1989a: 34). In both Mazel's and Hall's work the relationship between environment, settlement choice, subsistence and stone tool making was investigated through the concept of 'intensification'. Intensification normally refers to increased production and productivity, the former is subject to demand whilst the latter is not necessarily tied to it. Population pressure may be one reason for intensification (Cohen 1977). Bender (1978) indicated that increased production may be associated with social and demographic change. Similarly, Hayden (1981) has suggested that an emphasis on small package foodstuffs or so-called r-selected food items (i.e. fish, insects etc.) may be tied to population growth or increased sedentism.

Both Mazel (1989a, 1989b) and Hall (1990) made considerable use of the concept of 'intensification' to investigate people-people interaction. The concept was however, employed much earlier. H. J. Deacon made use of the term to explain some of the patterns he observed in his Eastern Cape sites. At Melkhoutboom, the hunting of territorial antelope and the collection of a wide range of plant species provided evidence for the potential existence of sedentary practices, fixed territories due to knowledge of the landscape and precise location of resources, and for increasing population density due to the closer nesting of population cells (H. J. Deacon 1976: 121). Nor were subsistence and technological adaptation to environment necessarily seen as the significant factors. The covering of the top of a child burial child with a layer of ochre provided evidence of ritual behaviour which is difficult to recognise, but demsonstrates a clear competence to cope with the environment (H. J. Deacon 1976: 122).

Mazel (1989a, 1989b) combined a study of proposed *xaro* alliance networks, stone artefacts, animal and plant remains to examine changing gender roles between 7 000-2 000 B.P in the Thukela Basin, KwaZulu Natal. Hall (1990) combined similar archaeological evidence but included burials in his study of post mid-Holocene groups in the southern and eastern Cape to argue for distinct behavioural differences in the hunter-gatherer archaeology of the region which he believed were clearly at odds with the ethnography. Hall's argument was drawn from several lines of evidence. Firstly, increased exploitation of riverine fish and freshwater mussel was observed ca. 4 000 B.P., and the appearance of pits for plant food storage appear in pre-2 000 B.P. contexts at sites in the Cape Fold Belt, namely: Edgehill, Welgeluk, Boomplaas, Melkhoutboom and Hellspoort. Secondly, the use of exotic stone raw materials and clustering of burials were seen as signals of social identity.

Unlike settlement systems such as aggregation and dispersal that aims to alleviate economic and social stresses amongst hunter-gatherers, Hall (1990) believed 'intensification' provided evidence of a risk management strategy which emphasises productivity and production as a response to population saturation, group circumscription, reduced mobility, competition and heightened identity He believed that the archaeological trajectory in the Eastern Cape was towards exclusive social systems, away from general reciprocity, towards differentiation, closure, exclusion and heterogeneity (Hall 1990).

Since then, research into questions of reduced mobility and distinct social identity amongst Holocene hunter-gatherers has continued. Recently, work has focussed on the archaeological record of the Robberg Peninsula and Plettenberg Bay. Long-term dietary differences ascertained from isotope signatures have been noted in skeletons found at

Robberg/Plettenberg Bay, including Nelson Bay Cave and Matjes River Rock Shelter. This difference suggests exclusive hunter-gatherer populations with differing subsistence basis, reduced mobility and perhaps distinctive material culture signatures (Ludwig 2005, Sealy 2006).

Thus, archaeological research in several regions of the southern and Eastern Cape has highlighted a trend of economic and social exclusivity amongst LSA hunter-gatherers particularly, from mid-Holocene times onwards. Whether the presence of fish traps is a component of that complexity is as yet unknown. If the fish traps along the south coast are indeed shown to be of considerable antiquity, as some have argued (Avery 1975; Poggenpoel 1996), their construction may have been linked to increased prehistoric population and widening diet-breadth practices. The application of mass capture devices such as fish traps does at some level imply increased population numbers at the time that they were built. There are also implications for group and individual mobility, since people would have needed to be close to these key localities on the landscape at times when conditions were optimal for good catches.

The distribution of fish traps, mainly along the south coast, may tentatively reflect exclusivity among groups occupying the region. Avery's (1975) postulation that they could date between the period 3 000-2 000 B.P is an attractive one. Firstly, because hunter-gatherers were undergoing shifts in social, economic and settlement patterns pre-and post-3 000 B.P. in regions of the southern Cape. Similar trends have been observed along the west coast between the period 3 000-2 000 B.P, including shifts to large open shell midden occurrences and increasing diet-breadth practices (Jerardino 1996; Jerardino & Yates 1997). Alternatively, it is plausible to suggest that fish traps may be related to the introduction of pastoralism in the southern Cape. If fish traps date to the last 2 000 years it is difficult to say whether they might have been a pastoralist cultural signature or hunter-gatherer response to encroaching pastoralists and a decreasing resource base. At the moment, the best way of distinguishing hunter-gatherer and pastoralist sites is by the presence absence of ceramics and domesticated animals.

2.4 Holocene fishing evidence

A detailed account of Holocene fishing strategies in South Africa can be found elsewhere (Poggenpoel 1996; van Niekerk 2004). The aim here is to make some general observations and to consider how these relate to fish trapping. Figure 2.1 shows the distribution of excavated archaeological sites in the Western Cape from which fish remains have been recovered.

Detailed information regarding fish species composition and diversity exists for most of the twenty-seven sites shown in Fig. 2.1. Little information is, however, available for key sites like Oakhurst, Matjes River and the Kabeljous River Shelter. The first two were excavated many years ago, when identification and analysis of fish bone was not routine. The distribution of sites closely reflects areas where most archaeological work has been done. The area between Cape Agulhas and Wilderness (Oakhurst) is relatively poorly known. Blombos Cave and the Garcia State Forest sites are the only sites along that part of the south coast for which information exist on the fish fauna. Table 2.1 lists the fish species identified from sites shown in Fig. 2.1. For certain areas like Garcia State Forest (GSF), and Pearly Beach (PB), information from several small sites located in these areas have been combined. NISPs and MNIs are not shown in this table, becuase this information is available for most but not all of the sites shown. Reference is made in the text to the relative importance of the different species shown in Table 2.1.

Approximately, twenty-eight species representing eight families and twenty genera are listed in Table 2.1. Fishes of the Sparid family are the most commonly occurring with twenty species represented. Species of fish caught in fish traps can be diverse, but the southern mullet, *Liza richardsonii,* usually constitute the bulk of the catch. Two species of mullet, *Mugil cephalus* and *Liza richardsonii,* are present in fourteen of the sites, although in varying numbers. These two species are more prominent in sites along the west coast, especially the Elands Bay area, than along the Cape Peninsula, the south coast and the south east coast, with the notable exception of Blombos Cave. This situation is unexpected considering that the highest density of fish traps occurs along the south coast.

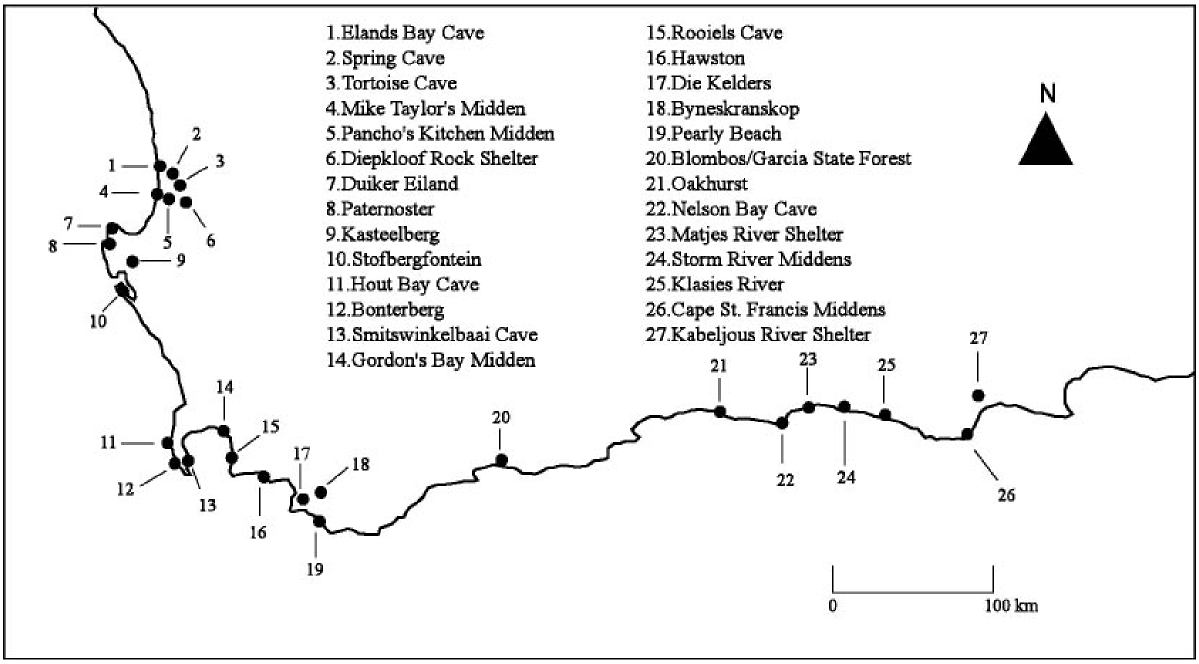


Figure 2.1. Distribution of archaeological sites with fish remains from the west, south and south east coast. Map adapted from Poggenpoel (1996).

Elands Bay Cave and sites nearby are located close to a large estuary/lagoon, the Verlorenvlei. Of the six sites shown in Fig. 2.1, fishing was most prevalent at the largest most intensively occupied sites: Elands Bay Cave and Tortoise Cave. The remains of 1710 fish were identified at EBC and 986 at TC (Poggenpoel 1996). Fishing was less important at the other Verlorenvlei sites. *Lithognathus lithognathus* (white steenbras), *Rhabdosargus globiceps* (white stumpnose), *Liza richardsonii* (southern mullet) and *Mugil cephalus* (flathead mullet) were the most important species exploited at these sites. The first two species use estuaries as nurseries. Mullet are tolerant of a range of salinities and often occupy river mouths and lagoons. The species composition therefore points towards a strong estuarine emphasis, consistent with the location of these sites close to the mouth of the Verlorenvlei.

At EBC fishing was most intensive in the terminal Pleistocene levels, between 11 000 B.P and 9 000 B.P. In fact, levels dating to ca. 11 000 B.P. account for 61% of the total fish recovered at EBC (Poggenpoel 1996). The three most dominant species in this layer, *L. lithognathus*, *R. globiceps* and *L. richardsonii,* account for 58.3% of the fish recovered at the site. Forty-four percent of the white steenbras, *L. lithognathus,* recovered from this time period are juveniles, of a size that typically lives in estuarine nurseries rather than in the

Table 2.1. Diversity of fish species from archaeological sites on the west, south and south east coast of the Western Cape.

	West coast								South West Coast						South Coast					South East Coast				
Common name	DE	DPC	EBC	PKM	PM	SBF	SC	TC	BNK1	DK1	GBM	HBC	RC	SWBC	BBC	GSF	HAW	PB	SFT1	FTS	NBC	OH	SR1	SR2
Carpenter									x												x			
Dageraad															x									
Red Stumpnose																							x	
Roman															x	x							x	x
Black Musselcracker										x			x	x	x	x				x	x			
Zebra			x																		x			
Blacktail			x					x	x	x			x	x	x	x				x	x		x	x
Janbruin															x						x			
West Coast Steenbras			x																					
White Steenbras		x	x	x		x	x	x	x	x		x	x	x		x	x		x	x	x		x	
Sand Steenbras									x												x		x	
Hottentot	x		x		x	x	x	x	x	x		x	x	x	x						x			
Bronze Bream																							x	
																	x	x	x					
Red Steenbras													x		x	x					x			
White Stumpnose			x	x		x	x	x	x		x	x	x	x				x	x		x			
Cape Stumpnose																				x				
Natal Stumpnose										x													x	x
Streepie			x																	x	x			
White Musselcracker															x	x		x	x		x	x		
Steentjie								x							x	x								
Kabeljou			x				x	x	x			x									x	x		
Galjoen			x				x		x	x		x	x	x		x		x	x	x	x			
Spotted Rockcod																					x			
Southern Mullet	x		x			x			x			x			x	x				x	x			
Flathead Mullet		x	x	x			x	x					x											
Elf			x			x	x	x	x	x						x					x	x	x	
Cape Yellowtail																x					x			
Snoek			x																					
													x								x			
											x										x			

ocean. The intensity of fishing during the Holocene at EBC is less pronounced than in the Pleistocene, almost disappearing after about 1 000 B.P, coinciding with the closure of the mouth of the Verlorenvlei.

The fishing strategy at Tortoise Cave was similar to that of Elands Bay Cave. Four species dominated, *R. globiceps* (40%), *L. lithognathus* (39.7%), *A. Feliceps* (8.1%) and *M. cephalus* (6.5%). White stumpnose were numerous in layers 14-5b, ca. 7 700-3 400 B.P., but then decreased in number to be replaced by white steenbras in the last 3 000 years. Ninety percent of the white steenbras in the lower layers were below the age of six years, an age class normally associated with estuaries, while 84% of the white steenbras in the layers post dating 1 700 B.P. fall within the estuarine range (Poggenpoel 1996).

Fishing was not particularly important at Spring Cave and in the LSA levels at Diepkloof but the evidence from these two sites is consistent with the strategies practiced at EBC and TC. Only 69 fish were recovered from SC, of which 38 were *L. lithognathus*, and 7 flathead mullet. At Diepkloof only two species are present, *L. lithognathus* and *M. cephalus*, the white steenbras being the most abundant (Poggenpoel 1996).

Sites on the Vredenburg Peninsula yielded very few fish remains. Paternoster Midden only had 72 fish, all of which were *P. blochii* (Robertshaw 1979), and Duiker Eiland yielded the remains of 46 fish, 37 *P. blochii* and 9 *L. richardsonii* (Poggenpoel 1996). Evidence from three pastoralist sites at Kasteelberg (KBA, KBB, KBE) suggests that fish was of limited importance. Fish bone in these sites was sparse and it was suggested that most could have come from the stomachs of seals (Smith 2006). Fish bone was similarly rare at the herder sites of Atlantic Beach, immediately north of the Cape Peninsula (Sealy *et al*. 2004). This pattern may therefore indicate that fish was of limited importance to pastoralists. The one west coast site with substantial fish bone that dates within the last 2 000 years is Stofbergfontein (SBF), on the southern shore of the Langebaan Lagoon on the Churchaven Peninsula. Two units were excavated with the main unit dated to 1 550 ± 55 (Pta-1903) (Robertshaw 1979; Poggenpoel 1996). A total of 348 fish were recovered of which 79.6% are the southern mullet. The white steenbras *L. lithognathus* comprise 16.4% of the assemblage. The overwhelming dominance of mullet is consistent with fish trapping, and three fish traps are present in the vicinity, two of which two are located in the lagoon and one to the south at Kreeftebaai. These fish may, however, also have been caught with nets or baskets in the shallow waters of the lagoon. A small number of hottentot, *P. blochii,* rarely caught in fish traps indicates that some fishing took place at the coast. The evidence from this site fits well into the overall west coast picture: where fishing was practised relatively intensely, emphasis was placed on estuaries or lagoons

Archaeological sites on or near the Cape Peninsula (Hout Bay Cave, Smitswinkel Bay Cave, Gordons Bay Midden, Rooiels Cave, Die Kelders and Byneskranskop), highlight similar fishing strategies. Hottentot, *P. blochii* was the dominant species present at all the sites mentioned above, except at GBM, where *R. globiceps* were prevalent (van Noten 1974). Hottentot favours kelp beds and are common in shallow and deep-water reefs. The preference for hottentot at these sites probably reflects a local habitat factor in that the coastline in this area is often deeply shelved and less suitable for fish traps. These fish were probably line-caught. Hout Bay Cave is the only site in this area where mullet (*L. richardsonii*) feature strongly, and even here the numbers remain low. There is no data available regarding the sizes of the fish procured, but the Palmiet River is 600 m south of the cave. The mouth of the river was active as an estuary during the early 1960s allowing fishermen to trek for mullet, white stumpnose and white steenbras (Poggenpoel & Robertshaw 1981). Trek or trekking refers to a method of open boat seine net fishing primarily geared towards the exploiation of shoaling species such as mullet.

Gordon’s Bay Midden is the only site of this group that is not dominated by hottentot *P. blochii*. Here, the white stumpnose *R. globiceps* are prevalent with 218 individuals identified, all from layer 3, dated to 3 220 ± 55 (Gr N-4374) (van Noten 1974). Seventy percent of the total fish assemblage recovered comes from this layer. The remaining fish, from the two overlying layers, could be identified only to family level, as sparids, sharks and rays. The point of interest is in the size distribution of the stumpnose. One-hundred and fifteen were identified as adult and one-hundred and three as juvenile. This suggests that fishing took place both at the coast and in estuarine enviroments.

The assemblage of Rooiels Cave is interesting. Located on the banks of the Rooiels River estuarine species were extremely uncommon. The dominant species were *P.blochii* and black musselcracker, *C. nasutus* (Poggenpoel 1996). Black musselcracker are a solitary reef-dwelling species and although they are sometimes caught in fish traps they are commonly landed from rocky promontories (van der Elst 1993), although they are known as strong fighters. Here too, these were probably obtained by line-fishing, possibly targeting this particular species.

Open shell midden sites at Pearly Beach and Hawston shared similarities with the Cape Peninsula sites and also with DK1 and BNK1, although fishing in these areas was practised at a smaller scale. Four open shell middens at PB yielded fish remains, although only 20 fish were recovered. Seven of the 20 fish were identified as *Pachymetopon spp*. Single individuals of *R. globiceps*, *Sparodon durbanensis*, and *Dichisius capensis* were recovered. The rest of the fish remains could not be identified to family or species level. Another open shell midden in the Pearly Beach area, SFT 1, yielded 11 fish remains. Five types were identified, one individual of each of *Lithognathus spp*., *S. durbanensis*, *R. globiceps*, *Pachymetopon spp*., *D. capensis* and two individuals of indeterminate species (Avery 1976).

The Hawston midden sample (HAW 1) yielded a total of 69 fish. The range of species retrieved was limited. Thirty-seven *Pachymetopon spp*. were recovered, comprising the bulk of the assemblage. Only three *Lithognathus spp*. were identified and 29 individuals were of indeterminate species. Six stratigraphic layers were excavated with Layer 2 dated to 1 860 ± 60 (Pta-834) and Layer 6 to 1 900 ± 40 (Pta-835) (Avery 1976).

At Garcia State Forest fish was retrieved from five of the eight sites excavated namely, GSF 1, 2, 6, 7 and 8. Two methods were used to calculate MNIs, counts on cranial bones and counts on post-crania. The first method yielded a total MNI of 112 individuals, and the second 136, a relatively minor difference (Henshilwood 1995). This suggests that fish were not being processed elsewhere and brought into the area or transported elsewhere. Fishing was most intensive at sites at GSF 6 and 8, with 10 of the eleven species identified present at site GSF 8. This site yielded the most fish, 97 in total and GSF 6 yielded 23. The black musselcracker, *C. nasustus* was the most common species of fish present at GSF, accounting for 42% of the total number of fish recovered. This species was most abundant in GSF 8 with 48 individuals and at GSF 6 with 17 individuals, accounting for 49.5% and 74% respectively of the total MNIs. The mullet *L. richardsonii* is present only at GSF 8, 19 individuals comprising 19.6% of the assemblage. There are no fish traps in the immediate vicinity of the

GSF sites. The closest fish traps are 18 km west at Steenbokfontein and 20 km east at Still Bay. Mullet regularly shoal in the shallows at Blombos beach, and may have been caught with nets (Henshilwood 1995).

The Later Stone Age sequence at Blombos Cave dates to within the last 2 000 years. Four hundred and sixty eight individuals have been identified representing eleven species. *Liza richardsonii, Chrysoblephus cristiceps* and *Chrysoblephus laticeps* were the commonest occurring species. The southern mullet was the most abundant with 64 individuals identified. MNIs derived from vertebrae are considerably lower than those derived from the cranial bones in all the layers. Van Niekerk (2004) suggested that this could indicate that the fish were being processed at the site and the post-crania transported elsewhere. Alternatively people were chewing the vertebrae which are not too difficult to do with mullet.

There are several important sites along the south east coast which yielded abundant fish remains. However, with the exception of Nelson Bay Cave, the fish remains from most sites have not been systematically studied. Sites for which such information exists are Nelson Bay Cave (Inskeep 1987), Storm River 1 and 2 (also known as Swartrif Midden) (H. J. Deacon 1970), and an open shell midden near Cape St. Francis called FTS (Binneman 1995). Limited to no data is available for earlier excavations at Oakhurst and Matjes River Rock Shelter. Oakhurst is central to this study as it was the fish remains recovered from this site that led Goodwin (1946) to postulate the antiquity of fish traps investigated in this thesis. Recently excavated sites such as the Kabeljous River Shelter and re-excavations of Klasies River Cave 1 and Cave 5a and many open shell midden sites along Cape St. Francis focus only on changes in fish bone densities, not species identifications. (Binneman 1995).

At Nelson Bay Cave fishing was clearly a major economic endeavour. Well over 14 000 fish have been identified representing 19 species. Fourteen species of fish were common of which 7 are associated with rocky locations, and may have been caught from anywhere on the Robberg Peninsula (Inskeep 1987). Poggenpoel (1996) suggested that the presence of blennies and *Clinidae* in the mid-Holocene levels may indicate the use of fish traps. However, as no such features exist in the vicinity of the cave it is more likely that they were obtained from rock pools which are exposed below the cave during periods of low tide (Inskeep 1987). Inskeep (1987) suggested that during the mid-Holocene high sea stand it may have been necessary to go further, to the south side of the Peninsula where it joins the mainland, to collect these fishes.

Frequency and diversity of fish species appear to be stratigraphically patterned at NBC. There are two periods in which fish enter the cave in reduced numbers. The first period dates to around 5 300 B.P. and the second to around 3 300 B.P., and appear to be associated with broad changes in artefact classes. The densities of certain species (*C. nasutus*, *L. mormyrus*, *P. blochii*, and *P. rupestris*) are low and decrease through time. The elf *P. saltatrix* was intensely harvested in the lower units (148-104) but was neglected in the middle and upper units. A similar pattern was observed for *R. globiceps* (Inskeep 1987).

Other species such as *Diplodus sargus capensis* and *Sarpa salpa* were procured in high numbers in the lower and middle units. There was also an increase in the number of *Seriola lalandi* and *D. sargus capensis* procured in the middle units. At NBC the most marked change occurs from the middle to upper units. There is an emphasis on three species in the upper units, *S. lalandi*, *L. lithognathus* and *S. salpa*. Catches of *S. lalandi* (yellowtail) became more regular in the upper units and there is also an increase in size. Although the numbers of *L. lithognathus* are low in comparison to some of the other species, this species is 9 times more abundant in the upper units compared to the underlying units. The presence of *D. sargus capensis* declines by almost 40% in the upper units. Importantly the weight of fish consumed in the upper units is twice what it had been previously (Inskeep 1987).

The southern mullet *L. richardsonii* was not particularly important at NBC, and its presence is sporadic. The Piesang River is located 5 km north of the cave and has a well developed tidal estuary. It has been suggested that this location was the likely source for both the southern mullet and the sand steenbras *Lithognathus mormyrus* (Inskeep 1987).

The two Storms River sites yielded few remains of fish. At Swartrif Midden 20 fish were identified of which *D. sargus capensis* was most abundant. At Storms River 1 26 fish were recovered with the same species the highest contributor (H. J. Deacon 1970). Of the sites excavated by Binneman (1995) in the Cape St. Francis area, fish remains have been identified only from a small open shell midden (FTS) between Thyspunt and White Point. Two fish traps were noted in the area. The midden was located near a large fish trap and yielded fish remains and pottery. The species found in this site are given in Table 2.1. *Sarpa salpa* (streepie) was the most common fish identified, while other species contributed little to the assemblage (Binneman pers. com.). A single southern mullet individual was identified. Considering the proximity of this midden to the fish traps in the area it is of interest that mullet, the most common species caught in fish traps are not present in significant quantities at this site. *S. salpa* are small, attaining a size of 30 cm. They occur in rock pools and on shallow near-shore reefs. The fact that the bones of such small fish were well preserved at FTS indicates that conditions of preservation were good, and if larger fish had been present, they would have been recovered.

As mentioned above, the only information available on fish remains from other sites in the Cape St. Francis area reports densities of fish bone, not identifications. At the Kabeljous River Shelter fish weight per volume peaked at 4 450 B.P., 3 250 B.P. and 2 150 B.P. The mean fish bone mass per volume in the more recent units were slightly higher than that of the mid-Holocene Wilton unit. At Klasies River Cave 5a the fish bone volume was marginally higher in the Wilton units compared to the later Kabeljous units. Fish bone peaked at ca. 3 300 B.P., thereafter declining and peaking sharply between ca. 2 800 and 2 500 B.P. The surface units yielded low densities of fish bone (Binneman 1995).

The general pattern described above indicates that local habitat factors such as coastal topography play a vital role in determining fishing strategies and what fishes are being caught. We have information on fish remains from a number of sites along the Western Cape coast, but more work is needed to understand the overall pattern. Further work is needed especially for the area of the south coast, particularly between Cape Agulhas and Mossel Bay. We have information only from the Blombos/Garcia State Forest area.

2.5 Fishing technology

Pre-colonial fishing technology in South Africa is not well understood. The earliest evidence comes from three sites: Nelson Bay Cave (Inskeep 1987), Byneskranskop (Schweitzer & Wilson 1982), and Elands Bay Cave (Parkington 1977). These Caves have yielded small slivers of bone, smoothed and sharpened at both ends, commonly known as fish gorges, and thought to have been used to catch fish. This type of artefact is known only from coastal sites, and appear to be similar to ethnographic examples. Mr. Pike of the Gouritz River told Goodwin (1946: 140), that years before a fisherman "found stuck away in a hole a fishing line made from a certain wild vine of fibrous texture. This had been shredded and turned into fishing line, and the hook was a bone tied in the middle and sharpened on each side". Maclaren (1958) on the other hand, noted that amongst fishermen in Mozambique the thorns of *Acacia* are used as fish hooks. At EBC fish gorges are associated with deposits dating to between 10 000-8 500 years ago (Poggenpoel 1996), and at BNK 1 eight fish gorges date to within this period (Schweitzer & Wilson 1982). The fish gorges from NBC were also found in deposits dated to the same time period (Inskeep 1987). A single fish gorge, similar to the ones describe from the sites mentioned above have been found at Smitswinkel Bay Cave on the Cape Peninsula. It was found in a layer dated to 1 420 ± 35 B.P. (Pta-2198), and is the only known fish gorge from deposits later than 7 000 B.P. (Poggenpoel 1996).

Small rounded stones often made from indurated shale, with grooves ringing them, have been speculated to be either line sinkers or net weights. Examples have mainly been found in sites along the south coast, Matjes River Shelter (Low 1960), Swartrif Midden (H. J. Deacon 1970), Nelson Bay Cave (Inskeep 1987). More recently, stone sinkers have been found at Noetzie near Knysna (Halkett pers. comm). At Matjes River, five sinkers have been identified, two from Layer A and three from Layer B (Ludwig 2005). Layer A is undated but could date anywhere in the last 3 000 years. Inskeep (1987: 418) reported 138 sinkers from NBC, but they are common only in levels aged 3 500 B.P. and younger (Ludwig 2005).

It is possible that nets may have been used for fishing purposes. There are few examples of cord and twine recovered from dry caves, where conditions of preservation are especially good. At Melkhoutboom netting made from *Cyperus textilis* were found (H. J. Deacon 1974). Deacon beliefs that the mesh size of ± 10 mm would have been too fine to be used in fishing or hunting and suggested that it may have been used for carrying plant foods, i.e. corms or bulbs. Parkington and Poggenpoel (1971) reported that various sorts of twine or string were manufactured from plant fibres at De Hangen. The strongest were made from the stem of *Cyperus* twisted into a two stranded twine some 5 mm thick. Three pieces of this were recovered from the excavation. In addition, a fourth piece of string 3 mm in diameter made from different plant fibres was also found. Other specimens included a long length of curved fibre made from the stem of a reed or rush, and a piece of string 30 cm long made from twisted stem fibres of a grass or rush. These examples illustrate that indigenous people had the knowledge to manufacture various string or twine artefacts from plant fibres. It is possible that netting for fishing purposes may also have been made, but did not preserve because of poor preservation conditions in coastal areas.

2.6 Summary

The first part of this chapter surveyed some issues in the study of coastal hunter-gatherers around the world, including the role that processes of intensification play in restructuring subsistence and social organizing strategies. The second part of this chapter examined aspects of the Holocene archaeology of the Western and Eastern Cape of South Africa. The evidence suggests that hunter-gatherer groups in the area were intensifying their use of resources from the mid-Holocene. In this chapter I indicated that, in the temperate climate of the south coast where resources are expected to be available year round, fish traps are likely to have been built as a result of population pressure. It would be interesting to investigate whether these features constituted personal property and catches thereof unequal access to wealth.

CHAPTER 3

Excavations at Paapkuil Fontein 281, Cape Agulhas

3.1 Introduction

Vywerbaai is a small bay located about 5–10 km west of the fishing village of Struisbaai (Fig. 3.1). “Vywer” is the local Afrikaans name for “fish trap” and “Vywerbaai” would translate into “fish trap bay”. Towards the middle of 2004 the Archaeology Contracts Office (ACO), based at the Department of Archaeology, University of Cape Town, conducted a Phase 1 Archaeological Impact Assessment of Portion 15 of the farm Paapkuil Fontein 281, Cape Agulhas, immediately inland from Vywerbaai. The area surveyed consisted of 53 hectares of coastal strandveld including low coastal and secondary dunes running the breadth of the site (Hart 2004). The adjacent shoreline is characterised by a rocky shoreline, gentle sloping boulder beaches and gullies which contain numerous stone walled tidal fish traps in various states of preservation (Fig. 3.2).

Eleven variously preserved Later Stone Age (LSA) shell middens were identified during the survey and numbered Paapkuil Fontein 1-11 (Fig. 3.2). Mitigation of the shell middens was recommended to offset the impact of proposed low density residential development. The proposed mitigation provided an opportunity to excavate and analyse the contents of some of the middens and in so doing determine if any evidence existed linking the middens to the use of the fish traps. If so, and if it should prove possible to obtain radiocarbon dates for the relevant remains, this could provide a date for the use of the traps. This chapter reports the findings of the excavations at Paapkuil Fontein 281.

Paapkuil Fontein 281 borders the Cape Agulhas National Park on both sides. The area experiences a Mediterranean climate with hot dry summers and wet cool winters. The prevailing wind blows from the southeast during the summer and northwest during the winter.

It receives approximately 450 mm of rainfall per annum, with most of this falling during the winter. Daily temperatures range between 17 °C-23 °C in the summer and between 10 °C-16 °C in the winter. The Agulhas plain is considered one of the most important components of the Cape Floral Kingdom and includes some 2 000 indigenous species of which 100 are endemic to the area. Vegetation consists primarily of Overberg Dune Strandveld extending from Cape Hangklip to Cape Agulhas.

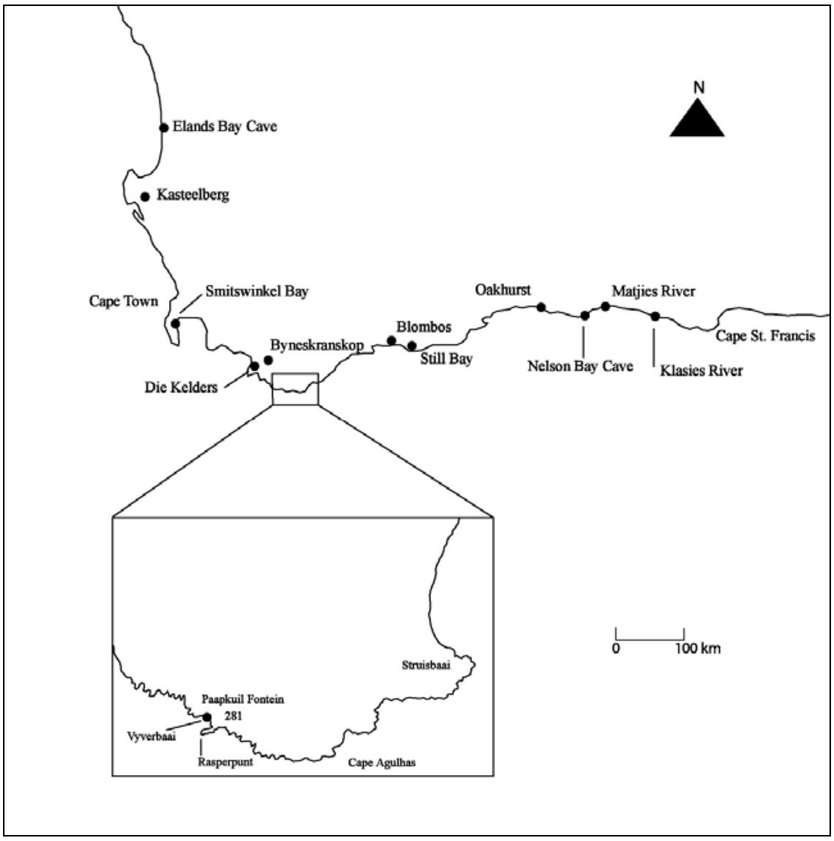


Figure 3.1. Map showing the location of Paapkuil Fontein and other important archaeological sites along the southern Cape.

3.2 Choice of sites and excavation methods

Four shell middens namely Paapkuil Fontein 4, 5, 7 and 11, were chosen for excavation. Figure 3.2 indicates their positions relative to the fish traps. These four middens were chosen because of their proximity to the fish traps, and because they appeared to have some depth of deposit, therefore offering the best possibility of preserving *in situ* fish remains. Middens containing a range of material were favoured as this would allow one to investigate the range of activities conducted at the site. Middens not chosen for excavation consisted of thin scatters of surface material or sites disturbed by road building activities or natural erosion processes.

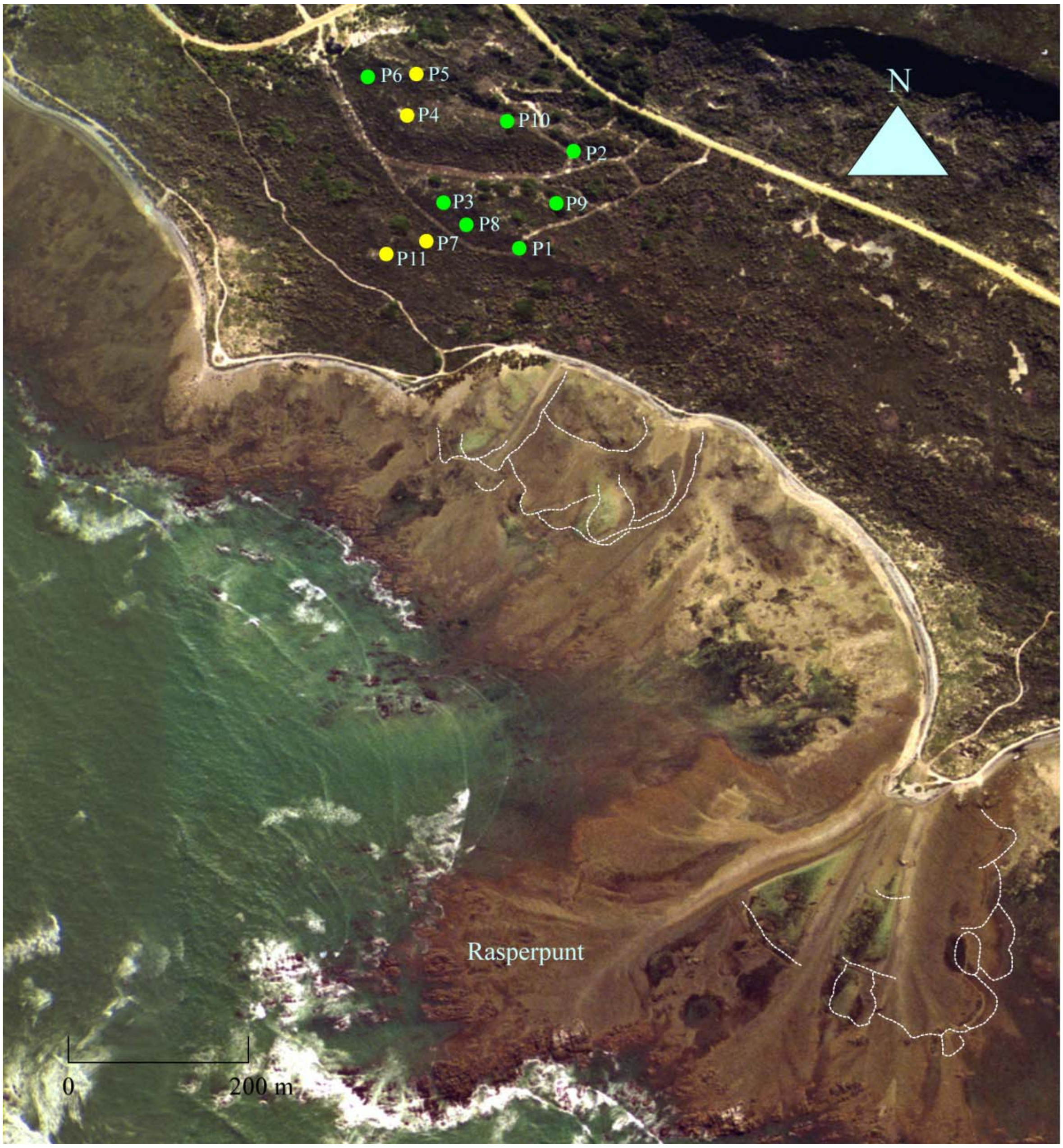


Figure 3.2. Map showing locations of Paapkuil Fontein shell middens and nearby stone-walled tidal fish traps.

The Paapkuil Fontein sites were excavated in 1 m x 1 m squares laid across the densest part of the midden. Where possible, sites were excavated according to natural stratigraphy, occupation layers or changes in sediment colour, consistency or texture. In sites where no stratigraphic indicators could be discerned, deposit was removed in arbitrary 10 cm spits.

Unless otherwise stated, all deposit was passed through a 3 mm mesh sieve. Initially, we tried to sieve through a 3 mm nested over a 1.5 mm mesh sieve, but because the sand was damp, very little went through the finer mesh. We subsequently abandoned this approach, and used only the 3 mm mesh sieve. All material recovered from the sieves was retained, clearly labelled and bagged in brown military sand bags for later analysis in the lab. Radiocarbon dates were calibrated using the Pretoria calibration curve for the southern hemisphere (Talma and Vogel 1993), updated in 2000. Calibrated dates are given at a one sigma range.

3.3 Paapkuil Fontein 4

This shell midden was located high on a dune, situated about 300 metres inland of the fish traps (Fig. 3.2). This midden was overlain by sterile dune sand. Deposit was eroding out of the side of the dune, including shell, ostrich eggshell and flaked stone. A part of the midden appeared to have eroded out in this way, making it difficult to estimate the original size of the site. Figure 3.3 shows part of the midden before excavation.

Figure 3.3. Part of Paapkuil Fontein 4 before excavation showing midden deposit eroding out the side of the dune.

This site was chosen for excavation because it contained a relatively wide range of archaeological material. Preservation of *in situ* deposit was expected to be good as dune sand covered much of the remaining midden. The overburden was removed with the aid of the spades, and was not screened as it was wind deposited dune sand.

Three and a half 1 m x 1 m squares were excavated H9, H10, H11 and G10. Only half of the square adjacent to H10 could be excavated, due to the slope of the dune. The deposit in squares H11 and G10 thinned out considerably, probably approaching the edges of the midden.

3.3.1 Stratigraphy and Dating

No stratigraphic layers could be discerned. Ten centimetre spits were excavated to retain some stratigraphic control and aid comparison across squares. Four spits were removed from each square with the exception of square H10 where a fifth spit was also excavated, after the overburden was removed. This was the base of the deposit, with sterile sand underneath. Figure 3.4 shows the section drawing.

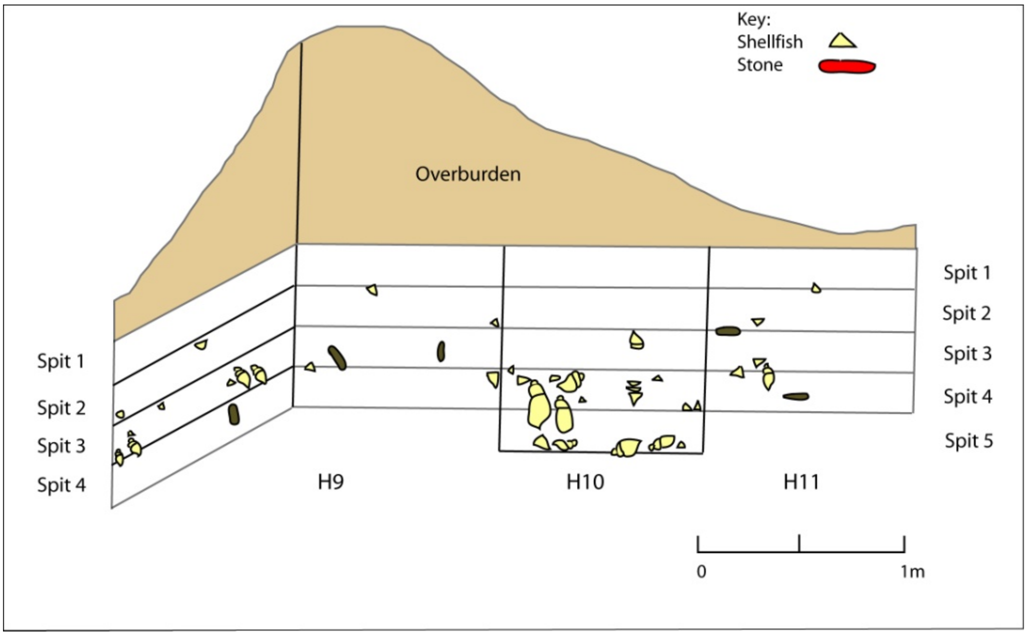


Figure 3.4. Section drawing of H/I section, and H8/H9 section.

A single radiocarbon date was obtained on marine shell from square H10 spit 4, yielding a date of 4 870 ± 80 B.P. (GX-32533). This was the area in which finds were the most dense.

3.3.2 Results

A total area of 3.5 m² was excavated constituting 1.5 cubic metres of deposit, excluding the overburden. In total, 72.0 kg of archaeological material was retrieved after sieving. Marine shell comprises the bulk of this at 43.7 kg, stone: 28.2 kg, ostrich eggshell: 102g, bone: 12.7g and ochre: 8.2g. All of the material recovered has been analysed and is reported below.

3.3.3 Lithics

The numbers and percentages of the stone recovered are given in Table 3.1. Of the 37 stone pieces recovered all were quartzite. There were no retouched artefacts. Twenty-four manuports account for 65% of the total assemblage. Three hammerstones were recovered, two from squares H10 spit 4 and spit 5 and one from G10 spit 2. A single upper grindstone was recovered from square H9 spit 3.

Table 3.1. Stone artefact assemblage of Paapkuil Fontein 4.

Class	Raw material	Spit 1	Spit 2	Spit 3	Spit 4	Spit 5	Total
Chips	Quartzite	1			1	1	3
Chunks	Quartzite		2		1	1	4
Core	Qaurtzite				2		2
Non - Utilized manuports	Quartzite	8	3	1	7	2	24
Utilized Hammerstones	Quartzite		1		1	1	3
Upper grindstone	Quartzite			1			1

A flat stone which was perhaps collected with the intention of using it as a lower grindstone was recovered from square H11 spit 2 (Figure 3.5). This was included in the manuports category. The scarcity of formal stone artefacts in late Holocene southern Cape coastal sites has been well documented (Maggs & Speed 1967; Klein 1974; Avery 1976, Robertshaw 1979; Poggenpoel & Robertshaw 1981; Binneman 1995; Henshilwood 1995) and may indicate that these did not play a major role in food procurement. At any rate, it appears the activities undertaken at this site did not require the use of formal stone artefacts. The date of 4 870 ± 80 B.P. (GX-32533) (with a marine correction of - 500 years for the apparent age of sea water, ca 4 370 B.P.) is, however, rather earlier than most of these informal coastal lithic assemblages.

Figure 3.5. Flat stone recovered from square H11 spit 2. Scale in 10 mm intervals.

Interestingly, only Binneman's (1995) work at Klasies River Cave 1 has yielded a similarly early date of 4 700 B.P. for the macrolithic quartzite industry he calls the Kabeljous. The assemblage from Paapkuil Fontein 4 is small, and it is difficult to know whether a larger sample might have included rare retouched pieces. On the basis of the evidence available, however, this assemblage appears to be an early late Holocene macrolithic assemblage, which lacks formal retouch.

Three pieces of ochre were recovered from Paapkuil Fonetin 4. All three pieces were from spit 3, two from square H10 and one from square H9. The pieces are fairly small and none showed any visible signs of grinding.

3.3.4 Ostrich eggshell

In total, 47 ostrich eggshell fragments weighing 102 grams were recovered. None of the pieces has been worked and no beads were found. The majority of the fragments come from Square H10, with 37 fragments retrieved from Spit 3 and 6 fragments from Spit 5.

3.3.5 Shellfish

All of the shellfish remains recovered were identified, counted, and where possible, measured. Minimum numbers of individuals and percentage values for the different species are given in Table 3.2. A wide range of inter-and sub-tidal species was exploited at this site. Two species of shellfish, the alikreukel *Turbo sarmaticus* and limpet *Scutellastra longicosta* comprise the bulk of the shellfish assemblage at 34% and 22.9% respectively, 56.9% of the site total. The limpet *Cymbula oculus* was the third highest contributor at 8.7% of the total assemblage. None of the other eighteen species identified contributed more than 8% of the assemblage. This pattern remains relatively consistent throughout the spits and suggests that shellfish collecting remained relatively constant through time. However, percentage values for *S. longicosta* are lower in spit 1 in comparison with the other spits. The inverse pattern applies to *T. sarmaticus* with higher percentage values in spit 1 in comparison to the other spits. This may indicate a subtle difference in shellfish collection in spit 1.

T. sarmaticus can be found in the mid-tidal region and sub-tidally to a depth of 7 metres. *S. longicosta* inhabits the mid-tidal region (Kilburn & Rippey 1982). While other species of shellfish were collected, each contributed only a small percentage to the total assemblage. Meehan (1982) reported that during her stay with the Anbarra of Arnhem Land Northern Territory (Australia) shell collection primarily targeted one species, whilst other species supplemented and added some variety to the main course. It is possible that shellfish collecting at Paapkuil Fontein 4 followed similar lines.

Table 3.3 shows the mean shell lengths for the different species of limpets and the maximum diameters of opercula of Turbo species. Mean shell length for the different species remains relatively constant throughout the deposit, taking into account the standard deviations. The mean diameters of *Turbo sarmaticus* opercula range from 21.8 to 25.6 mm. The size distribution of opercula of *Turbo sarmaticus* are shown graphically in Appendix A. In the sample as a whole, and in all spits except for spit 5, opercula with diameter between 20-24.9 mm are most abundant. The distribution is slightly skewed to larger classes, with the biggest opercula measuring 45.0-49.9 mm. In spit 5, opercula measuring 15.0-19.9 mm and 25.0-29.9 mm are slightly more abundant than 20.0-24.9 mm. This may reflect greater availability of larger individuals during the earliest occupation of the site. The sample from spit 5 is, however, smaller than those from the other spits, so this explanation must be treated with caution.

Table 3.2. MNIs and percentage values for shellfish excavated at Paapkuil Fontein 4.

	Spit 1		Spit 2		Spit 3		Spit 4		Spit 5		Total	
Species	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**
Scutellastra cochlear	75	9.4	10	1.6	5	0.4	5	0.4	–	–	95	2.2
Scutellastra longicosta	112	14.1	161	25.7	275	23.5	314	24.5	123	29.0	985	22.9
Scutellastra Barbara	25	3.1	18	2.9	44	3.8	49	3.8	13	3.1	149	3.5
Scutellastra barbara/longicosta?	12	1.5	8	1.3	31	2.6	21	1.6	9	2.1	81	1.9
Scutellastra argenvillei	–	–	–	–	3	0.3	2	0.2	–	–	5	0.1
Scutellastra granularis	–	–	–	–	1	–	–	–	1		2	–
Cymbula oculus	42	5.3	51	8.1	101	8.6	140	10.9	39	9.2	373	8.7
Cymbula miniata	–	–	–	–	3	0.3	–	–	2	0.5	5	0.1
Dinoplax gigas	2	0.3	2	0.3	1	–	4	0.3	2	0.5	11	0.3
Limpet spp.	88	11.1	13	2.1	56	4.8	27	2.1	14	3.3	198	4.6
Turbo sarmaticus	320	40.3	196	31.3	393	33.6	426	33.3	123	29.0	1458	34.0
Turbo cidaris cidaris	8	1.0	1	0.2	7	0.6	11	0.9	2	0.5	29	0.7
Oxystele tigrina	8	1.0	50	8.0	73	6.2	87	6.8	25	5.9	243	5.7
Oxystele sinensis	41	5.2	45	7.2	76	6.5	98	7.7	27	6.4	287	6.7
Oxystele variegata	–	–	2	0.3	–	–	–	–	–	–	2	–
Oxystele spp.	16	2.0	36	5.7	53	4.5	12	0.9	19	4.5	136	3.2
Haliotis midae	2	0.3	7	1.1	4	0.3	1	–	1	0.2	15	0.3
Haliotis spadicea	–	–	–	–	3	0.3	1	–	–	–	4	–
Burnupena spp.	43	5.4	27	4.3	40	3.4	81	6.3	24	5.6	215	5.0
Perna perna	–	–	–	–	1	–	–	–	–	–	1	–
Total	794	100	627	100.1	1170	99.7	1279	99.7	424	99.8	4294	99.9

Table 3.3 Mean sizes and standard deviations for the measured shellfish at Paapkuil Fontein 4. All measurements in mm.

Turbo cidaris cidaris opercula	8	13.1	11.5	15.9	1.7	1	8.8	–	–	–	7	10.8	9.5	12.7	1.3	11	10.3	8.2	14.3	1.7	2	11.2	9.5	13.1	2.5
Scutellastra cochlear	18	32.4	24.5	51.1	6.2	3	27.5	19.9	38.1	9.1	2	33.6	29.3	38.6	6.6	1	31.2	–	–	–	–	–	–	–	–
Scutellastra longicosta	75	56.8	43.4	76.2	6.1	90	57.7	41.2	71.9	6.5	124	58.8	44.9	73.6	6.3	161	58.0	5.3	64.1	4.6	48	60.3	48	77.4	5.8
Scutellastra barbara	22	63.1	50.0	74.9	7.0	12	58.5	46.0	73.0	9.7	26	63.1	52.3	73.2	6.0	36	63.3	8.2	44.9	8.2	11	66.3	50	94.4	11.7
S. barbara/longicosta ?	8	53.3	45.1	65.1	7.4	–	–	–	–	–	11	56.4	45.8	72.8	9.0	15	63.3	7.4	46.9	7.4	4	58.2	49	66	7.4
Scutellastra argenvillei	–	–	–	–	–	–	–	–	–	–	3	64.9	58.4	68.9	5.8	1	68.9	–	–	–	–	–	–	–	–
Scutellastra granularis	–	–	–	–	–	–	–	–	–	–	1	43.0	–	–	–	–	–	–	–	–	1	34.0	–	–	–
Cymbula oculus	20	59.5	41.2	75.4	7.6	22	60.9	48.9	75.7	6.5	29	63.2	54.1	75.6	4.9	62	61.6	5.7	43.8	5.7	15	61.3	52	68.6	5.4
Cymbula miniata	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	67.1	56	80.2	16.9

3.3.6 Bone

Bone was extremely rare. In total, 53 fragments were recovered weighing 13.2 grams. Bone recovered was very fragmented which made identification extremely difficult. Five animals could be identified: steenbok, tortoise, small mammals, micromammals and snake. The minimum number of individuals for each was one (Table 3.4). A single fish vertebra was found in square H10 spit 3. It could not be identified to species level. With only one fish bone found during excavation it is possible that it may have been brought onto the site by a non-human agent.

Table 3.4. Faunal remains from Paapkuil Fontein 4.

Fauna	**NISP**	**MNI**	**Burnt/blackened**
Steenbok	1	1	–
Tortoise	5	1	2
Snake	1	1	–
Small Mammal	9	1	4
Micromammal	2	1	–
Unidentified	35	–	–
Fish	1	–	–
Total	54	6	6

3.4 Paapkuil Fontein 5

This was the largest of the four shell middens excavated at Vyverbaai, situated about 330 metres from the fish traps near the top of a dune. This midden was chosen for excavation because a compact mass of *in situ* shell, approximately 40 cm thick, and which appeared to retain good stratigraphy was visible eroding out the edge of the dune. The lens comprised tightly compacted *Oxystele spp*. The exact size of the midden could not be ascertained as much of it had been covered by dune sand. In addition, some of the material had been exposed and lost by erosion.

Five 1 m x 1 m squares were excavated numbered E10, D10, D11, D12 and D13 (Fig 3.6). Due to the bulk of finds (again, mostly shellfish) recovered only the material from square D11 has been analysed. Finds from the other squares are available for possible future analysis.

Figure 3.6. Excavated squares at Paapkuil Fontein 5 after both shell layers had been removed from E10, D10 and D11. Square E10 is in the top left hand corner and square D10 adjacent to it. Note the presence of a lower grindstone in the picture in square D12/13.

3.4.1 Stratigraphy and Dating

Stratigraphy was more complicated than at the other middens excavated. Figure 3.7 shows the section drawing for this midden. A sterile dune sand overburden approximately 50 cm in depth was removed with spades until the shell rich levels were reached. Excavation was then continued with trowels. The archaeological deposit was characterised by a dark grey sandy loam, wedged between over and underlying sterile white dune sand. This indicated that the deposit was *in situ* and relatively undisturbed.

Excavation began in square E10. This was bioturbated and excavated in arbitrary 10 cm spits. The "Surface" spit was mainly sterile with infrequent shell, probably the result of bioturbation of material from the underlying *in situ* layer. Below "Surface", four spits were removed from E10. It was subsequently possible to recognise, in the adjacent square D10, two shell layers 1 and 2, separated by a thin layer of sandy loam.

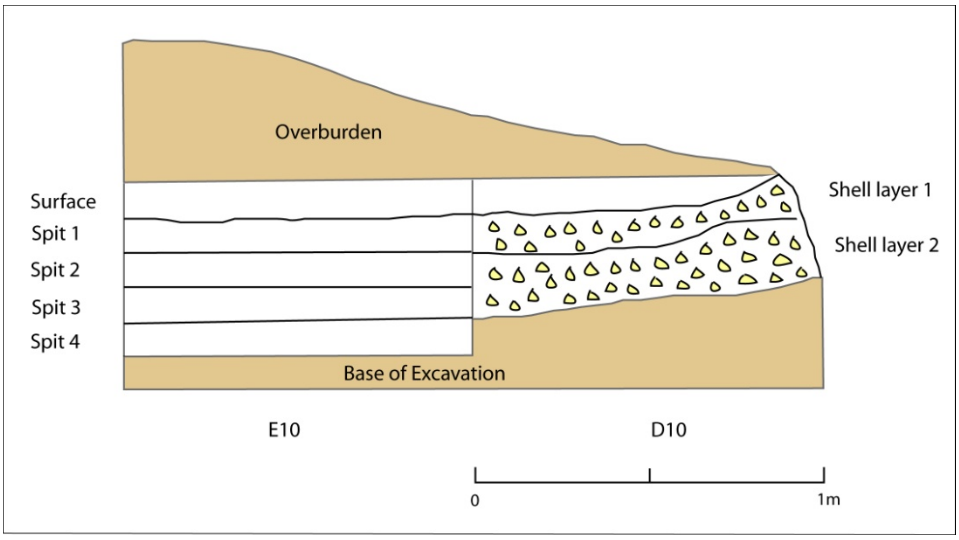


Figure 3.7. Section drawing along 10/9 line.

These shell layers were followed across squares D11 and D12, but layer 1 appeared to wedge out towards square D13. In D13 shell layer 1 was not clearly defined; the surface layer appeared to be directly underlain by shell layer 2.

Two radiocarbon dates on marine shell were obtained for this site. Marine shell from D11 shell layer 1 yielded a date of 2 250 ± 60 B.P. (GX-32529). Marine shell from shell layer 2 from the same square yielded a date of 2 320 ± 70 B.P. (GX-32531). The dates overlap at two standard deviations and suggest that these layers are very close in age, if not identical.

3.4.2 Results

A total area of 5 m² was excavated constituting 1.7 cubic metres of deposit. In square D11, 0.4 cubic metres of deposit was removed, which yielded 82.9 kg of archaeological material after sieving. Since this is, by itself, a large quantity of material, only the finds from square D11 have been analysed and are reported here. A breakdown of the finds is as follows, marine shell: 80.4 kg, stone: 2.4 kg, bone: 21.3g, ostrich eggshell: 11.3g, ochre: 7.8g and charcoal: 42.7g. All of the material from D11 has been analysed and is reported below.

3.3.3 Lithics

One hundred and thirty seven stone artefacts were recovered from square D11, and are listed in Table 3.4. Quartzite was the dominant raw material accounting for 78.1% of the site total, quartz 21.2% and silcrete 0.7%. Much of the quartzite is in the form of manuports, rather than

Table 3.5. Stone artefact assemblage from Paapkuil Fontein 5, square D11

		Overburden		Surface		Shell layer 1		Shell layer 2		Total	
Class	Raw Material	n	%	n	%	n	%	n	%	n	%
Chips	Quartz	–	–	–	–	5	45.5	3	13.6	8	36.4
	Quartzite	–	–	–	–	–	–	–	–	–	–
	Silcrete	–	–	–	–	–	–	–	–	–	–
Chunks	Quartz	1	16.7	–	–	5	45.5	10	45.5	16	38.1
	Quartzite	2	33.3	2	66.7	–	–	7	31.8	11	26.2
	Silcrete	–	–	–	–	–	–	–	–	–	–
Cores	Quartz	1	16.7	–	–	1	9.1	–	–	2	4.8
	Quartzite	–	–	–	–	–	–	–	–	–	–
	Silcrete	–	–	–	–	–	–	–	–	–	–
Flakes	Quartz	2	33.3	–	–	–	–	2	4.5	3	7.1
	Quartzite	–	–	1	33.3	–	–	1	4.5	2	4.8
	Silcrete	–	–	–	–	–	–	–	–	–	–
Total Waste	Quartz	4	66.7	–	–	11	100.0	14	63.6	29	69.0
	Quartzite	2	33.3	3	100.0	–	–	8	36.4	13	31.0
	Silcrete	–	–	–	–	–	–	–	–	–	–
	Total	**6**	**100.0**	**3**	**100.0**	**11**	**100.0**	**22**	**100.0**	**42**	**100.0**
Non - utilized											
manuports	Quartzite	–	–	17	100.0	34	100.0	36	100.0	87	100.0
Total non-utilized		**–**	**–**	**17**	**100.0**	**34**	**100.0**	**36**	**100.0**	**87**	**100.0**
Utilized											
Hammerstones	Quartzite	–	–	–	–	2	100.0	2	100.0	4	66.7
Upper grindstones	Quarzite	–	–	1	50.0	–	–	–	–	1	16.7
Chopper	Quartzite	–	–	1	50.0	–	–	–	–	1	16.7
Total utilized		**–**	**–**	**2**	**100.0**	**2**	**100.0**	**2**	**100.0**	**6**	**100.0**
Retouched		–	–	–	–	–	–	–	–	–	–
MRP	Quartz	–	–	–	–	–	–	1	50.0	1	50.0
	Silcrete	–	–	–	–	–	–	1	50.0	1	50.0
Total retouched		**–**	**–**	**–**	**–**	**–**	**–**	**2**	**100.0**	**2**	**100.0**

flaked pieces. Within the waste category, quartz accounts for 69% of the site total and quartzite the remaining 31%.

Two miscellaneous retouched pieces were found in shell layer 2, one on quartz and the other on silcrete. Two lower grindstones were found. These come from the surface of square C13 and in shell layer 2 of D12. The grindstone from D12 (Fig. 3.8) has an elongated, linear grinding surface and with time would perhaps have developed a groove, similar to examples excavated at Kasteelberg B, on the Vredenburg Peninsula, although this is speculative. These grindstones are normally associated with herders and at Kasteelberg B date to the second millennium AD (Smith 2006). The lower grindstone recovered from the surface of C13 has a smooth flat grinding surface and seemed to have been broken (Fig. 3.9). The lower grindstones are not included in Table 3.5 because they did not come from D11.

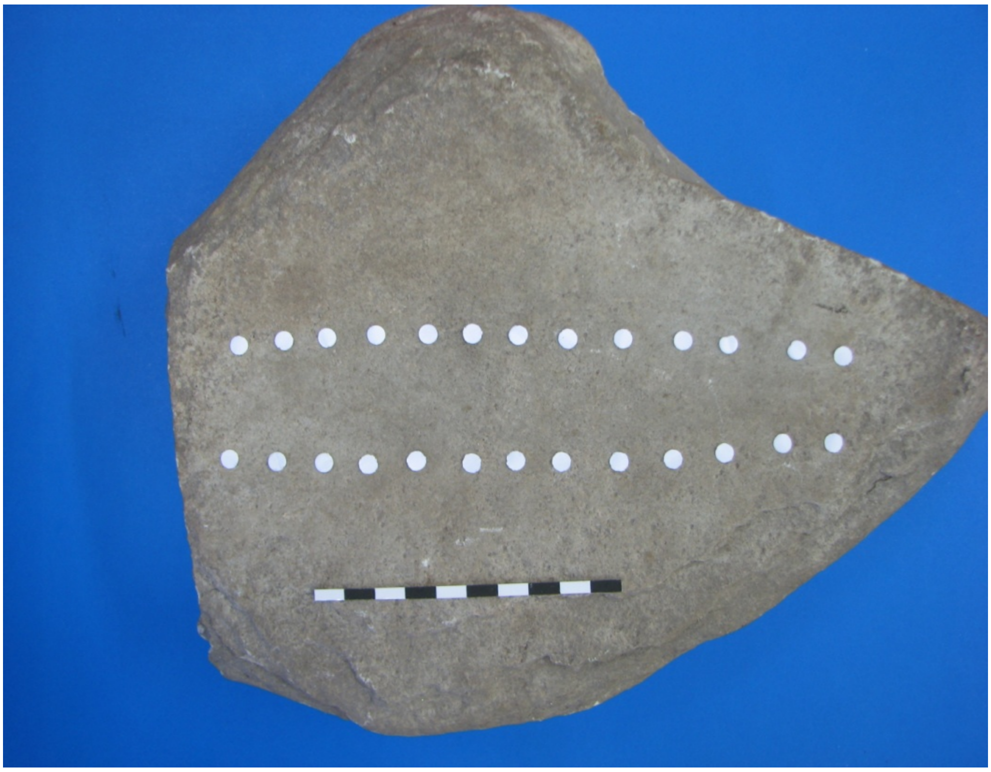


Figure 3.8. Lower grindstone recovered from Paapkuil Fontein 5, square D12 shell layer 2. Dotted line indicate elongated linear grinding surface. Scale in 10 mm intervals.

Figure 3.9. Lower grindstone with a smooth flat grinding surface recovered from Paapkuil Fontein 5, surface of square C13. It has been broken on the left-hand side. Scale in 10 mmm intervals.

3.4.4 Ostrich eggshell

Four ostrich eggshell fragments weighing a total of 11.3 grams were recovered from shell layer 1 square D11. None show any signs of working.

3.4.5 Shell artefacts

A single *Nassarius kraussianus* bead was found in shell layer 2. *N. kraussianus* are common in Holocene assemblages along the south coast, including Scott's Cave (Deacon & Deacon 1963), Wilton Large Rock shelter (J. Deacon 1972), Melkhoutboom (H. J. Deacon 1976), Boomplaas (Deacon *et al*. 1978), Die Kelders (Schweitzer 1979), Byneskranskop (Schweitzer & Wilson 1982), Nelson Bay Cave (Inskeep 1987), The Havens Cave (Binneman 1995), Klasies River Cave 5 (Binneman 1995) and the Kabeljous Shelter (Binneman 1995). They have also been reported from the Middle Stone Age at Blombos Cave (d' Errico *et al.* 2005) from levels dating to 75 ka and 78 ka by optically stimulated luminescence.

At Boomplaas the majority of the 30 *Nassa* beads found come from the BLD units dated to 1 955 ± 65 B.P. (UW-336) (Deacon *et al.* 1978). At BNK 1 (Schweitzer & Wilson 1982) they are present in Layers 14-1 with a date of 9 760 ± 85 B.P. (Pta-587) for their first appearance which is roughly contemporaneous with the situation observed in The Havens Cave sequence (Binneman 1995). This is somewhat earlier than the mid-Holocene date for their appearance in the Nelson Bay Cave sequence (Inskeep 1987). At DK 1 they are the largest component of the perforated shell ornaments accounting for about 55.2% of the assemblage (Schweitzer 1979).

3.4.6 Shellfish

All of the shellfish remains recovered from square D11 were identified, counted and when possible, measured. Minimum number of individuals and percentage values for the different species are given in Table 3.6. A wide range of inter and sub-tidal species were exploited. Two species of shellfish, *Oxystele tigrina* and *Turbo sarmaticus* comprise the bulk of the assemblage at 47.2% and 16.3% respectively, 63.5% of the assemblage. Three species of *Oxystele*, *O. tigrina*, *O. sinensis* and *O. variegata* were exploited accounting for 68.6% of the square total.

Paapkuil Fontein 5 is primarily an *Oxystele* midden, with *O. tigrina* being collected in abundance. This species is generally smaller than *O. sinensis,* which was also collected. *O. tigrina* is found higher up on the shore in the mid-tidal region, whereas *O. sinensis* normally inhabits the lower intertidal, accessible at spring low tides. This is true also of *T. sarmaticus* (Kilburn & Rippey 1982). *O. tigrina* are small so a large number are required to contribute significantly to the overall diet. One possible explanation for the relatively large quantities of *O. tigrina* in the assemblage is that this species may have been collected at times when some of the larger shellfish species were unattainable, perhaps periods other than spring low tides or in rough conditions when the lower reaches of the intertidal may have been too dangerous. With the exception of *Haliotis midae, T. sarmaticus* was the largest shellfish collected and was the most important food species. While percentage values for the other species remain low, three species namely *S. longicosta*, *C. oculus* and the giant chiton *D. gigas* were also collected in some quantities. Interestingly, Paapkuil Fontein 5 was the only site where *D. gigas* (1.9% or 136 individuals) were found in significant quantities. *Haliotis midae* are also present at the site but contributed less than 1% to the total assemblage. However, larger individuals provide good returns in terms of food (Avery 1976, McLachlan Lombard & 1981; Binneman 1995; Proudfoot *et al.* 2006).

Table 3.6. MNIs and percentage values of shellfish excavated at Paapkuil Fontein 5, square D11.

	Surface		Shell layer 1		Shell layer 2		Total	
Species	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**
Scutellastra cochlear	–	–	7	0.3	8	0.2	15	0.2
Scutellastra longicosta	7	1.4	49	2.0	87	2.1	143	2.1
Scutellastra barbara	2	0.4	–	–	–	–	2	0.02
Scutellastra barbara/longicosta?	–	–	–	–	7	0.2	7	0.1
Scutellastra argenvillei	–	–	12	0.5	26	0.6	38	0.5
Scutellastra granularis	2	0.4	5	0.2	9	0.2	16	0.2
Cymbula oculus	6	1.1	126	5.3	246	6.0	378	5.3
Cymbula granatina	–	–	–	–	1	0.02	1	0.01
Cymbula compressa	–	–	–	–	2	0.04	2	0.02
Dinoplax gigas	7	1.3	47	2.0	82	2.0	136	2.0
Limpets spp.	6	1.1	38	1.6	58	1.4	102	1.4
Turbo sarmaticus	94	18.4	329	13.8	736	17.5	1159	16.3
Turbo cidaris cidaris	–	–	–	–	3	0.07	3	0.04
Oxystele tigrina	95	18.6	1137	47.8	2121	51.0	3353	47.3
Oxystele sinensis	148	29.0	245	10.3	360	8.6	753	10.6
Oxystele variagata	–	–	3	0.1	–	–	3	0.04
Oxystele spp.	101	19.7	307	13.0	356	8.4	764	10.8
Haliotis midae	2	0.4	7	0.3	20	0.5	29	0.4
Haliotis spadicea	1	0.2	–	–	–	–	1	0.01
Burnupena sp.	40	7.8	71	3.0	72	1.7	183	2.5
Donax serra	–	–	–	–	1	0.02	1	0.01
Crepidula porcellena	–	–	1	0.04	8	0.2	9	0.1
Nassarius kraussianus	–	–	–	–	1	0.02	1	0.01
Total	511	100	2377	100	4196	100	7084	100

Their relatively low visibility at Paapkuil Fontein 5 may therefore be quite misleading. Although none of the shells recovered were sufficiently complete to measure, individuals present may have contributed significantly to the diet.

Measurements for the different species of shellfish excavated at Paapkuil Fontein 5 are given in Table 3.7. Taking into account the standard deviations there appears to be no significant differences in the sizes of the different species throughout the deposit. This is not surprising as the two dates obtained for this site are virtually identical. Size distribution of opercula of *Turbo sarmaticus* are shown graphically in Appendix A. The patterns seen here are rather different from those at Paapkuil Fontein 4. Smaller opercula (size classes 15.0-19.9 mm and 10.0-14.9 mm) are more common, although size class 40.0-44.9 mm is also relatively well represented. Overall, however, there are more smaller opercula at Paapkuil Fontein 5 than at Paapkuil Fontein 4.

Table 3.7. Mean sizes and standard deviations for the shellfish at Paapkuil Fontein 5, square D11.

	Surface					Shell Layer 1					Shell Layer 2				
Species	n	mean	min	max	std.dev	n	mean	min	max	std.dev	n	mean	min	max	std.dev
Turbo sarmaticus opercula	82	19.1	5.7	48.8	10.1	279	18.6	6.2	50.6	9.7	636	22.7	8.4	47.9	9.9
Turbo cidaris cidaris opercula	2	58.5	57.7	59.3	0.8	3	10.2	9.0	12.7	2.0	3	10.2	9.0	12.7	2.0
Scutellastra cochlear	–	–	–	–	–	5	30.7	18.9	47.3	11.6	3	37.5	32.5	40.3	4.4
Scutellastra longicosta	–	–	–	–	–	18	59.0	36.3	71.4	7.9	29	58.8	48.2	72.8	6.9
Scutellastra argenvillei	–	–	–	–	–	8	73.3	67.8	81.3	4.3	7	77.3	71.8	86.4	4.7
Scutellastra granularis	1	47.3	–	–	–	5	46.0	44.5	48.4	1.6	5	44	42.4	46.2	1.6
Cymbula oculus	1	55.9	–	–	–	25	59.1	48.1	70.6	5.5	54	61.4	45.9	81.0	8.5

3.4.7 Bone

Only 54 fragments of bone weighing 13.9 grams were recovered from square D11. The faunal material recovered from this site is given in Table 3.8. The bone recovered was very fragmented and two fragments were burnt. Only six animals could be identified in square D11. These included the remains of small and medium bird, tortoise, small mammal, carnivore and a single seal. There was no fish bone. Fish bone was also not noted in any of the other squares during excavation, despite the fact that the field team was specifically looking out for it.

Table 3.8. Faunal remains from Paapkuil Fontein 5.

Fauna	NISP	MNI	Burnt/blackened
Small aves	3	1	–
Medium aves	1	1	–
Tortoise	1	1	–
Small mammal	2	1	–
Small carnivore	1	1	–
Seal	1	1	–
Unidentified	45	–	2
Total	54	6	2

3.5 Paapkuil Fontein 11

This was a fairly small midden, which in total probably did not measure more than 10 m². It is situated about 150 metres from the fish traps. Unlike Paapkuil Fontein 4 and Paapkuil Fontein 5, this midden was not elevated near the top of a dune, but was situated in a low-lying flat area close to the bay, and was exposed on the surface prior to excavation (Fig. 3.10). The site was therefore subject to erosion, and some of the original contents may have been lost. Six 1 m x 1 m squares were excavated numbered J9, J10, J11, K9, K10 and K11. The excavation extended right to the edges of the midden.

Figure 3.10. Exposed midden deposit of Paapkuil Fontein 11 before excavation. Scale bar measures 20 cm.

3.5.1 Stratigraphy and Dating

The midden was dug stratigraphically down to a depth of 40 cm. Three stratigraphic layers were identified, a surface layer, a shell layer and a sand layer. The surface layer consisted of exposed loose material. It was about 5 cm deep, and was removed with brushes until more dense shell was encountered, in a layer approximately 10 cm deep. This was removed separately as the shell layer. Underneath the shell layer, shell was much more loosely scattered in the sand layer, which continued down to a depth of 40 cm where excavation ceased. The shell and sand layers were visible only in squares K9 and K10. In the adjacent squares, only the surface layer was present, with sterile dune sand underneath. Marine shell from the sand layer in square K9 yielded a radiocarbon date of 1 319 ± 60 B.P. (GX-32532).

3.5.2 Results

A total area of 6 m² was excavated constituting 0.53 cubic metres of deposit. In total, 51.3 kg of archaeological material was retrieved after sieving. Marine shell comprises the bulk of this at 45.6 kg, stone: 5.6 kg, ostrich eggshell: 1.3g, bone: 14.4g, ochre: 0.53g and pottery: 12.8g. All of the material recovered has been analysed and is reported below.

3.5.3 Lithics

The numbers and percentages of the stone recovered are given in Table 3.9. A total of 290 stone pieces were analysed. Quartzite was the dominant raw material accounting for 72.8% of the site total. Quartz accounts for 25.2% and silcrete the remaining 2%. Silcrete was extremely rare in this site, as at other excavated sites at Paapkuil Fontein. Five silcrete flakes were recovered, with one being utilized. Eighty-two percent of the stone recovered falls within the waste class. Within this class 85.8% of the artefacts recovered are chips and chunks; 73.6% of which are chunks.

Two miscellaneous retouched pieces were found. Both pieces were made from quartz, and come from square K9 sand layer and the surface of J9. Utilized artefacts, too, were rare at this site. Three utilised flakes were recovered during excavation. These come from the surface of J10, the sand layer in K9 and the shell layer in K10. A flat stone, perhaps imported with the intention of using it as a lower grindstone, was recovered from the surface of J9 (Fig. 3.11).

Figure 3.11. Flat stone recovered from the surface of J9 May have been brought onto the site with the intention of using it as a lower grindstone. Scale in 10 mm intervals.

Table 3.9 Stone artefact assemblage of Paapkuil Fontein 11.

		Surface		Shell layer		Sand layer		Total	
Class	**Raw material**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Chips	Quartz	8	8.1	3	5.6	7	8.1	18	7.5
	Quartzite	1	1.0	4	7.4	6	7.0	11	4.6
	Silcrete	–	–	–	–	–	–	–	–
Chunks	Quartz	17	17.2	8	14.8	18	20.9	43	18.0
	Quartzite	55	55.6	30	55.6	48	55.8	133	55.6
	Silcrete	–	–	–	–	–	–	–	–
Cores	Quartz	3	3.0	–	–	–	–	3	1.3
	Quartzite	–	–	–	–	1	1.9	1	0.4
	Silcrete	–	–	–	–	–	–	–	–
Flakes	Quartz	2	2.0	3	5.6	1	1.2	6	2.5
	Quartzite	11	11.1	4	7.4	5	5.8	20	8.4
	Silcrete	2	2.0	1	1.9	1	1.2	4	1.7
Total waste	Quartz	30	30.0	14	25.9	26	30.2	70	29.3
	Quartzite	67	67.7	39	72.2	59	68.6	165	69.0
	Silcrete	2	2.0	1	1.9	1	1.2	4	1.7
	Total	**99**	**100**	**54**	**100**	**86**	**100**	**239**	**100**
Non-utilized									
Manuports	Quartzite	36	100	1	100	9	100	46	100
Total non-utilized		**36**	**100**	**1**	**100**	**9**	**100**	**46**	**100**
Utilized									
Flakes	Quartz	1	100	–	–	–	–	1	33.3
	Quartzite	–	–	–	–	1	100	1	33.3
	Silcrete	–	–	1	100	–	–	1	33.3
Total utilized		**1**	**100**	**1**	**100**	**1**	**100**	**3**	**100**
Retouch									
MRP	Quartz	1	100	–	–	1	100	2	100
Total retouched		**1**	**100**	**–**	**–**	**1**	**100**	**2**	**100**

3.5.4 Ostrich eggshell

A single piece of undecorated ostrich eggshell was recovered from the surface of K9.

3.5.5 Pottery

Five small pot sherds were found. One sherd recovered from square K9 sand layer has a thickened rim (9.2 mm) (Fig 3.12). This is comparatively thick, compared with sherds recovered from other sites along the southern Cape (Schweitzer 1979, Schweitzer & Wilson 1982, Henshilwood 1995). Unfortunately, the sherd is too small to allow reliable estimation of the diameter of the mouth of the vessel. The very slight curvature, in combination with the thickness, probably means that it came from a large pot. The remaining four sherds were undecorated originating from the body. Two of these could be measured. The sherd from K9 sand layer has a thickness of 6.6 mm and the sherd from the surface of J9 also has a thickness of 6.6 mm.

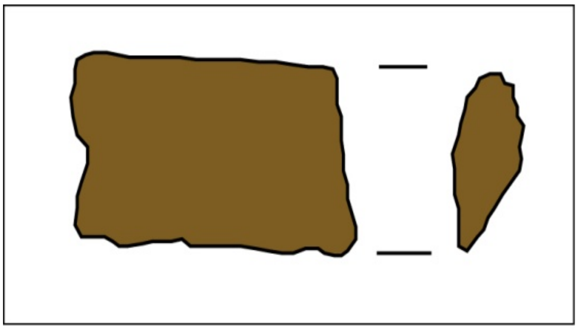


Figure 3.12. Rim sherd from square K9 showing exterior and section views. Scale: actual size.

3.5.6 Shellfish

All of the shellfish remains recovered were identified, counted and, when possible, measured. Minimum numbers of individuals and percentage values for the different species are given in Table 3.10. The range of species present in this site is similar to those found in the other Paapkuil Fontein sites. Sixteen different species were collected. Two species (*T. sarmaticus* and *O. tigrina*) comprise the bulk of the assemblage at 31.7% and 32.7% respectively, 64.4% of the site total. Although, *O. tigrina* is relatively small, it is clear that some preference was given to it, reflecting the ease with which it could be collected. However, subsistence was primarily geared towards the exploitation of *T. sarmaticus,* the most important species in terms of meat weight. The frequencies of the other excavated species were low and it is likely that they did not play an important part in the overall diet.

Table 3.10. MNIs and percentage values for the shellfish assemblage at Paapkuil Fontein 11.

	Surface		**Shell Layer**		**Sand Layer**		**Total**	
Species	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**
Scutellastra cochlear	2	0.2	2	0.7	1	0.1	5	0.2
Scutellastra longicosta	2	0.2	1	0.4	3	0.4	6	0.3
Scutellastra argenvillei	7	0.6	–	–	7	0.9	14	0.6
Scutellastra granularis	3	0.3	3	1.1	2	0.3	8	0.3
Cymbula oculus	26	2.2	2	0.7	7	0.9	35	1.5
Cymbula granatina	–	–	–	–	2	0.3	2	–
Dinoplax gigas	12	1.0	2	0.7	5	0.6	19	0.8
Limpets spp.	21	1.8	6	2.2	14	1.7	41	1.8
Turbo sarmaticus	419	35.6	95	34.2	213	26.3	727	31.7
Turbo cidaris cidaris	20	1.7	1	0.4	16	2.0	37	1.6
Oxystele tigrina	347	29.5	74	26.6	302	37.2	750	32.7
Oxystele sinensis	70	6.0	18	6.5	70	8.6	158	6.9
Oxystele variegata	6	0.5	1	0.4	1	0.1	8	0.3
Oxystele spp.	101	8.6	38	13.7	72	8.9	211	9.2
Haliotis midae	6	0.5	3	1.1	6	0.7	15	0.7
Burnupena spp.	107	9.1	27	9.7	76	9.4	210	9.2
Crepidula porcellana	9	0.8	1	0.4	9	1.1	19	0.8
Fissurellidea aperta	17	1.4	4	1.4	4	0.5	25	1.1
Total	1175	100	278	100.2	810	100	2290	99.7

Table 3.11 shows the mean sizes of the different species. Shells other than the opercula of *T. sarmaticus* were more fragmented in the shell layer and sand layer. This accounts for the very small numbers of measurements in these layers. The only species for which there are meaningful samples from more than one layer are *T. sarmaticus* and *T. cidaris cidaris.* There was no variation in size of either species from one layer to another. It is likely that all three layers contain material deriving from a single occupation, but somewhat bioturbated, so that variation in the sizes of the shellfish would not be expected. Size distributions of opercula of *T. sarmaticus* are shown graphically in Appendix A. These are similar to the patterns seen at Paapkuil Fontein 5. Size classes 15.0-19.9 mm and 10.0-14.9 mm are the most abundant, followed by 20.0-24.9 mm. There is, however, a 'tail' of larger size classes, so that mean operculum size □ 20 mm.

Table 3.11. Mean sizes and standard deviations of the measured shellfish at Paapkuil Fontein 11. All measurements in mm.

	Surface					Shell Layer					Sand Layer				
Species	**n**	**mean**	**min**	**max**	**std.dev**	**n**	**mean**	**min**	**max**	**std.dev**	**n**	**mean**	**min**	**max**	**std.dev**
Turbo sarmaticus opercula	180	19.2	6.5	52.0	10.7	67	20.6	7.8	45.9	9.7	150	20.1	1.3	48.2	9.2
Turbo cidaris cidaris opercula	17	10.8	7.4	17.0	2.6	1	10.3	–	–	–	11	11.6	7.4	15.0	2.5
Scutellastra cochlear	2	31.2	30.8	31.7	0.6	–	–	–	–	–	–	–	–	–	–
Scutellastra longicosta	1	57.2	–	–	–	–	–	–	–	–	–	–	–	–	–
Scutellastra argenvillei	3	77.3	67.4	84.6	9.1	1	87.7	–	–	–	1	81.3	–	–	–
Scutellastra granularis	1	38.4	–	–	–	–	–	–	–	–	–	–	–	–	–
Cymbula oculus	5	59.0	50.2	68.7	7.0	–	–	–	–	–	–	–	–	–	–

3.5.7 Bone

Thirty-four fragments weighing a total of 13.7 grams were recovered. (Table 3.12). A relatively large proportion of the fragments recovered were burned or etched by stomach acids. The range of animals present in this site is similar to those found at the other excavated Paapkuil Fontein middens, including small bird, tortoise, small and medium mammal. There was no fish bone.

Table 3.12. Faunal remains from Paapkuil Fontein 11.

Fauna	**NISP**	**MNI**	**Stomach acid**	**Burnt/blackened**
Small aves	2	1	–	–
Tortoise	8	1	–	–
Small mammal	14	1	4	3
Medium mammal	1	1	–	–
Otomys?	1	1	–	–
Unidentified	7	–	–	1
Total	34	5	4	4

3.6 Paapkuil Fontein 7

All three of the previously described excavated sites contained large amounts of shellfish, relatively little cultural material, and almost no bone, including fish bone. Two of the sites (Paapkuil Fontein 4 and 5) were eroding out near the tops of dunes, and the third (Paapkuil Fontein 11) was a surface site in a low-lying flat area close to the bay.

The criteria for selecting Paapkuil Fontein 7 for excavation were somewhat different from the other sites. We set out to find a site which was less exposed and therefore less subject to erosion. The midden was not visible on the surface with the exception of a few isolated shells which alerted us to the possibility that there might be a midden buried below the ground surface. It was located in a flat area close to the bay and about 40 metres east of Paapkuil Fontein 11. The surface of the area was sandy with some vegetation growth. A test hole was dug to see whether there was any *in situ* sub-surface deposit worth excavating. A dense *in situ* shell midden was found approximately 5 cm below the surface.

On some parts of the site, especially around bushes, the surface sand was considerably deeper than 5 cm, and was removed with spades. It was not screened as this was wind-deposited dune sand. Four 1 m x 1 m squares numbered A4, A5, Z4 and Z5 were excavated stratigraphically until sterile underlying dune sand was encountered.

3.6.1 Stratigraphy and Dating

Three stratigraphic layers were identified, surface, shell layer 1 and shell layer 2. The surface contained mainly bioturbated material from the *in situ* shell layer, disturbed by root growth. Once this had been removed, the main shell bearing layers were exposed. Shell layer 1 was approximately 12 cm thick and consisted of a tightly compacted dump of shell refuse with relatively clearly defined margins. Shell layer 2 was present only in square A5, where animal burrowing could be observed. It is possible that what we thought was a new stratigraphic layer was in fact remnants of shell layer 1, vertically displaced from the main shell accumulation. For the purpose of this analysis, however, they have been kept separate. The bulk of the midden extended over the four squares. Only small amounts of deposit are likely to have remained in adjacent squares.

Marine shell from square A5 Shell layer 1 yielded a date of 1 450 ± 60 B.P. (GX-32530), fairly similar in age to the date obtained for Paapkuil Fontein 11.

Figure 3.13. Squares A4 and A5. Top of shell layer after surface has been removed. Square A4 is in the foreground of the the picture and A5 in the background.

3.6.2 Results

A total of 4 m², excluding the overburden, was excavated and constituted 0.8 cubic metres of deposit. In total 72.1 kg of archaeological material was retrieved after sieving. Marine shell comprises the bulk of this at 71.2 kg, stone: 905.2g, ostrich eggshell: 3.5g and bone: 7.9g.

3.6.3 Lithics

Only 16 pieces of stone were recovered (Table 3.13) of which 13 are manuports and three hammerstones. Quartzite was the only raw material type present. It is likely that this site was used as a shellfish processing location and the hammerstones were probably used for the processing of shellfish.

Table 3.13. Stone artefact assemblage from Paapkuil Fontein 7.

Class	Raw material	Surface	Shell layer 1	Shell layer 2	Total
Non - utilized manuports	Quartzite	5	7	1	13
Utilized Hammerstones	Quartzite	–	2	1	3

3.6.4 Ostrich eggshell

Two ostrich eggshell fragments were present in the site. These come from the surface of square Z4 and shell layer 1 of square Z5.

3.6.5 Shellfish

All the shellfish remains recovered were identified, counted and, where possible measured. Minimum numbers of individuals and percentage values for the different species are given in Table 3.14. *T. sarmaticus* was the main species targeted, contributing 43.5% of the total assemblage. *O. tigrina* was the second common most species contributing 22.8% of the assemblage. Minimum numbers of individuals for the different limpet species were relatively small. *C. oculus* was the most common limpet species in the assemblage and contributed only 3.2% of the total MNI.

Table 3.14. MNIs and percentage values for the shellfish assemblage of Paapkuil Fontein 7.

	Surface		Shell Layer 1		Shell Layer 2		Total	
Species	**no**	**%**	**no**	**%**	**no**	**%**	**no**	**%**
Scutellastra cochlear	1	0.1	5	0.3	–	–	6	0.2
Scutellastra longicosta	11	1.1	10	0.6	1	0.3	22	0.7
Scutellastra barbara	5	0.5	4	0.2	–	–	9	0.3
Scutellastra argenvillei	6	0.6	10	0.6	4	1.3	20	0.7
Scutellstra granularis	–	–	1	–	–	–	1	–
Cymbula oculus	39	3.9	44	2.5	14	4.5	97	3.2
Cymbula miniata	–	–	2	0.1	–	–	2	–
Cymbula granatina	1	0.1	–	–	1	0.3	2	–
Dinoplax gigas	5	0.5	6	0.3	1	0.3	12	0.4
Limpet spp.	12	1.2	37	2.1	12	3.9	61	2.0
Turbo sarmaticus	404	40.8	804	45.4	125	40.6	1333	43.5
Turbo cidaris cidaris	13	1.3	16	0.9	2	0.6	31	1.0
Oxystele tigrina	274	27.7	357	20.2	68	22.1	699	22.8
Oxystele sinensis	101	10.2	151	8.5	25	8.1	277	9.0
Oxystele variegata	1	0.1	1	–	–	–	2	–
Oxystele spp.	47	4.8	129	7.3	29	9.4	205	6.7
Haliotis midae	6	0.6	40	2.3	3	1.0	49	1.6
Burnupena spp.	59	6.0	139	7.9	18	5.8	216	7.0
Crepidula porcellana	4	0.4	14	0.8	5	1.6	23	0.7
Total	989	99.9	1770	100	308	99.8	3067	99.8

Interestingly, 49 *Haliotis midae* were present, a species that is rare at the other three excavated sites. Although it contributed only about 1.6% of the number of shellfish present, it is one of the most economical species to exploit in terms of flesh mass and food return**.**

Table 3.15 shows the mean shell lengths for the different shellfish species. Once again, only the two species of *Turbo* are present in all three layers in sufficiently large numbers to allow meaningful comparison. The sizes are very similar in each layer. The size distribution of opercula of *T. sarmaticus* are shown graphically in Appendix A. At this site, size class 15.0-19.9 mm is most abundant. As at Paapkuil Fontein 5 and 11, the mean diameter of *T. sarmaticus opercula* is ca. 20 mm.

Table 3.15. Mean sizes and standard deviations for the measured shellfish at Paapkuil Fontein 7. All measurements in mm.

	Surface					Shell layer 1					Shell layer 2				
Species	**n**	**mean**	**min**	**max**	**std.dev**	**n**	**mean**	**min**	**max**	**std.dev**	**n**	**mean**	**min**	**max**	**std.dev**
Turbo sarmaticus opercula	291	19.4	1.8	49.3	8.2	312	20.5	7.6	49.4	8.9	58	18.4	9.8	46.3	8.9
Turbo cidaris cidaris opercula	11	12.0	9.8	15.2	1.7	16	11.8	9.1	16.1	1.9	2	11.9	11.8	12.0	0.1
Scutellastra cochlear	1	26.9	–	–	–	1	25.8	–	–	–	–	–	–	–	–
Scutellastra longicosta	1	54.7	–	–	–	2	56.9	51.6	62.9	8.0	–	–	–	–	–
Scutellastra barbara	2	69.9	68.7	71.2	1.7	–	–	–	–	–	–	–	–	–	–
Scutellastra argenvillei	1	76.3	–	–	–	7	76.3	69.8	82.9	5.0	2	82.7	75.1	91.2	11.4
Cymbula oculus	4	55.6	51.1	65.9	6.6	4	61.2	54.2	69.8	7.2	3	61.7	55.1	65.5	5.8

3.6.6 Bone

Paapkuil Fontein 7 yielded very little bone, 21 fragments in total, weighing 12.3 grams. The faunal material recovered from this site is presented in Table 3.16. A large percentage of the bone fragments have been modified by gnawing and stomach acids, 23.8% and 33.3% respectively. Small bird, tortoise and small mammal could be identified. Bone recovered from this site is not very significant. Most remains are of microfauna with fragments of bird and tortoise also present. No fish bones were recovered.

Table 3.16. Faunal remains from Paapkuil Fontein 7.

Fauna	NISP	MNI	Gnawing	Stomach acid
Small aves	2	1	–	2
Tortoise	2	1	–	–
Small mammal	8	1	5	–
Unidentified	9	–	–	5
Total	21	3	5	7

3.7 Discussion

3.7.1 Dating

Radiocarbon dates obtained for the four sites excavated at Paapkuil Fontein indicate a sequence of occupation spanning the last 5 000 years before present. Table 3.17 gives a summary of the radiocarbon dates and highlights important information for the Paapkuil Fontein sites. Attention is drawn to general patterns observed in the faunal and cultural assemblages across all four sites.

3.7.3 Lithics

Stone artefacts and manuports comprise the majority of the cultural remains recovered from the Paapkuil Fontein sites. Retouched artefacts were extremely rare, present only in the two larger assemblages at Paapkuil Fontein 5 and 11. They account for less than one percent of total artefacts recovered from all four sites. Miscellaneous retouched pieces (MRPs) are the only type present in this class, with three out of the four found made from quartz and the remaining one from silcrete.

Quartzite is the dominant raw material in all sites, accounting for 72.5% of the stone artefacts recovered and is the only raw material present in Paapkuil Fontein 4 and 7. The number and range of artefacts recovered from these two sites was extremely limited. Quartz is the second most common raw material, accounting for about 24.6% of all stone recovered. Small quantities of silcrete make up the rest of the assemblage.

Table 3.17. Summary table of the important information for each of the sites excavated.

Site	Dates	Lithics	Shellfish % MNI
P4	4 870 ± 80 B.P. 3083(2969)2887 B.C.	Quartzite only n = 35	*T. sarmaticus* 34 % *S. longicosta* 22.9 % *Oxystele* (all spp.) 15.6 % *C. oculus* 8.7 %
P5	2 250 ± 60 B.P. 221(278)370 A.D. 2 320 ± 70 B.P. 120(207)278 A.D.	Quartzite dominated n = 145	*Oxystele* (all spp.) 68.6 % *O. tigrina* 47.2 % *T. sarmaticus* 16.3 % *C. oculus* 5.3 % *D. gigas* 1.9 %
P11	1 319 ± 60 B.P. 1202(1259)1296 A.D.	Quartzite dominated n = 290	*Oxystele* (all spp.) 49.1 % *O. tigrina* 32.7 % *T. sarmaticus* 31.7 % *C. oculus* 1.5 %
P7	1 450 ± 60 B.P. 1043(1103)1191 A.D.	Quartzite only n = 16	*T. sarmaticus* 43.5 % *Oxystele* (all spp.) 38.6 % *O. tigrina* 22.8 % *C. oculus* 3.2 %

Stone artefacts are generally more abundant in Paapkuil Fontein 11 and 5 although formal tools remain rare. Utilized artefacts are present at all four excavated sites but in small numbers. Hammerstones are the most numerous artefact in this class and are present in all the sites. They are also the only artefact type present at Paapkuil Fontein 7. The hammerstones recovered from this site are rounded quartzite pebbles with bruising on one side, consistent with having being used as hammers. The lack of other stone artefacts from the site suggests knapping activities were rare. It is therefore likely that the hammerstones may have been used for processing shellfish, although shellfish and in particular *T. sarmaticus* were no more fragmented than at the other excavated sites.

Grindstones (upper and lower) are present only at Paapkuil Fontein 5, with possible lower grindstones recovered from Paapkuil Fontein 4 and 11, although these were classified as manuports. The lower grindstones recovered from Paapkuil Fontein 5 have already been discussed in detail and do not warrant any further discussion.

The stone assemblages of Paapkuil Fontein 5 and 11 are similar. The relatively larger proportion of quartz, especially in the chip class, indicates activities other than the processing of shellfish. Generally, though, the number of stone artefacts was small in both sites and the range of activities conducted may have been limited.

The dissimilarities between Paapkuil Fontein 11 and 7 are striking, although the dates obtained for both sites are similar at 1 319 ± 60 B.P. (GX-32532) and 1 450 ± 60 B.P. (GX-32530) respectively. The very small stone assemblage of Paapkuil Fontein 7 (n = 16) is of interest. This is similar to that observed in the lower spits of Paapkuil Fontein 4 which yielded a date of 4 780 ± 80 B.P. (GX-32533). The most likely explanation is that the primary activity at Paapkuil Fontein 7 and 4 was the processing of shellfish, with few other tasks carried out at these locations.

Although the dates obtained for the excavated sites indicate occupation of the area spanning the last 5 000 years before present, no real temporal patterns could be observed within the stone artefact assemblage. Stone was present in small quantities at all the sites; formal artefacts were extremely rare or absent. This pattern suggests that the primary activity at Paapkuil Fontein was the collection and processing of shellfish with limited stone knapping activity at Paapkuil Fontein 5 and 11.

One of the striking features of the lithic assemblage at Paapkuil Fontein is the almost complete absence of retouched artefacts. Although the number of stones recovered from the four sites was low in comparison to other coastal sites in the southern Cape, the assemblage is broadly similar to other late Holocene coastal assemblages in the south and south-western Cape. Diagnostic artefacts are generally low. This pattern has been noted at Bonteberg Shelter (Maggs & Speed 1967), Die Kelders (Schweitzer 1979), Byneskranskop (Schweitzer & Wilson 1982), Smitswinkelbaai (Poggenpoel & Robertshaw 1981), Nelson Bay Cave (Inskeep 1987). Similar observations were also made at Klasies River Cave 5A and 5B and 1 (Binneman 1995), Storms River Mouth middens (H.J. Deacon 1970), the Garcia State Forest sites (Henshilwood 1995), Cape St. Francis middens and the late Holocene deposits at the Havens Cave and the Kabeljous River Shelter (Binneman 1995). Along the west coast, in the Elands Bay area, some late Holocene assemblages include more formal artefacts (Orton 2006).

The reason for the relatively low numbers of formal artefacts in late southern Cape coastal assemblages is not entirely clear. Goodwin (1952: 137) and Clark (1959: 2007) postulated that the exploitation of marine resources did not require the use of elaborate technology. Klein (1974) suggested this pattern could be interpreted as the result of sampling error or that formal tools were not required. H.J. Deacon (1976) suggested that the absence of formal tools and in particular small convex scrapers at coastal sites may have been the result of the replacement of plant food gathering with shellfish collecting.

Although there is greater variation in stone artefact assemblages during the last 2000 years before present than during the mid-Holocene (J. Deacon 1984), this may be explained, in part, as a result of the differing nature of activities or the intensity with which those activities were carried out. In certain cases formal artefacts may be entirely absent, for example at Scott's Cave (Deacon & Deacon 1963), the Pearly Beach shell middens (Avery 1976), Smitswinkel Bay Cave (Poggenpoel & Robertshaw 1981), or present in very low numbers, as at Gordon's Bay (van Noten 1974). It is interesting to note that the absence of formal stone artefacts may relate to an increase in the abundance of bone implements and shell artefacts at coastal sites. However, this is not always the case as only two bone implements and no shell artefacts were found at Bonteberg shelter, while a range of bone and shell implements were found at Witsands (Goodwin & Van Riet Lowe 1929: 261) and Smitswinkel Bay; bone and shell implements were present at Nelson Bay Cave (Inskeep 1987) and Matjes River Rock Shelter (Ludwig 2005). While no bone implements were found at the Paapkuil Fontein sites, bone artefacts are generally more numerous at coastal sites.

The virtual absence of formal stone artefacts from the lower spits at Paapkuil Fontein 4 is interesting. These units yielded a date of 4 870 ± 80 B.P. which, when corrected for the apparent age of seawater, converts to approximately 4 370 B.P. Small convex scrapers are normally the dominant formal tool type during the Wilton. These type of scrapers accounted for 52% of the formal tools at BNK 1 (Schweitzer & Wilson 1982) and 72.4% at Wilton Large Rock Shelter (J. Deacon 1972). At The Havens Cave (Binneman 1995: 52), scrapers are the most important formal tool type accounting for 91.6% of the formal class. There is a slight variation in this pattern in that backed scrapers are the most important form during the Wilton at Garcia State Forest making up 31% of the formal class. Scrapers here account for only 16.5% of the formal tool assemblage. At BNK 1 they account for 12.2% of the retouched artefact category and are numerous only in layers post-dating 4 000 years before present. Interestingly, there is a decrease in the frequency of scrapers and an increase in adzes at BNK 1 and by layer 3 adzes accounted for 56% and scrapers 34% of the retouched artefact category. No date was obtained for layer 3 but the underlying layer 5 was dated to 3 900 ± 60 B.P. (Pta-1571) and the overlying layer 2 yielded a date of 3 400 ± 55 B.P. (Pta-1569).

A possible reason for the lack of formal artefacts at Paapkuil Fontein 4 is that they may not have been required as the primary activity was the exploitation of marine resources. Binneman (1995) reported the oldest date for the Kabeljous industry in the south eastern Cape at Klasies River Cave 1 at 4 700 B.P. The Kabeljous industry consists of heavy duty cobble tools and large segments. Although no formal tools such as large segments were found at Paapkuil Fontein 4, the informal nature of the stone assemblage may indicate some similarities to Binneman's (1995) Kabeljous industry.

Ochre was present in very small amounts at Paapkuil Fontein 4, 5 and 11. All of the pieces were very small and none showed any signs of modification. However, possible traces of ochre were present on the grinding surface of a lower grindstone found at Paapkuil Fontein 5 square C13 (Fig. 3.9).

3.7.4 Shellfish

An examination of the shellfish assemblage at Paapkuil Fontein indicates that, in terms of food value, *T. sarmaticus* was the species most exploited at all sites. At Paapkuil Fontein 5, 7 and 11, *Oxystele* was also extremely important. At the oldest site, Paapkuil Fontein 4, *S. longicosta* constituted almost a quarter of the shellfish assemblage. At the more recent sites, limpets were relatively unimportant. Although eighteen different species are present in the assemblage not all are present at each of the sites, and the numbers of some species are so low that they seem to have played a minimal dietary role in the overall assemblage. With the possible exception of Paapkuil Fontein 5 where *Oxystele spp*. and in particular *O. tigrina* is especially numerous, *T. sarmaticus* undoubtedly contributed the bulk of the food component in terms of flesh.

One of the striking features about the shellfish assemblage is the relatively low numbers of *Haliotis midae* at Paapkuil Fontein 4 (0.3%), 5 (0.4%) and 11 (0.7%). *H. midae* was more numerous at Paapkuil Fontein 7 with 49 individuals recovered, contributing 1.6% to the total assemblage. This is a large species and one of the most rewarding shellfish to exploit in terms of edible flesh. The relatively low numbers of this species at sites 4, 5 and 11 is surprising, especially in light of the predominance of *T. sarmaticus* at these sites. It is possible that *H. midae* may not have been favoured or that larger individuals may have been inaccessible during the time of occupation.

One of the objectives of the shellfish analysis was to compare the Paapkuil Fontein sites to other south coast sites. This was somewhat hindered by the fact that few detailed studies exist on open air sites along the south coast. However a few notable examples do exist, including the work done by Avery (1976) at Pearly Beach and Hawston, Binneman (1995) at Cape St. Francis and Henshilwood (1995) at Garcia State Forest, Blombos. One of the difficulties in making detailed comparisons with these studies is the different research objectives of each. Avery (1976), for example, distinguished middens on the basis of meat mass contributed by different shellfish species. On the other hand, Binneman (1995) distinguished midden sites on a model of Economic Return Rates (ERR). In other words, shellfish was examined on a basis of the ratio of meat weight to shell weight. At Garcia State Forest, near Blombos, the objective was to investigate temporal patterns in the exploitation of the littoral zone (Henshilwood 1995). The idea was to see whether specific areas of the littoral zone were being targeted at different times and whether these differences could be explained in terms of environmental, social and/or cultural factors.

While a large body of evidence exists for the exploitation of molluscs in coastal cave sites, the data may not be directly comparable to open air locations. Meehan (1982), for example, makes the distinction between processing and dinnertime sites. She observed that some shellfish are processed and eaten near to their procurement localities, taken purely as a snack, whilst other species may find their way back to more formal dinnertime or camp sites. Furthermore, possible differences in the nature of the littoral zone immediately adjacent to coastal sites may affect the shellfish assemblage. This situation makes comparisons of shellfish between sites with different coastal settings extremely difficult. Keeping these limitations in mind, only broad comparisons could be made between the Paapkuil Fontein sites and other localities, focussing on temporal patterning.

The earliest analysed assemblage Paapkuil Fontein 4, is characterised by relatively high proportions of *Turbo sarmaticus* (34%), the limpets *Scutellastra longicosta* (22.9%) and *Cymbula oculus* (8.7%). An interesting feature of this site is the relatively low proportions of *Oxystele spp.* present, relative to the other sites, contributing 16.3% (all species) to the assemblage. The proportions of the different species of shellfish present in the site remain relatively constant throughout the deposit. The overall pattern for this site suggests that shellfish targeted were the most economical in terms of return of food.

The shellfish assemblages of Paapkuil Fontein 5, 7 and 11 are very similar. *Oxystele spp.* are the most numerous shellfish, in particular *O. tigrina. T. sarmaticus* are the second most common shellfish and was the major food contributor (see Table 3.17). Of note is the rarity of limpets (all species) at all three sites. At present it is unclear why this should be the case. It is possible that limpets may not have been favoured or environmental factors may have played a role, but this remains speculative at present. At Paapkuil Fontein 5, the giant chiton *D. gigas* is much more numerous than at the other Paapkuil Fontein sites, while at Paapkuil Fontein 7 and 11 *Burnupena spp.* seem to have been of greater importance.

It is noteworthy that mussels of all types are extremely rare in the Paapkuil Fontein shellfish assemblages. A single *Perna perna* was identified at Paapkuil Fontein 4, and one *Donax serra* at Paapkuil Fontein 5. This is in marked contrast to many other south coast sites, where *P. perna* was a favoured food item.

It is clear from the shellfish assemblages at Paapkuil Fontein that there is a pattern of increased abundance of smaller shellfish species such as *Oxystele,* in particular, *O. tigrina* and *Burnupena spp.* in the more recent sites. This pattern of increased *Oxystele spp.* correlates with a decline in the number of limpets. At the Garcia State Forest sites described by Henshilwood (1995), *T.sarmaticus* was the most common shellfish species in all the sites. There, too, the species features less strongly in the post-2 000 B.P. sites, being supplanted by *Oxystele spp.* An interesting distinction between the post-2 000 and pre-2 000 sites is the differing strategies employed in exploiting the littoral zone. Subsistence strategies after 2 000 B.P. focussed more intensively on shellfish in the shallower inter-tidal, in the same way as at Paapkuil Fontein. This contrast with the situation in the pre-2 000 sites, where the clear focus was on the exploitation of shellfish occurring in the lower reaches of the littoral zone, such as *Turbo spp., S. argenvillei, S. tabularis* and *Haliotis spp.*

Along the Cape St. Francis coast, Binneman (1995) identified several categories of middens based on their contents. These include Hunter-Gatherer (HG), Hunter-Collector-Fisher (HCF), Pastoralist and Ceramic type middens. Ceramic middens were distinguished from Pastoralist sites on the basis of the absence of domestic fauna in their assemblages. Although some degree of overlap exists between these categories, the main aim of Binneman's investigation was to examine different shellfish collection strategies. Binneman found that HG, HCF and pastoralist middens displayed similar collection strategies. In general, they collected species with the highest meat mass, often collecting from the lower balonoid zone where larger species occur. Binneman suggested that collection took place mainly during new moon and full moon phases. Ceramic middens, on the other hand, reflected a different collection strategy. Groups that occupied these sites collected mainly small, easy to collect species with a low meat mass from the upper balonoid zone.

While it is tempting to interpret increased collection of small shellfish species as "intensification", or perhaps suggest that it is a pattern uniquely observable in post-2 000 B.P. assemblages, more evidence is needed to see whether this is a real pattern or the result of random variation. In some instances increased emphasis on the collection of smaller species such as *Oxystele spp*. occurs in assemblages dated to the mid to late mid-Holocene such as at Klasies River Mouth Cave 5A (Binneman 1995). This may reflect a broadening of collection strategies by collecting more regularly, irrespective of tidal cycle. Another explanation could be that increased collection of small, low yield species might have been as a result of the lack of availability of larger species. It is clear that better dated sequences are needed to tease apart these temporal variations in resource exploitation.

The Kolmogorov-Smirnov test was used to see whether there were statistically significant differences in the sizes of opercula of *T. sarmaticus*, both between and within sites. The maximum diameters of opercula of *T. sarmaticus* were grouped into 5 mm categories, and compared between two samples at a time. The test is based on the difference between the two cumulative distributions. It is non-parametric, i.e. it does not require that data be normally distributed. The results are given in Appendix B. The results show that there is a significant difference at the 0.05 level in the size distribution of *T. sarmaticus* opercula between Paapkuil Fontein 4 and Paapkuil Fontein 5, and between each of these and Paapkuil Fontein 7 and 11. There was no significant difference between Paapkuil Fontein 7 and 11. Within sites, there was a significant difference between stratigraphic units only at Paapkuil Fontein 5.

T. sarmaticus opercula are relatively small at Paapkuil Fontein, with means between 18-25 mm. This is smaller than the archaeological samples in the Garcia State Forest sites

(Henshilwood 1995), where the majority of the means clustered between 25-30 mm. (Henshilwood 1995: Figure 6.7: 126). At GSF, there was a decrease in mean operculum length through time. The largest opercula were found in the sites which predate ca. 5 000 years before present. The smallest occurred in GSF 7/2 and 7/1 which date to around 2 700 years before present and were similar in size to GSF 9 which yielded a date of ca. 480 years before present. Henshilwood ascribed the decrease in operculum length through time to three factors, namely human predation, tidal condition at the time of collection, which may be related to the length of time a site was occupied, or environmental change. He did not see correlations between operculum size and site location or site type.

At Paapkuil Fontein, too, mean sizes of *T. sarmaticus* opercula are larger in the oldest site, dating to 4 400 B.P., than in three sites that date to within the last 2 000 years (once the marine correction has been applied to C-14 dates on shell). This may be due, as Henshilwood and others have suggested, to more intensive collection pressure in more recent times. It is, however, difficult to rule out the possibility that environmental changes may also have played a role.

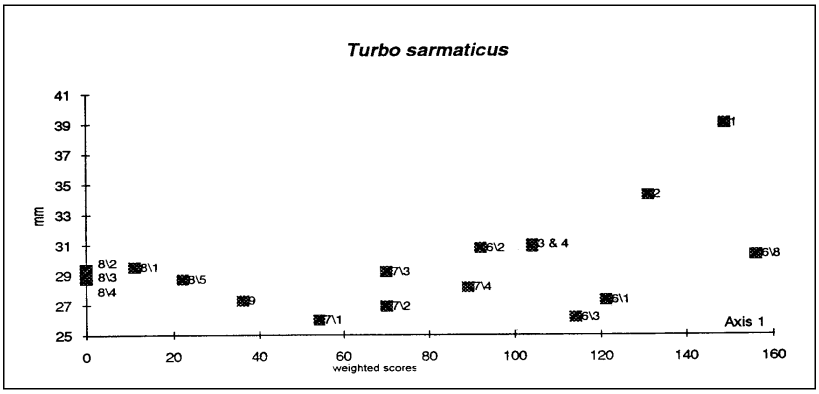


Figure 3.14. Distribution of mean sizes of opercula of T. sarmaticus at Garcia State Forest. (Henshilwood 1995: 126).

Using the equation **op Ø (mm) = 0. 504 shell breadth (mm) + 1.791** (McLachlan & Lombard 1981) the shell breadth was calculated from the mean operculum length for each site at Paapkuil Fontein. This data is given in Table 3.18. The results indicate that the mean sizes of *T. sarmaticus* collected fall within the sub-adult class, which is individuals <50 mm. The current minimum legal size limit is 63.5 mm shell width. The small mean size of *T. sarmaticus* indicates that smaller individuals were taken more often than larger individuals. Juvenile and sub-adult *T. sarmaticus* inhabit a wider range of the infralittoral, whilst larger individuals are only found in deeper sub-tidal conditions. It is possible that larger individuals may not always have been accessible. It should be noted however, that some of the largest individuals found at Paapkuil Fontein sites are well beyond the legal size limit and are significantly larger than individuals found in areas where the species are currently being over-exploited (Proudfoot *et al.* 2006).

Table 3.18. Table indicating T. sarmaticus shell breadth calculated from mean operculum lenght for each excavated site.

	Paapkuil Fontein 4	
Unit	mean operculum length (mm)	shell breadth (mm)
Spit 1	23.1	**49.4**
Spit 2	22.7	41.5
Spit 3	21.8	39.7
Spit 4	25.6	**47.2**
Spit 5	21.8	39.7
	Paapkuil Fontein 5	
Unit	mean operculum length (mm)	Shell breadth (mm)
Surface	19.1	34.3
Shell layer 1	18.6	33.4
Shell layer 2	22.7	41.5
	Paapkuil Fontein 7	
Unit	mean operculum length (mm)	Shell breadth (mm)
Surface	19.4	34.9
Shell layer 1	20.5	37.1
Shell layer 2	18.4	33.0
	Paapkuil Fontein 11	
Unit	mean operculum length (mm)	Shell breadth (mm)
Surface	19.2	34.5
Shell layer	20.6	37.3
Sand layer	20.1	36.3

3.7.5 Bone

The remains of terrestrial fauna were extremely rare in the Paapkuil Fontein sites. For the most part bone recovered during excavation was very fragmented, making identification difficult. Considering the rarity of bone it is likely that terrestrial fauna played a minimal dietary role or that the bone present may have been accumulated through non-human agents. The absence of fish bone strongly suggests that fishing was not the major attraction for occupying this particular stretch of coastline, despite the presence of the large number of fish traps in the bay.

3.8 Summary

The primary objective of the excavations at Vywerbaai was to investigate the possible existence of a relationship between the excavated shell middens and the fish traps. The evidence presented here does not indicate a relationship between the fish traps and the middens. A wide range of dates spanning the past 5 000 years before present was obtained for the middens but none of the sites yielded fish bone, apart from a single vertebra found in Paapkuil Fontein 4. It is possible that this specimen may have been brought on site by a non-human agent.

While it is possible that the fish traps may have been used by the occupants of the excavated sites and the fish processed elsewhere, it seems unlikely that none of the fish would have been discarded at the shell middens. Large catches of fish would not have been processed very far from the place of procurement, and these sites provide the best evidence of pre-colonial human use of the area. A mid-Holocene marine transgression of between 2-1 m has been reported for areas of the south coast coinciding with the deposition of the lower layers at Paapkuil Fontein 4 (Reddering 1988, Marker & Miller 1993, 1995). Any fish retrieved from this site coinciding with the mid-Holocene transgression could not have been related to the use of those fish traps visible in the adjacent bay at Paapkuil Fontein. Paapkuil Fontein 5, 7 and 11, however, post-date the mid-Holocene high sea level. At the time these sites were occupied, sea level was at approximately its present position. These sites, however, also do not show evidence for fishing. The best explanation for the almost total absence of fish in the Paapkuil Fontein middens is that the fish traps were not, in fact, in use at the time that the middens accumulated. The limited range of faunal and cultural material at all the sites suggests that the range of activities was limited with a tight focus on the exploitation of marine molluscs.

While the four excavated sites at Paapkuil Fontein provide a good chronology for prehistoric occupation of the area a comparative sample was needed to substantiate the findings of this Chapter. Chapter 4 will present the findings of similar work at Still Bay, examining the contents of shell middens located near stone-walled tidal fish traps.

CHAPTER 4

Results from Still Bay and Jongensfontein

4.1 Introduction

The area of Still Bay has the highest density of fish traps found anywhere along the south coast, providing a perfect opportunity to further investigate the archaeological time-depth of these traps. However, residential development has seriously impacted on the preservation of archaeological sites in the area. The findings of three open shell midden sites are reported in this chapter: Still Bay 1 and 2, located near Still Bay harbour, and Jongensfontein, located on a private residential property, west of Still Bay. These sites were not excavated as part of this thesis; they had previously been excavated as part of a mitigation process. The contents of two of the sites (Still Bay 1 and 2) were analysed for the purpose of this thesis. The discussion of the findings at Jongensfontein is based on the excavator's report.

Climatically, the area experiences hot dry summers and cool wet winters. Still Bay receives approximately 650 mm rainfall annually. Summers are usually warm with daily temperatures between 20 °C-28 °C. Winters are considered mild with daily temperature averaging 12 °C-20 °C. The area contains a high number of rare endemic limestone fynbos species associated with calcareous, neutral to alkaline, shallow sands overlying limestone and associated calcretes of the Bredasdorp formation (Bredenkamp *et al.* 1996). Dune fynbos is dominant on the coastal fringe. It has been noted that disturbance of the soils normally result in major increases in the mole rat populations, perhaps the result of an increase in geophytes (Bredenkamp *et al*. 1996).

Figure 4.1. 1: 10 000 orthophoto showing the location of various archaeological sites at Still Bay and their proximity to fish traps shown as dotted white lines. Area enclosed by dashed yellow line demarcates survey.

4.2 Survey

The area from Noordkapperpunt to Morris Point was surveyed during February 2006, to locate shell midden sites with potential for excavation as part of this thesis. The area surveyed is shown in Figure 4.1. Vegetation cover was thick, making visibility poor. Three LSA shell middens sites were found in this survey, two near Noordkapperpunt (NKP 1 & 2), and one near Morris Point (MRP 1). Six LSA sites, including the three examined by the ACO in 1991 SB 1-3 (Rubin 1991), are present in the area. The sites are all located on Morris Point and Noordkapperpunt, close to the fish traps. No sites were found between these two points. Dense vegetation cover could be one reason for low visibility of sites.

Two of the sites recorded in the 2006 were small surface scatters, while NKP 1 was a larger midden. The full extent of MRP 1 could not be ascertained as only the edge of the midden was visible. Only shell and stone was observed. Shell included the remains of *T. sarmaticus*, *S. longicosta*, *S. cochlear* and whelks. Quartzite flaking debris was noted. Faunal remains were not observed, although, this does not preclude the possibility that fauna may be present sub-surface.

NKP 1 and 2 are situated next to each other. NKP 1 is the larger of the two sites. The centre of the site is about 20 m in diameter, but the site extends over an area of about 50 m in diameter. A large concentration of silcrete stones in the south/southwest corner appear to separate the site into two activity areas. Artefactual remains include stone (quartz and silcrete predominate), cores, flakes and thumbnail scrapers, pottery and one piece of ochre was observed. Faunal material included the remains of marine and terrestrial animals. A few fragments of fish were observed.

There is some overlap between NKP 1 and 2. Site 2 was much smaller than NKP 1. The midden has an approximate diameter of 15 m. No stone was observed at this site. Ostrich eggshell was present and a single OES bead was found. The shellfish observed included, *T. sarmaticus, S. longicosta, C. granatina*, and *Oxystele spp*. Some bone was noted although no fish could be seen.

The three sites described above are surface sites. Two appear very likely to have shallow deposits, and the third NKP 1 may or may not have had any depth of deposit. In light of this it was thought that sites with deeper deposits would better fit the purpose of this project. Two LSA sites (SB 1 and SB 2) had been excavated during 1991 as part of a contract archaeology mitigation process (Rubin 1991). The material from these two excavations had been only cursorily analysed, but was fully analysed for this project. The two sites are situated on Morris Point, not very far from the Still Bay harbour fish traps. The site of Jongensfontein is reported here because this was also a substantial midden with a relatively deep sequence, although the materials excavated from this site were not available for analysis. This site also provided a comparative sample to compare with Still Bay and Paapkuil Fontein.

Although the site of NKP 1 was not excavated for this project, the site does provide some potential for future work. It contains a range of archaeological material and, although, it is unclear whether it has a stratigraphic sequence, it may provide some valuable spatial information.

4.3 Still Bay 1

Still Bay 1 (SB 1: Fig. 4.1) is a small midden which lies 50 m up-slope on the western side of the Still Bay harbour slipway. The site consisted of a single lense of shell eroding out along a 15 m stretch of dune cap.

At the time of excavation most of the site had already been lost through erosion. Nonetheless, three 25 cm x 25 cm quadrats were excavated, indicating that undisturbed *in situ* deposit still lay underneath. A sample from the eroded section of the site called ‘slope’ was passed through a 3 mm over a 1.5 mm mesh screen. A preliminary analysis was done during 1991. The material has now been fully analysed for the purpose of this project. The results are given below.

4.3.1 Stratigraphy and Dating

Detailed stratigraphic information is not available because the excavation was limited to test quadrats to see whether any deposit existed below the surface. No radiocarbon dates are available for SB 1.

4.3.2 Results

In total 3.59 kg of material was analysed from SB 1. Marine shell comprised the bulk of this at 3.45 kg, stone: 133.8g, OES: 2.4g and bone: 3.07g.

4.3.3 Lithics

Seven pieces of stone were noted in the sample analysed, all of which were manuports. Six of these were quartzite and one small quartz pebble was identified. Three of the manuports came from the 1.5 mm fraction, the small quartz pebble included.

4.3.4 Ostrich eggshell

Two pieces of ostrich eggshell were identified, both from the 3 mm fraction. Neither showed modification.

4.3.5 Shellfish

All the shellfish curated from Still Bay 1 were identified, counted and where possible measured. Minimum number of individuals and percentage values for the different shellfish analysed from SB 1 are given in Table 4.1. Two-hundred and two individuals were identified in the 3 mm fraction. *Oxystele* (all species) accounts for 50% of the total, *Limpet spp*. 28.2% (all species combined accounts for 43%) and *S. cochlear* 8.9%. The brown mussel *Perna perna* accounts for 5% of the total. *Turbo sarmaticus* was rare at this site; only 4 individuals were identified. Limpets could not readily be identified to species level. It is possible that under better preservation condition the range of limpet species identified in the assemblage could have been increased from the four species identified.

The number of shellfish identified from the 1.5 mm fraction was small, only 22 individuals. This included *S. cochlear*, *D. gigas*, *T.sarmaticus*, *Oxystele spp*., and *P. perna*. Mean sizes of measurable shellfish are given in Table 4.2. Measurements could be done on only three *opercula* of *T. sarmaticus* and *S. cochlear*.

Table 4.1. MNIs and percentage values for the different shellfish analysed at SB 1.

	3 mm fraction		1.5 mm fraction		Total	
Species	**no**	**%**	**no**	**%**	**no**	**%**
Scutellastra cochlear	18	8.9	1	4.5	19	8.4
Scutellastra longicosta	9	4.4	–	–	9	4.0
Cymbula oculus	2	1.0	–	–	2	0.9
Dinoplax gigas	1	0.5	1	4.5	2	0.9
Limpet spp.	57	28.2	1	4.5	58	25.9
Turbo sarmaticus	4	2.0	1	4.5	5	2.2
Oxystele tigrina	29	14.4	–	–	29	13.0
Oxystele sinensis	34	16.8	–	–	34	15.1
Oxystele spp.	38	18.8	16	72.7	54	24.1
Perna perna	10	5.0	2	9.1	12	5.3
Total	202	100	22	99.8	224	99.8

Table 4.2. Mean sizes and standard deviations of the measured shellfish at SB 1.

Species	n	mean	minimum	maximum	std. dev.
Turbo sarmaticus opercula	3	16.4	12.3	19.5	3.7
Scutellastra cochlear	8	18.2	13.8	25.3	4.5

4.3.6 Bone

The remains of terrestrial and marine animals are given in Table 4.3. Twenty-one fragments of bone were recovered, weighing 3.07 grams. All of the terrestrial remains come from the 3 mm fraction, mostly tortoise and small mammal.

Table 4.3. Faunal remains from SB 1.

Category	NISP	Burned/blackened
Tortoise	4	
Small mammal	8	1
Unidentified	2	
Fish	7	
Total	21	1

Seven fish remains were recovered. These all come from the 1.5 mm fraction, and include 5 vertebrae, 1 ultimate vertebrae and 1 scale. The remains could not be identified to genus or species level. Since this site was badly eroded at the time of excavation, it is likely that post-depositional processes were a major factor why fish remains were recovered only in the 1.5 mm mesh.

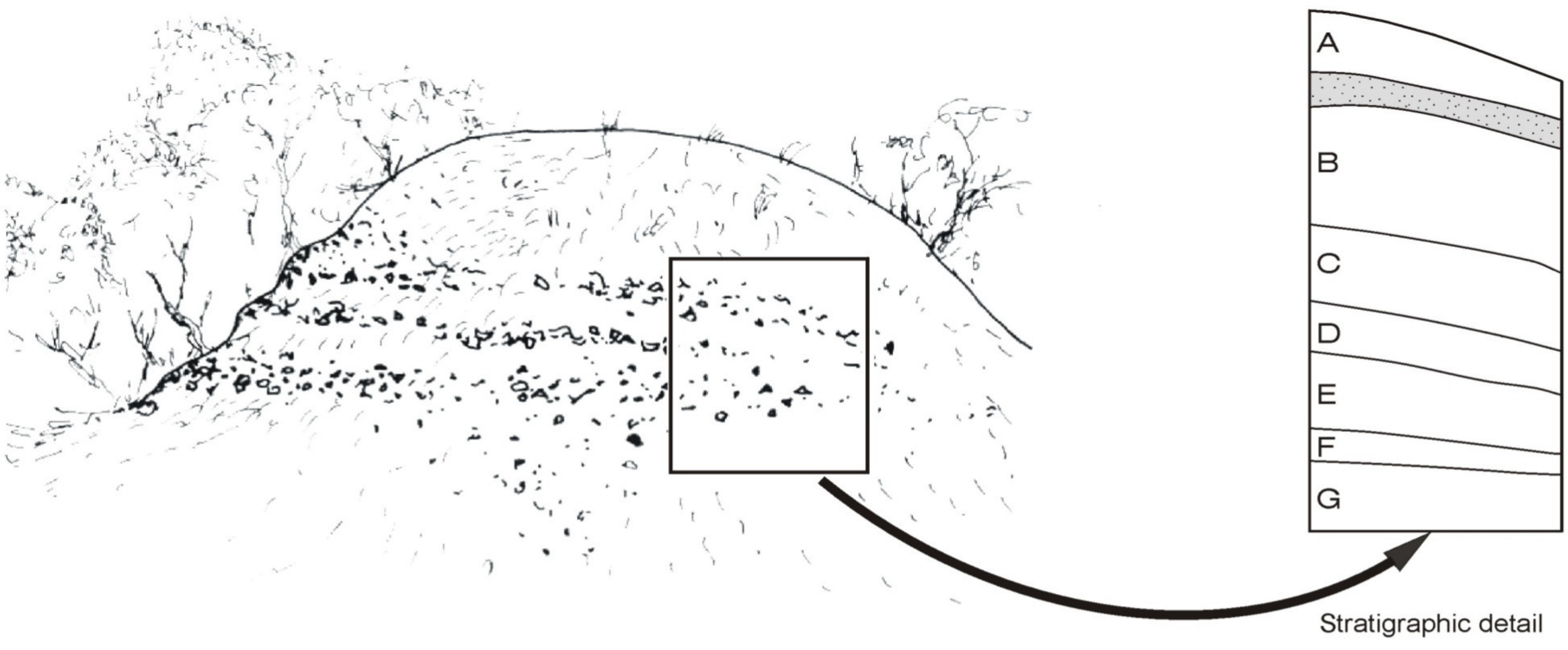
4.4 Still Bay 2

Still Bay 2 is a large midden located on a dune behind the Still Bay harbour master's office, and close to the Still Bay harbour fish traps (Fig. 4.1). It was identified during a Phase 1 archaeological impact assessment of the area conducted during 1991 by members of the Archaeology Contracts Office of the University of Cape Town. The visible portion of this site contained a well stratified *in situ* compacted shell midden. A section of this midden was sampled during mitigation in that same year. The material recovered was housed at the University of Cape Town but had not been fully analysed until 2007, as part of the work undertaken for this thesis. Finds from six stratigraphic units were analysed and provided an ideal opportunity to investigate whether there was a relationship between the site and the nearby fish traps.

4.4.1 Stratigraphy and Dating

During excavation of this site, units were labelled in alphabetical order unit A to G; unit A represents the uppermost unit and unit G defines the lowermost unit, according to Fig. 4.2. Material from two further stratigraphic units, H and I, was also boxed with units A-G, but because H and I were not indicated in the excavators' section drawing, and it was unclear whether these were part of the stratigraphic sequence, or recovered from elsewhere on the site, material from these units was not included in the analysis. A general stratigraphic schema of Still Bay 2 is shown in Fig. 4.2.

Two radiocarbon dates from marine shell were obtained for this site. Marine shell from a depth of 0.05 m yielded a date of 2 455 ± 20 B.P. (Pta-8465), which yields a most likely calibrated date of 56 A.D., with a one-sigma range from 28-77 A.D. Marine shell from a depth of 1.5 m yielded a date of 2 890 ± 60 B.P. (Pta-8467), which yields a most likely calibrated date of 466 B.C., with a one-sigma range from 552-388 B.C. The radiocarbon dates were calibrated using the Pretoria calibration curve for the southern hemisphere (Talma & Vogel 1993), updated in 2000. Approximately 435 years separates these two dates and considering the depths from which these dates were obtained, deposition of this site occurred rapidly.



Key to stratigraphic detail

A. Mixed *Patella* sp., *Turbo sarmaticus*, *Oxystele tigrina* dominated.
B. *Patella* dominated, decreased amounts of *Oxystele tigrina* and other species.
C. Dominated by fragmented *Oxystele tigrina*, decreased *Patella*.
D. *Patella* dominated in a matrix of fragmented *Oxystele*.
E. *Turbo* sp. dominate together with *Patella longicosta*.
F. Yellow sand - shell dominated by fragmented *Oxystele tigrina*.
G. Final *Patella* and *Turbo* dominated lense overlying sterile dune.

Figure 4.2. Stratigraphic schema of Still Bay 2. From Rubin (1991)

4.4.2 Results

In total 14.5 kg of material was analysed from units A-F. The material from unit G could not be located. Marine shell comprises the bulk of this at 14.1 kg, stone: 8.8g and bone: 31.8g.

4.4.3 Lithics

Four pieces of stone were found, two quartzite manuports and two flakes, one on quartzite and one on crypto-crystalline silicate. The two manuports came from unit E and unit F. The quartzite flake came from unit C and the CCS flake from unit D.

4.4.4 Shellfish

All the shellfish in the sample curated from Still Bay 2 were identified, counted and where possible measured. Minimum numbers of individuals and percentage values for the different species are given in Table 4.4. The range of species exploited is similar to those found in the Paapkuil Fontein sites. *Scutellastra longicosta* (27.4%), *Oxystele tigrina* (15%), and *Turbo sarmaticus* (16.4%) comprise the bulk of the assemblage. Together, these three species account for 53.2% of the minimum number of shellfish at the site. If all species of *Oxystele* are included, this rises to 80%.

There appears to be very little patterned variation in the composition of shellfish throughout the sequence. However *S. longicosta,* which is dominant in most units, is supplanted by *O. tigrina* and *T. sarmaticus* in unit C and by *T. sarmaticus* in unit F, as the dominant shellfish. The numbers of *Oxystele* also spike in these units with all species accounting for 63.6% and 59.2% respectively. *S. longicosta* accounts for only 6.4% in unit F. This is interesting as this unit is described as yellow sand dominated by *O. tigrina*. The underlying unit G, for which in the excavators' notes the excavated material was not available for analysis, is described by the excavators as dominated by limpets and *Turbo*, with sterile dune sand underneath. From the evidence available it appears that the lack of limpets in unit F may suggest selectivity in resource procurement. Interestingly *Perna perna* are present only in the uppermost units A-C and entirely absent in the rest of the sequence.

Table 4.4. MNIs and percentage values of the different shellfish analysed at Still Bay 2.

	Lens A		**Lens B**		**Lens C**		**Lens D**		**Lens E**		**Lens F**		**Total**	
Species	no	%	no	%	no	%	no	%	no	%	no	%	no	%
Scutellastra cochlear	17	12.2	7	4.0	7	3.2	6	3.2	2	0.7	5	4.0	44	4.0
Scutellastra longicosta	41	29.5	78	44.3	26	11.7	68	36.2	84	32.1	8	6.4	305	27.4
Scutellastra barbara	2	1.4	–	–	2	0.9	2	1.1	–	–	–	–	6	0.5
Scutellastra barbara/longicosta?	2	1.4	6	3.4	–	–	22	11.7	6	2.3	–	–	36	3.2
Cymbula oculus	6	4.3	8	4.5	5	2.3	1	0.5	3	1.1	1	0.8	24	2.1
Dinoplax gigas	–	–	–	–	1	0.4	–	–	–	–	–	–	1	0.1
Limpet spp.	2	1.4	12	6.8	4	1.8	1	0.5	3	1.1	2	1.6	24	2.1
Turbo sarmaticus	24	17.3	22	12.5	32	14.4	24	12.8	46	17.6	34	27.2	182	16.4
Oxystele tigrina	4	2.8	27	15.3	53	23.9	13	6.9	39	14.9	30	24	166	15.0
Oxystele sinensis	13	9.4	5	2.8	11	5.0	8	4.3	17	6.5	7	5.6	61	5.5
Oxystele variegate	–	–	–	–	–	–	1	0.5	–	–	–	–	1	0.1
Oxystele spp.	7	5	5	2.8	77	34.7	41	21.8	54	20.6	37	29.6	221	19.9
Haliotis midae	–	–	1	0.6	–	–	–	–	2	0.7	1	0.8	4	0.4
Haliotis spadicea	2	1.4	–	–	–	–	1	0.5	4	1.5	–	–	7	0.6
Haliotis spp.	5	3.6	–	–	–	–	–	–	1	0.4	–	–	6	0.5
Burnupena spp.	2	1.4	2	1.1	–	–	–	–	1	0.4	–	–	5	0.4
Perna perna	12	8.9	3	1.7	4	1.8	–	–	–	–	–	–	19	1.7
Total	139	100	176	99.8	222	100.1	188	100	262	99.9	125	100	1112	100

Table 4.5. Mean sizes and standard deviations for the measured shellfish at Still Bay 2.

	Lens A					Lens B					Lens C					Lens D					Lens E					Lens F				
Species	n	mean	min	max	st.dev	n	mean	min	max	std. dev.	n	mean	min	max	std. dev.	n	mean	min	max	std. dev.	n	mean	min	max	std. dev.	n	mean	min	max	std. dev.
Turbo sarmaticus opercula	15	20.1	9.7	30.3	5.9	13	23.7	16.0	39.0	5.8	27	19.0	9.3	29.1	4.8	23	21.3	14.4	33.7	4.7	28	22.5	12.8	34.7	5.9	32	22.0	13.9	35.5	4.9
Scutellastra cochlear	8	40.7	12.6	53.5	16.4	3	41.7	21.6	52.8	17.5	5	42.2	24.8	53.3	13.5	4	30.8	16.9	49.9	15.1	2	40.4	26.0	54.9	20.4	3	51.7	48.9	55.0	3.1
Scutellastra longicosta	6	40.6	37.3	46.8	3.6	8	63.7	54.1	76.6	8.3	5	54.5	51.0	61.6	4.1	17	62.0	56.3	77.2	5.1	23	63.3	52.8	72.5	4.2	4	61.1	55.0	65.4	4.3
Scutellastra babara	2	51.0	48.8	53.1	3.1	-	-	-	-	-	1	60.8	-	-	-	1	62.9	-	-	-	-	-	-	-	-	-	-	-	-	-
S. barbara/longicosta?	-	-	-	-	-	2	61.0	57.8	64.2	4.5	-	-	-	-	-	8	64.6	58.7	68.1	3.1	1	66.0	-	-	-	-	-	-	-	-
Scutellastra argenvillei	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cymbula oculus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	55.7	-	-	-

4.4.5 Bone

The remains of terrestrial and marine animals in the sample are given in Table 4.6. Only 30 fragments of mammal and reptile could be identified representing a minimum of 4 animals: seal, tortoise, snake, and small mammal.

Table 4.6. Faunal remains from Still Bay 2.

Category	NISP	MNI	Burnt/blackened
Seal	1		
Tortoise	15		
Snake	4	1	
Small mammal	10		2
Unidentified	78	–	1
Fish	94	3	
Total	202	4	3

Ninety-four fish bones were identified, representing a minimum of three individuals. A breakdown of the body parts present are given in Table 4.7. The species present are Cape stumpnose and black musselcracker. The fish from this sample were small: approximately 12 cm. Stumpnose enter estuaries and lagoons during juvenile stage and leave its confines when they reach sexual maturity. The small size of the fish from this site are consistent with their having been caught near the mouth of the nearby Goukou River.

Table 4.7. Skeletal body parts of marine fishes from Still Bay 2.

Element	Unit A	Unit C	Unit D	Unit E	Unit F	Total
Vertebrae	17	2	12	5	6	47
Ultimate vertebrae	–	–	–	–	–	1
Quadrate	1	–	–	2	2	5
Hayomandibula	–	–	–	1	2	3
Basi-occipital	–	–	–	1	–	1
Spines	8	1	2	3	5	19
Pectoral spine	–	–	1	–	–	1
Scales	–	–		3	2	6
Endopterygoid	–	–	–	1	–	1
Supra-orbital	–	–	–	1	–	1
Cleithrum	–	–	1	–	–	1
R. dentary*	1	–	1	–	–	2
R. maxilla*	–	–	–	–	1	1
Unid. Fragments	–	–	5	–	–	5
Total	26	3	22	17	18	94

*R. dentary: x 2 *Rhabdosargus holubi*
*R. maxilla: x 1 *Cymatoceps nasutus*

4.5 Jongensfontein

The site of Jongensfontein is a large open shell midden situated 5 km west of Still Bay (Fig. 4.3). The site is approximately 70 metres from the shoreline, and a fish trap, now in disrepair, is located on the shore immediately east of the midden.

Figure 4.3. 1: 10 000 orthophoto showing position of Jongensfontein site relative to fish trap (dotted white line).

The midden was uncovered during the excavation of foundation trenches for a new house on Erf 157. Excavation of the site was conducted with a mechanical excavator, and monitored by

Mossel Bay Archaeology Project Cultural Resource Management (MAPCRM). The archaeological content removed was closely examined by the monitoring archaeologist, and the presence and absence of various categories of finds noted. The remains were, however, not counted or weighed so quantitative information of the type presented for the other sites in this thesis is not available. Roughly one cubic metre of deposit from each of the three main stratigraphic units was screened through a 1.5 mm mesh sieve and bagged for later analysis. Five military sandbags (one sieved and sorted) were filled with sieved material from each stratigraphic unit and buried on location for possible future analysis. Two buckets of sieved material from each stratigraphic unit underwent a rough sort. It was therefore not possible to examine it for this project. The information presented here is based on the archaeological report submitted to Heritage Western Cape (Nilssen 2003).

Although the exact extent of the midden could not be ascertained, what was uncovered measured approximately 6 m x 4 m. The depth of the midden ranged from 110 cm-140 cm, overlain by 40 cm-80 cm of sterile topsoil and aeolian sand.

4.5.1 Stratigraphy and Dating

Three major stratigraphic units were identified, based on changes in the archaeological material, particularly variation in shellfish composition, and sediment changes. These were labelled Top, Middle and Bottom (Fig. 4.4). Radiocarbon dates are not available for this site, but the midden lies on top of a raised beach approximately 2-3 m above present level, which is probably associated with the mid-Holocene marine transgression ca. 6 000-4 000 years ago. The absence of pottery in this site suggests a pre-date 2 000 date for this midden. Overall, therefore, the occupation is likely to date to ca. 4 000-2 000 B.P.

4.5.2 Lithics

Only 6 pieces of stone were noted in the report, of which 2 were artefacts: a quartzite flake from the top unit, and a hammer/grindstone from the bottom unit. Two manuports were observed in the middle unit, with one specimen showing evidence of grinding. The number of stone artefacts reported from the site is too small to understand how this assemblage fits into the southern Cape sequence. From the little evidence available the Jongensfontein lithic assemblage appears similar to macrolithic late-Holocene assemblages associated with other southern Cape coastal sites.

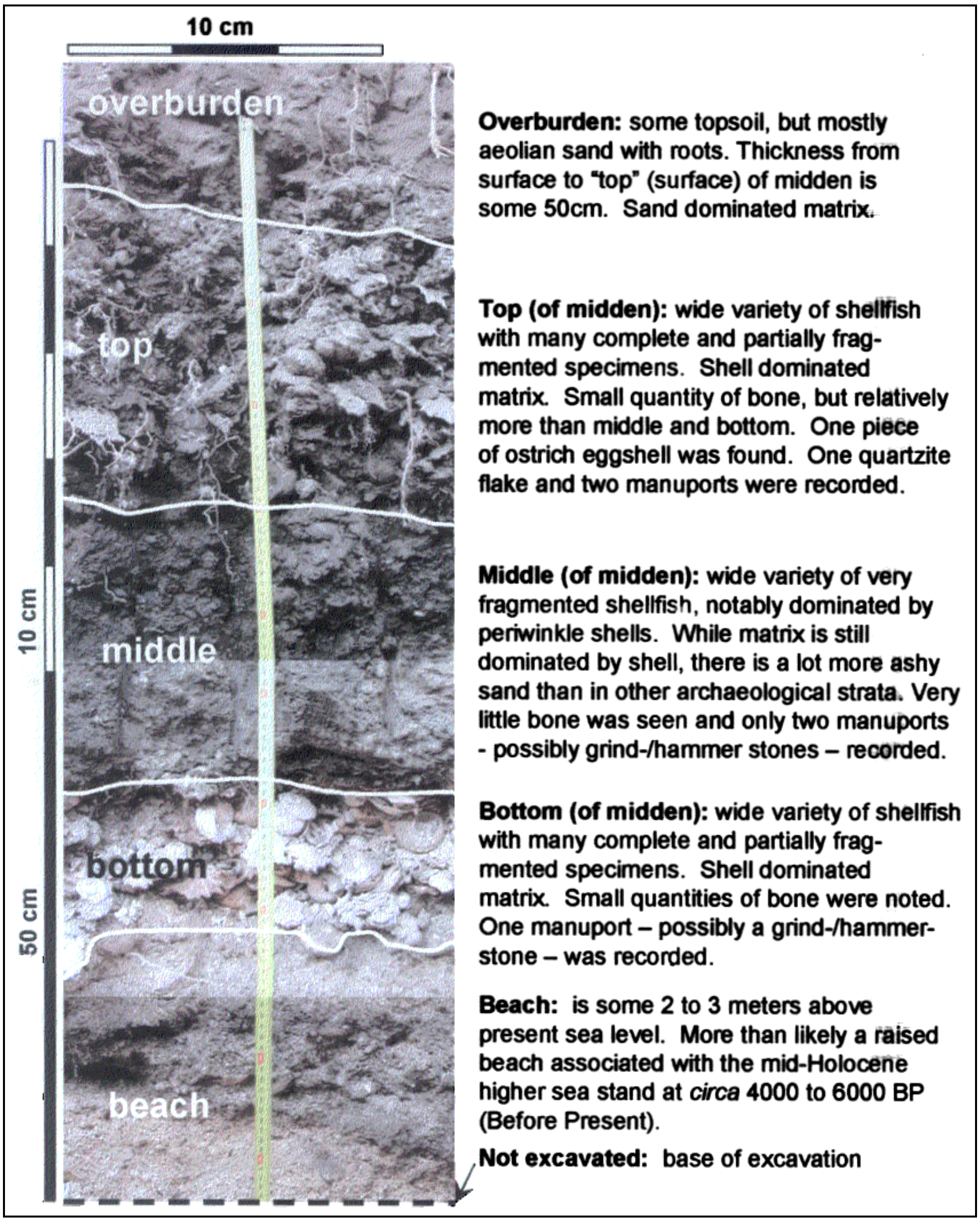


Figure 4.4. Stratigraphy of Jongensfontein deposits. From Nilssen (2003).

4.5.3 Ostrich eggshell

One piece of ostrich eggshell was recovered from the top unit. No pottery was reported so it is likely that the occupation may pre-date 2 000 B.P.

4.5.4 Shellfish

Occupation of this site was mainly focussed on the exploitation of shellfish-with this resource almost completely swamping the signal of other food debris. Variation in the composition of shellfish between the different units was noted. The top unit was limpet dominated. *Oxystele spp*. are present but less important than limpets. *T. sarmaticus*, *H. midae* and *H. spadicea* are also present. The Middle unit was dominated by *Oxystele spp*. Only two species of limpet were present in this unit, *C. granatina* and *S. cochlear*. The monitoring archaeologist noted that the sizes of *T. sarmaticus* were notably smaller in this unit than individuals in the other two units. The Bottom unit was limpet dominated with a wide variety of limpets present.

4.5.5 Bone

Faunal remains other than shellfish were relatively rare at this site and it was noted that a large sample would need to be excavated to obtain a representative sample. Terrestrial fauna included the remains of small mammal, tortoise, bovid size classes 1, 2, 4, marine bird, and microfauna, marine animals included the remains of seal and fish.

Nilssen (2003) noted that fish were present only in small numbers. A species list was not given as no identifications could be done on site. Rare fish bones were present in the Bottom and Middle units, but none were noted in the the Top unit. The small quantity of fish remains at this site suggests that the primary thrust of occupation of this site was geared towards exploiting marine and terrestrial resources other than fish. From the evidence at hand no link could be made between the midden and the fish trap in the area.

4.6 Summary

The results from the two midden sites at Still Bay and the midden at Jongensfontein indicate that the primary object of occupation was the exploitation of shellfish. The rarity of faunal material other than shellfish suggests that terrestrial and marine fauna played a minor role in the diets of the occupants. Fish is also notably rare at both sites. The patterns observed for Still Bay and Jongensfontein are similar to those observed at Paapkuil Fontein. The scarcity of fish at the Still Bay sites echoes its absence at the Paapkuil Fontein middens. Once again it is likely that if the fish traps were used at the time the middens were accumulating some fish remains would have found their way into the middens. I therefore suggest that the evidence now available from all seven sites in these two areas indicate that the traps were not in fact used by the occupants of these sites.

CHAPTER 5

ARCHIVAL RESEARCH

5.1 Introduction

The previous chapters of this thesis examined the antiquity of fish traps through a body of archaeological evidence. The archaeology presented in Chapters 3 and 4 found no clear association between the fish traps and pre-colonial shell middens excavated. Fish was in fact rare in certain sites and absent in others.

In a survey of early traveller accounts at the Cape no reference is made to the method of fishing with stone-walled fish traps in coastal areas. There are, however, references made to fishing with line and hook (Kolbe 1738 in Tompson 1913), spearing with sharpened wooden sticks (Tavenier 1660 in Raven-Hart 1971; Langhans 1694 in Raven-Hart 1971; Burchell 1824; see also Raven-Hart 1967), basket traps (Barrow 1806; Stow 1905), and the use of nets (Kolbe 1738 in Tompson 1913). Thom described how the Dutch bought a large quantity of steenbras from the local inhabitants in 1657 (enough to feed the garrison for 3-4 days), who speared the fish with assegais in a shallow lake similar to the Langebaan Lagoon. An extract from the journal of General Janssens described the fishing methods of the Bosjemans (Bushmen) of the Orange River area He writes "...if they expect a swelling of the stream, while the water is still low, they make upon the strand a large cistern, as it were, enclosed by a wall of stones, which serves as a reservoir, where if fortune is favourable, a quantity of fish are deposited at the subsiding of the waters" (Lichtenstein 1806: 55). Another reference to fish trapping comes from Schapera (1930: 138) who describes the building of stone walls across rivers for catching fish, among existing Bushmen. Both examples refer to freshwater fishing in the interior.

Because fish traps are still in use today, and had to be operated under strict licensing conditions, official records were kept about their distribution and the diversity of fishes caught. A surprising wealth of information about fish traps exists in the archives, dating to the period between the late 19th and early 20th century. The historical research was conducted at the Cape Archives, Roeland Street, Cape Town and the Government Publications housed at the library of the University of Cape Town. This chapter examines this wealth of information to obtain a view from the archive as an aid to understanding the history of construction and use of the fish traps.

5.2 A view from the archives: writing a history for the stone-walled tidal fish traps

The first mention of fish traps found in the archival record dates to 1892. The 1890s were a tumultuous period for the Cape fishing industry. By 1892 the industry at Cape Town was in decline; a commission was set up by Parliament in that same year to investigate the cause. Stock of the most important commercial fish *Thyrsites atun* (snoek) dwindled, and both fish and catch sizes were becoming smaller each year. Stakeholders in the industry were interviewed by the Parliamentary Commission; these included professional fishermen, boat owners, harbour administrators, and owners of fishing companies. Slow development of the fishing industry and the lack of knowledge about South African fishes were of paramount concern to the commission. Poor preservation methods and an inadequate system for transporting fish to markets were seen as major stumbling blocks that hindered the development of the industry. One of the significant results of this commission was the eventual employment of a marine biologist (J. D. Gilchrist) to investigate fishing grounds and explore the potential improved commercial fishing techniques.

Johan Stephan of Stephan Bros., who owned a large fishing company at the Cape, reported on the use of fish traps on the Western Cape coast, between Hoetjies Bay and Saldanha Bay. He testified that “there is a practice among the farmers who reside near reefs of rocks on the coast, of making ‘kraals’ or enclosures of stone for entrapping fish...” (Stephan 1892: 17, in lit.). While some of his later comments as to the amount of fish trapped were purely speculative, he was a strong proponent of the abolition of fish traps on the grounds that they were excessively destructive. John Louis McLachlan of Stumpnose Bay echoed similar sentiments. He stated that “certain parties in the vicinity destroy vast quantities of young fish by building sea walls among rocks sufficiently high to allow the flood tide to cover the same, and thereby entrapping fish which of course cannot escape at low water” (McLachlan 1892: 19 in lit.). Morris Fox (1892: 25 in lit.), who resided near the mouth of the Goukou River at

Still Bay, noted that people went along the beach to throw up “fibre walls of stone”, which retained fish as the tide receded, and proposed that these people should be made to buy licenses. Interestingly, J. M. Orpen (1892: 26 in lit.), of Mount Newton, indicated the use of fish traps in rivers, although he does not specify what type of fish traps people were using, whether stone-built fish traps or baskets or some other type.

Today fish traps are known from only a few isolated localities along the west coast, but the testimonies of J. Stephan and J. Maclachan suggests that their use may have been much more widespread than presently visible. The testimonies summarised above are unanimous on the destructive nature of tidal fish traps. This is not surprising, considering that the fishing industry was in a state of decline during the 1890s. From later communications it can be ascertained that tension existed between professional fishermen and people who operated fish traps. Disputes arose mainly from three points; 1) whether fish trap owners had to pay license fees, and 2) whether individuals had sole rights to use of traps and fish obtained from them, and 3) that people who operated fish traps situated their traps in the best locations for obtaining haarders, restricting the ability of trek fishermen to obtain this valuable fish.

Section 10 of the summary of the S.C.R. (Select Commission Regarding) stipulated that, in any future Act passed regarding the fishing industry, provision be made by proclamation preventing the destruction of fish through the practice of making ‘kraals’ or ‘enclosures of stone’ (Anon 1892 in lit.).

In August of 1893, the Fish Protection Act of 1890 was amended, the Regulations being published on the 24th November 1893. Section 2 stipulated that it “it shall not be lawful for any person or persons to construct or make use of any “kraal” or enclosures below high-water mark, for the purpose of snaring or catching fish of any description” (Anon 1893 in lit.). This regulation was reiterated by Proclamations 353 of 1894, 393 of 1895, and 81 of 1897. The Fish Protection Act of 1893 was eventually replaced by Act 43 of 1899. A second commission was held by Parliament in 1899 on the state of the colonial fisheries. While this session did not deal with fish traps, some of the issues raised are pertinent to the question, eg to do with the preservation of fish. F. Tothill, Fishery Officer in the districts from Plettenberg Bay to Jeffreys Bay, testified that it took an average of four days to sun and wind dry fish (weather permitting), and that this method required constant supervision to keep flies away and fish needed to be placed under cover when it rained (Tothill 1899 in lit.). Since the best

catches of fish in tidal fish traps are reported during winter months (du Toit 1912 in lit; Kemp 2006) spoilage due to rainy conditions may have been a considerable obstacle to pre-colonial fishers and a deterrent to fishing with this method. Although we know little about preservation of fish by indigenous people, if the above mentioned method was used, and considering the large quantities of fish normally associated with fish trapping events, then people would have had to remain in one place for quite some time after trapping took place.
Another Parliamentary Commission was held in April 1904, this time on the state of the Caledon Fisheries. An interesting statement was made by H. Breda, then owner of the property Paapkuilfontein, who stated that he allowed fishermen to squat on his property during the haarder (mullet) season (H. van Breda 1904 in lit). Unfortunately, the exact location where fishing took place and the methods used were not mentioned. This information does suggest that the area was a favoured place for fishing, in particular for mullet.

It was during this particular period, for the first time since 1892, that the use of fish traps became an important issue amongst provincial law makers. In several communications with the Secretary of Agriculture, two reasons were stressed why the ban on the building of fish traps should be repealed. Firstly, it was indicated that fish traps provided great assistance to bywoners (sub-farmers) and other poor whites living along the Riversdale coastline (A. Badenhorst 1924 in lit). Bywoners are a landless rural underclass who normally resides on the property of a farmer. Secondly, it was suggested that measures be put in place to enable landowners, particularly farmers owning land abutting the sea shore, to make use of fish traps again (Lowrens 1910 in lit.). In November 1905, the Divisional Council of Riversdale passed certain regulations regarding the catching of mullets or haarders in kraals (Anon 1905 in lit.). Section 1 of these regulations stated that it was not lawful to build traps or catch fish during the months of February to July. Section 2 stated that it would be lawful to make or use traps only during the months from August to January, by the owner of the land abutting the sea, or anyone authorised by such a person in writing to catch haarders during high tides of the new moon. Fish had to be no smaller than 8 inches (approximately 20 cm). During December of 1905, the acting Fishery Commissioner of Riversdale District, Morris Fox, inspected the fish traps at Still Bay and found most in disrepair with sand washed in. For these traps to have worked effectively, most would have had to have their walls repacked (Fox 1905 in lit.). In the ten to twelve years since the first banning of the making of fish traps, their preservation had been significantly impacted. This last point demonstrates the fragility of these features:

continual maintenance was important for effective use and the preservation of stone-built tidal fish traps.

It is unclear whether the regulations suggested by the Divisional Council of Riversdale, permitting the use of fish traps, were ever implemented, as Section 2 of the Fish Protection Acts of 1893 and 1899 were reinstated by Proclamation 456 of 1908. The reluctance to lift the restrictions was based primarily on the fact that it was difficult to manage these features. In some instances there was some uncertainty over who was responsible for individual fish traps. The farms in the dunes were owned in undivided shares by a number of farmers who visited the coastline periodically throughout the year and then left without opening them again (i.e. breaking down part of the wall to allow fish to escape). Bywoners were pointed out as being the principal abusers (Anon 1910 in lit). While policy makers had no quibble about permanent coastal residents making use of traps, concern was raised over the limited number of Mounted Police whose responsibility it was to monitor the traps, and it was felt that inadequate policing could lead to abuse and the unnecessary multiplication of fish traps in the area (Janisch 1910 in lit).

In a letter dated 11 November 1910, Attorneys at Law, H and P Lowrens, petitioned the Provincial Government on behalf of farmers of Riversdale and Mossel Bay Districts to grant permission for them "to again take up vywers to catch fish along the sea coast on their respective properties". The farmers provided the Government with a map indicating the location where they wished to built fish traps (Figure 5.1). In 1911 the Fisheries Ordinance came under Parliamentary review. Some members of the Provincial Council pointed out that fish traps would be beneficial to farmers visiting the coast for a holiday with their families, and who unlike professional fishermen were not equipped with the means, nets, boats etc, to acquire fish for their own consumption. It was suggested that fish traps be allowed under strict conditions that would obviate any abuse. The regulations were published under Section 6 of Proclamation 223 of 1911. The stipulations included the following: that no person may construct any fish trap unless in possession of a special permit issued in writing by an officer authorised by the Provincial Administrator. Secondly, applicants had to submit with their applications a sketch plan showing the area of planned construction and dimensions of trap. Thirdly, applicants who received permission to construct a fish trap had to demolish it if so instructed by the Administrator (Anon 1911 in lit.).

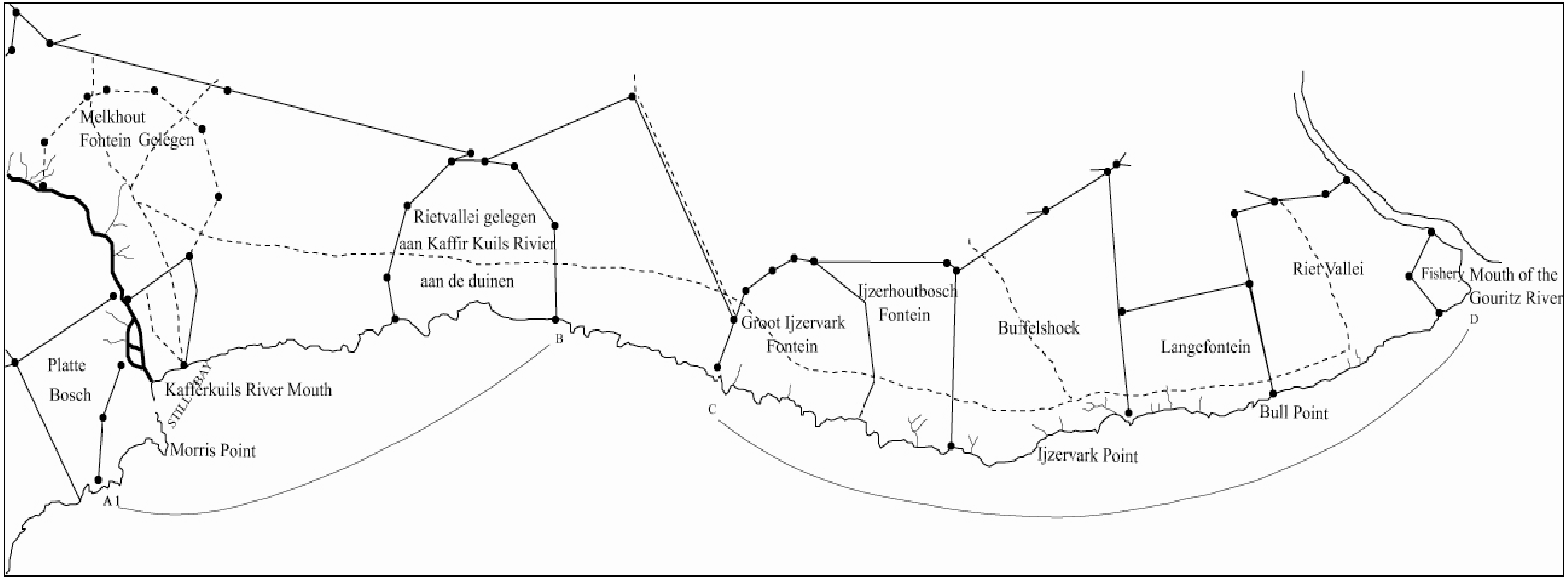


Figure 5.1 Map drawn up by Riversdale farmers in 1910 indicating the area in which they would like to erect or re-erect fish traps. Note the striking association between where farmers wished to erect fish traps and the position of the farms. This map corresponds with the locations of fish traps still visible today. Still Bay, Morris Point and Noordkapperpunt are shown at the left. Kafferkuils River has been re-named Goukou River. Archival document. Cape Archives. PAN 6 A120/B/13.

Table 5.1. Table indicating the name, date and location of people applying to erect fish traps after Proclamation 223 of 1911 was passed.

Applicant	Date	Location
H. Groenewald Rymerskraal	13.2.1912	700 yards from Marthas Point and 2500 yards from Skipskop Refused
Leonard Jocobsohn Wagenhuiskrantz	5.2.1912	Dimension of 83 yards x 200 yards x 61 yards at Rys Point . Refused.
C. Klynsmith Rymerskraal	17.2.1912	Near Marthas Point and 300 yards from Skipskop. Refused
J. Murtz Wagenhuiskrantz	30.1.1912 30.1.1912	Due south of Beacon at Bulldog Reef or Saxon Reef
H. Murtz Wagenhuiskrantz	5.2.1912	At the Beacon at Bulldog or Saxon Reef. Refused.
Jan Newman	27.1.1912	At the Beacon, commonly called Struis Point. Refused.
John Swart	21.2.1912	At Struis Bay. Refused.
D. Wyngaard Struis Bay	22.2.1912	At Struis Bay. Refused.
G. Wilson Skipskop	20.2.1912	Near Skipskop and Marthas Reef. Refused.
Tom Wilson Skipskop	21.11.1912	On Crownland adjoining the farm Skipskop. Granted.
P.J. Van Breda	22.2.1912	At Struis Bay. Refused.
D. L. Swart & M. D. van Breda Struis Bay		At the portion of Struis Bay called Hikers Hoek. Dimensions 50 yards x 120 yards x 150 yards. Refused.
M. E. du Toit	27. 1. 1912	South West of Beacon called Bull Dog or Saxon Reef. Refused.
D. P. Du Toit Prinskraal	27.1.1912	South east of Bulldog or Saxon Reef. Granted
J. W. Myburgh Vogelgezang	17.8.1912	At Wagenhuiskrantz near the Beacon Granted
G. de Wet Driefontein	19.9.1912	Near Marthas Point Dimensions 100 x 50 yards. Under Consideration.
P. E. de Kock	16.8.1912	At Struis Point. Under consideration.

A batch of applications was soon received mostly for localities along the Bredasdorp coastline. Table 5.1 lists the names of applicants and the place and dimensions of the fish traps constructed and Figure 5.2 is a map of the Bredasdorp coastline indicating the position of farms in relation to the coast where fish traps occur. The majority of the applications were not entertained on the basis that the intention was to fish for commercial profit (Anon 1913 in lit.). Of the 17 applicants who applied, permits were issued to three: D. P. du Toit of the farm Prins Kraal, T. Wilson of Skipskop and J. W. Myburgh of the farm Vogelgezang. P. E. Kock was the only person who identified himself as a bywoner residing on the farm Ronde Heuwel, belonging to Marthinus Swart. Applicants residing at Wagenhuiskrantz were probably fishermen, as this was the local fishing village. The families Murtz and Newman of Wagenhuiskrantz appear in the archival record as fishers owning lots at the fishing station. H. Groenewald applied to re-erect a fish trap at Marthas Point, while T. Wilson was granted permission to construct a fish trap on crown land adjoining the farm Skipskop. It is also interesting to see that individuals such as P. J. van Breda who would later strongly oppose the application of this method of fishing, also applied to construct a fish trap (P. J. van Breda 1925 in lit.).

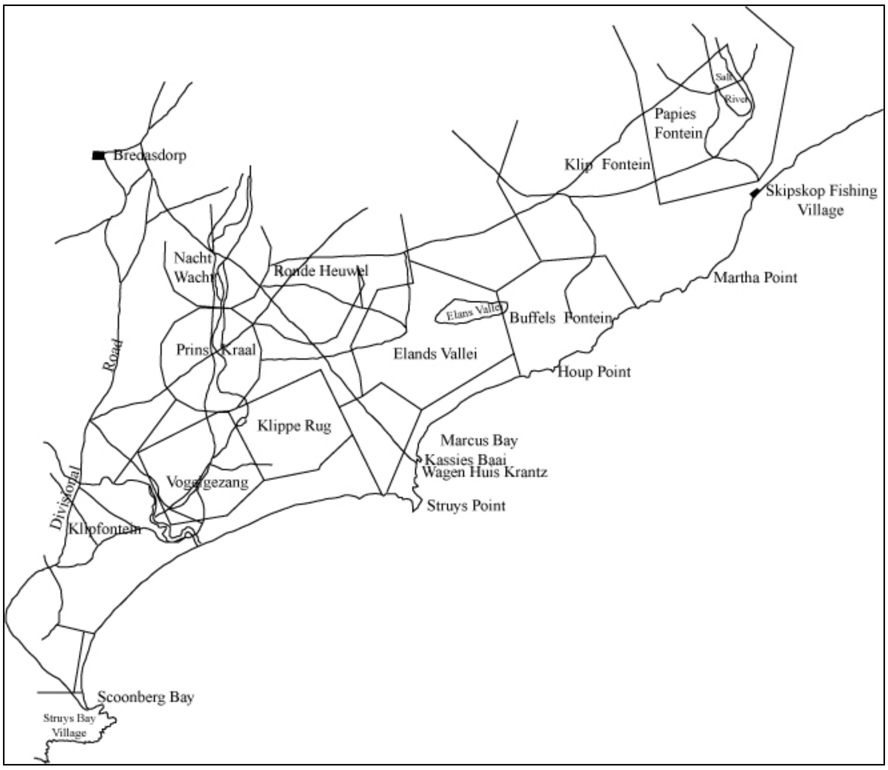


Figure 5.2. Map showing the Bredasdorp coast from Struis Bay to Skipskop. Note the location of farms and their positions relative to areas to where fish traps are located. Cape Archives PAN 55. K13/25.

The granting of these permits caused considerable tension, especially between fishermen and farmers living in the interior. Fishermen were of the opinion that if permits were to be issued, it should have been to them. Concern was also raised over fish traps being situated at the best locations, thereby restricting the grounds where fishermen could fish, in particular for mullet. In a letter to the Magistrate of Bredasdorp, dated February 1912, 30 fishermen of the Struis Bay area petitioned against the use of fish traps, especially by people not living on the coast (van Rath 1912 in lit.; Levin & de Wet 1912 in lit.). Protest was made that only fishermen residing at that particular coast were rightful operators of fish traps, because they had built fish traps in the past and that due to government legislation the walls had had to be opened (i.e. breached, to render traps non-functional). This probably refers to the Fish Protection Act of 1893. Secondly, fishermen felt that they were being disadvantaged and were now making losses due to permits being issued to non-coastal inhabitants.

In a letter by Attorneys Levin and de Wet to the Resident Magistrate of Bredasdorp acting on behalf of Carl van Rath and 30 fishermen from Struis Bay, further complaints were raised about the operation of fish traps. Specific objections were made about Dirk Swart's use of fish traps (Levin & de Wet 1912 in lit.). Here the main point of contention was the location. The traps were situated in all the best places for trekking haarders and the granting of these rights prevented the fishermen from operating their boats. Dirk Swart was never granted permission to make fish traps, so these ones were operated illegally.

In 1913, the Fishery Officer inspected the coastline from Port St. Johns to Cape Town, with the mandate to report specifically on the distribution of fish traps. No fish traps were reported from Port St. Johns, Port Alfred, Port Elizabeth, Jeffreys Bay, Plettenberg Bay, Knysna Lagoon, George or Mossel Bay. Fish traps were noted only from the Riversdale District. The fishery officer writes "the method of trapping fish, by constructing the fish kraal or vijver, seems to have been a regular practice engaged in by both farmers of the district and fishermen alike, and the whole coast, wherever there is a rocky reef, shows signs of the dismantled walls of these kraals which were used some years ago" (Cripps 1913 in lit.). At "Riet Vlei" fish traps were found in working order and being made use of. This was reported to the police in Albertinia and a mounted trooper was requested to demolish the walls of the traps. The Magistrate of Riversdale was also informed of the decision of the Executive Committee to dismantle fish traps (Weisbecker 1913b in lit.).

Fish traps authorised under Proclamation 223 of 1911 were inspected in May 1913, to see if they adhered to the regulations. The traps of D. P. du Toit provide an interesting case. Under the special regulations of the Fisheries Ordinance No 12 of 1911, permission to construct fish traps was primarily intended for farmers who wanted to acquire fish for personal consumption. Mr. Du Toit's initial application was refused on the basis that he was a professional fishermen wanting to fish for commercial gain. In his motivation he stressed that the object was not to sell fish but to use it on his farm. He further stated that he had to feed 12 labourers every day throughout the year, and a further 30 during the threshing season, excluding his own family. He adds (du Toit 1912 in lit.):

> I fail to see why *bona fide* farmers are not allowed to catch fish for their own use with fish kraals...what is actually the difference...whether we farmers in the W.P. (the backbone of the country) catch fish in kraals, or Natives catch them in nets, as long as we catch the correct size? I am quite sure that more cruelty is done by those hauling nets, when in the hands of Natives, than by a well constructed fish kraal in the hands of a *bona fide* farmer, who pays up and looks pleasant when Mr. Merryman requires money to get the wheel to turn.

On inspection of Mr. Du Toit's traps, it was found that two had been constructed, instead of the stipulated one. Surplus fish were being sold to residents, in contravention of the Fisheries Ordinance of 1911. The traps used by T. Wilson at Skipskop were also being used for commercial purposes. The outcome of this situation was the immediate cancellation of the permits issued to these individuals. The traps were demolished and they were informed that none would be allowed in future (Wesibecker 1913a in lit.). Figure 5.3 and 5.4 shows a rough plan and photograph of the fish traps constructed by Mr. du Toit, and Figure 5.5 is a photograph of Tom Wilson's fish trap. The plan was drawn and the photographs taken by the fishery officer in May 1913.

The biggest difficulty in regulating the practice of fish trapping was the limited number of police available to patrol the coastline. After the abolition of the fish traps in 1913, the number of references to them in the archives decline and only started to pick up in the mid-1920s. However, in 1919 there were reports that people were using fish traps at Skipskop. Constable Nowers investigated this claim and found that fishermen at Skipskop were in fact not engaging in fish trapping (Nowers 1919 in lit.). The confusion stemmed from an enquiry that a Mr Shea of Groenfontein farm, Bredasdorp, made at the Fishery Office at Cape Town about the possibility of fishermen making use of fish traps (Mansergh 1919 in lit.), although he never followed up on his initial enquiry. Nowers reported that he patrolled the coastline quite regularly for several years and not witnessed people making use of or building fish traps (Nowers 1919 in lit.).

From the mid-1920s the police implemented the regulations more vigorously. In a letter to the Provincial Secretary, the then Magistrate of Riversdale, A. Badenhorst, highlighted the importance that fish traps held for the subsistence of poor people in the area, especially at Still Bay (Badenhorst 1924 in lit.). J. D. Gilchrist, the Fishing Administrator, submitted recommendations to the Provincial Secretary in January 1924. He reiterated some of the concerns already mentioned. Interestingly, mention was made of the Natal Government's decision to abolish all fish traps in its waters, save a few in the mouths of the Tugela, Umzimkulu and the Tongaat Rivers. He also mentioned that there were still hundreds of fish

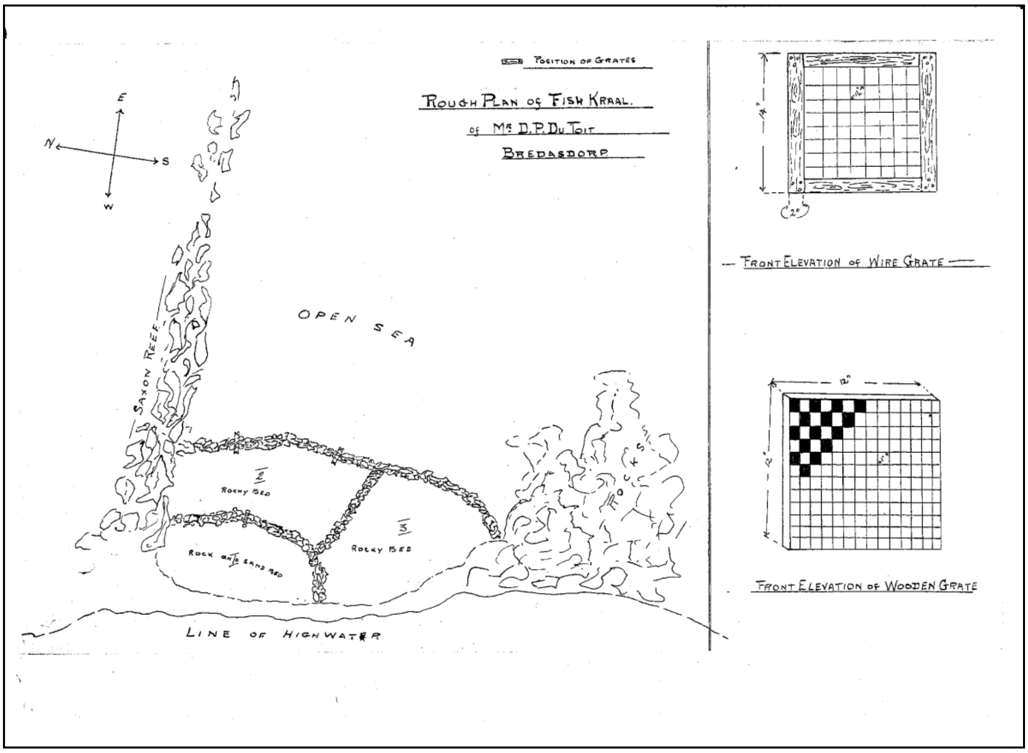


Figure 5.3. Rough plan of fish kraal of Mr. D. P. du Toit at Saxon or Bull Dog Reef. Plan done in May 1913. PAN 55 K23.

Figure 5.4. Photograph of fish traps of Mr. D. P. du Toit. Photograph taken in May 1913. PAN 55 K23.

Figure 5.5. Photograph showing the dry bed of Mr. Tom Wilson's fish trap, Skipskop. Photograph taken in May 1913. PAN 55 K23.

traps in Portuguese East Africa, but that the Government was gradually abolishing them Gilchrist 1924 in lit.). Gilchrist agreed with Badenhorst that, if enough water was retained in the traps during low tide so that fish could survive until the next high tide, no objection could be made to their use. He suggested that the whole matter be again referred to the Civil Commissioner or Magistrate for further enquiry and report.

In 1925, Section 17 of the Fisheries Ordinance No 30 of 1920 was amended. Section 17 of the Fisheries (Amended) Ordinance of 1925 read thus: "provided that the prohibition herein contained shall not apply to any fish kraal so situated as to contain sufficient water at every low tide to keep alive all fish therein until the turning of the tide" (Anon 1925), permission was not needed from the Provincial Government in order to construct fish traps. One of the significant results of this new amendment was obviously that regulating fish traps would become more difficult. Because no licence fee had to be paid, individual owners would be difficult to track down. In fact, it is difficult to ascertain who was making fish traps during this period. There are some exceptions; a few individuals continued to apply to the Provincial Government at Cape Town, although this was not necessary under the new regulations. Surprisingly, some applications came from as far as Johannesburg and Natal (Webber 1930 in lit.; Stansfeld 1933 in lit.). A careful reading of the literature reveals some clues as to who may have been responsible for building fish traps during this period.

In the letter from Mr A. Badenhorst to the Provincial Administrator, reference is made to the use of fish traps along the Still Bay coastline, from the Gouritz River Mouth to the Duivenhoks River, west of the Goukou River. From the tone of the letter it can be deduced that the majority of the people using them were poor, for whom fish provided a valuable income. As can be seen in the 1910 map provided by the farmers of the Riversdale District when they applied to the Government (Figures 5.1 and 5.2), the land bordering the sea was subdivided into several farms. Farmers and bywoners were probably responsible for making and using the fish traps.

As with the granting of the permits in 1912, most of the dissatisfaction came from the fishermen of Struis Bay. Peter van Breda, a resident of Struis Bay for 25 years, listed some of the major complaints in a letter dated July 1925, to the Fishery Office at Cape Town. Surprisingly he states that for the preceeding 25 years no fish traps had been in operation at the Bay, although other sources clearly reveal that some were used in the period 1912-1913 (van Rath 1912 in lit.; Levin & de Wet 1912 in lit.). The major contention was that fish traps were detrimental to the haarder fishery at the Bay. Struis Bay has short distances of rocky outcrops and long stretches of sandy beach. Most of the fish traps are located at these rocky outcrops. Fishermen again complained that fish trap operators were building their traps in all the best locations for trekking haarders during season and that this resulted in diminished catches for boat and seine net fishermen. Fishermen were also dissatisfied that fish traps were being monopolised by a few individuals and that people living at the Bay were excluded from using them. Mention was made that it was unfair that a person who lived a mile or so inland and who owned a shop at Brakfontein farm should own and operate a fish trap (van Rath 1912 in lit.). Fishermen at Struis Bay were of the opinion that the fishing industry would be better off without fish traps.

Dr. C. van Bonde inspected the fish traps at Cape Agulhas, Struis Bay, Arniston and Skipskop during February and March of 1931 (van Bonde 1931 in lit.). He raised concern over the unnecessary multiplication of fish traps along the Bredasdorp coastline and the unwanted destruction of immature haarders, but because the traps complied with the regulations set out by Ordinance No 6 of 1925, nothing could be done. This was the last time that mention of fish traps was found in the archival record.

From the evidence available it is clear that fish traps were primarily used and constructed by farmers and bywoners living on farms. There is a striking correlation between the distribution of fish traps and their immediate situational association with farms bordering on the coast. This is clearly demonstrated by the association of fish traps and farms along the Bredasdorp coast, between Cape Agulhas and Skipskop, and along the Still Bay coast, between Noordkapperpunt and the Gouritz River Mouth. These two areas contain the highest densities of fish traps found anywhere along the south coast.

The documents from the late 19th and early 20th centuries clearly demonstrated that fish traps were dynamic structures. They were actively being built, demolished and altered by farmers, bywoners and poor people alike, in response to legislation and the needs of local communities. They were not static features on the landscape; evidence of this is provided by the practice of 'opening' them on a seasonal basis. Local fishermen are said to have made use of some fish traps, especially in the Struis Bay area, but as their own means for catching fish became better, they started to view the use of stone-built fish traps more of a nuisance, rather than a valid way of procuring fish. The constant building and altering of fish traps by people from the interior was seen by local fishermen as an encroachment on their rights to practice their livelihood. These features were therefore politically dynamic, highlighting the often strenuous relationship between local fishermen and farmers from inland regions: fishermen sought protection from local government, while farmers saw themselves as the bloodline of the economy.

5.3 Summary

From the testimony of Mr. D. P. du Toit of Prinskraal, Bredasdorp, fish was used to feed farm labourers regularly throughout the year, with demand increasing during the threshing season. It is therefore plausible that one motivation of farmers to make use of fish traps was to provide additional food for their labourers. The use of fish traps would provide farmers with a free resource, especially after the passing of the Fisheries Ordinance of 1925.

There were at least three periods when fish traps were in operation, the period up to 1892, 1910-1913, and again from 1925 onwards. In 1905, the fish traps at Still Bay were poorly preserved and most were clogged with sand. Their walls had to be re-built to be functional. This was probably the result of the Fisheries Ordinance of 1893. Between 1910-1913 farmers petitioned the Cape Government to allow them again to build or re-built fish traps. From what can be deduced fishermen were generally less inclined towards the application of this method, and disagreed with the idea that people from the interior (or not living on the coast) should use them. It was also during this period that the Government and Magistrates were beginning to dismantle fish traps. This is best demonstrated by the inspection of the fishing stations along the coast of Bredasdorp between 1913-1914 by the Fishery Officer (Cripps 1913-1914 in lit.). At Skipskop and New Rush, west of Cape Agulhas, he reported that fishermen were trekking for haarders over the dilapidated walls of fish kraals. From Struis Bay to Agulhas he reported fishermen breaking open the walls of fish traps for trekking purposes. Interestingly, he reports that no fish traps were in use on the coast of Bredasdorp. Most of the fish traps visible today probably date to the period from the mid-1920s onwards.

Fish traps were formerly widely distributed along the South African coastline, much more so than the current distribution suggests. For the west and south coast the overwhelming evidence points to authorship by farmers and bywoners rather than the continued use and alteration of pre-existing ones. No archival research has so far been conducted for the KwaZulu/Natal and Mozambique coasts. The fact that fish traps have not really been reported to exist in these areas in recent decades, although they were reported in documents dating to the 1920s, confirms the widespread destruction of fish traps during the early 20th century.

CHAPTER 6

Discussion and Conclusion

6.1 Discussion

The aim of this chapter is to summarise and discuss the results of the previous chapters and assess the implications for the questions this thesis seeks to answer. In Chapter 2 I argued that the development of fishing is best explained through population increase and the need to extract more resources from the environment. However, on the basis of the evidence we have at present, there is no reason to believe that the use of fish traps streches back more than a couple of centuries on the Cape coast. I also summarised the evidence of fishing during the Holocene from sites along the Cape coast. There is a correlation between species composition and local habitat factors, such as shoreline topography and the presence of estuaries. Sites located near estuaries tended to have higher number of individuals of species using the habitat as nursery grounds, and species that tolerate a range of salinities. For example, sites around the Verlorenvlei, like Elands Bay Cave and Tortoise Cave have high numbers of estuarine species, and in particular mullet. The same is true of Stofbergsfontein, on the Langebaan Lagoon, dominated by mullet. In contrast, sites near rocky reefs are mostly dominated by reef dwelling species, for example Gordon's Bay Midden, sites in Garcia State Forest, including Blombos Cave, and some species at Nelson Bay Cave. In the latter case it was difficult to ascertain whether fishermen's preferences played a part in the changes in species composition through time (Inskeep 1987), although it is possible that this may have been the case.

In Chapters 3 and 4 I presented the results from the sites excavated at Paapkuil Fontein, Cape Agulhas and the analyses of the assemblages from Still Bay and Jongensfontein. At Paapkuil Fontein fish was virtually absent, whilst the fish present at SB 2 (Still Bay 2) are consistent with being caught in an estuary, the Goukou being less than one kilometre away. Jongensfontein yielded a little fish bone, but it was rare in comparison to the quantities of shellfish processed. In addition, at Waenhuiskrantz, at what use to be known as Saxon or Bull Dog Reef, there is a substantial shell midden accumulation extending over a large area close to the fish traps. On a site visit on 12 March 2006, the surface of this midden was visually inspected. While significant quantities of shell and terrestrial fauna were observed, no fish bone was visible. Fish was certainly not a major component of these middens.

The evidence from the archival documents summarised in Chapter 5 illustrates the dynamism of fish traps. This chapter clearly highlights that they were being built, used and torn down during the late 19th and early 20th century. Because of the orders to dismantle all operational fish traps in the area in 1913, the fish traps visible today between Cape Agulhas and Still Bay are unlikely to date further back than the 1920s or 1930s.

However, could the 19th-20th centuries records merely reflect the most recent end of a long history of the building and use of fish traps, extending back into the pre-colonial past? Evidence of what a fish trap midden ought to look like comes from the historic Argonanta Park site in Struisbaai. A midden associated with houses of the local fishing community, dated to around the turn of the 19th century, yielded substantial quantities of marine remains of which fish was the major component (Halkett 1996). Basic analysis of the fish from the seven squares excavated showed a range of species, similar across all seven squares, including haarder, black and white musselcracker, elf, silverfish, red stumpnose, white stumpnose, kabeljou, galjoen, silverfish, dassie, sand steenbras, white steenbras and shark. With the exception of dassie, silverfish and red stumpnose, the range of species present are all commonly caught in fish traps (see Table 1.1). Future detailed analysis of the fish remains from this site will provide quantitative information on the proportions of individual species. The excavation of historic middens associated in areas with fish traps provides a good avenue for future research. The archaeological record has yielded no assemblages like this, from sites excavated and analysed for this thesis, or others reported in the literature.

At Still Bay, there is a high density of fish traps (the area is famous for them), but is characterised by a relatively low density of middens. Could it be that fish caught in traps were processed at sites other than middens, which we have not identified? This is possible, but unlikely. If significant quantities of fish were caught in fish traps in pre-colonial times and processed anywhere nearby, we would expect to see some evidence of this activity, if large amounts of fish were caught in traps, they would have had to be processed and preserved immediately to minimise losses due to spoilage. Traditional methods of preserving include salting, smoking and sun-and-wind drying. Sun and wind drying takes between 4-5 days, in good weather conditions with no rain. Mullet are the principal species caught in fish traps today and probably also in the past. In South Africa, the traditional method of preserving mullet is by soaking the fish whole in salt water and then letting them dry in the sun and wind. The entire process can take up to two weeks in good weather (Anon 2005). We have not found any evidence that smoking may have taken place in the form of smoking platforms.

Archaeologists working in South Africa (Goodwin 1946; Avery 1975; Gribble 2005) and those abroad (Dortch 1997) have often assumed a pre-colonial origin of stone-built fish traps. As such these features have become part of the archaeological record and their perceived antiquity has been taken at face value. Part of the problem lay in the fact that there exists no absolute method of dating stone-built fish traps. Considerable work has been done on fish traps, in Australia (Dortch 1997, Randolp 2004; Angeles 2005), the United Kingdom (Bannerman & Jones 1999; Williams & McErlean 2002; O'Sullivan 2003), the Netherlands (Low Kooijmans 1987), Denmark (Pedersen 1995), in parts of Africa (Breen *et al.* 2001) and North America (Treganza 1945; Keegan 1986; Lutins 1992; Moss *et al.* 1990, Tveskov & Erlandson 2003, Foster 2005), al#Bahrain (Serjeant 1968), and Chile (Munita *et al*. 2004). Most of the research has focussed on building styles (Bannerman & Jones 1999; Lutins 1992; Kemp 2006). The aim of this thesis was to establish whether or not there is any association between fish traps and pre-colonial midden accumulations, which has received little attention in South Africa and elsewhere (Bannerman & Jones 1999).

In some instances stone-built fish traps previously thought to be of pre-colonial origin have been shown to be of more recent date, for example, through the use of aerial photography in Australia (Randolp 2004). In another instance, Treganza (1945) showed that a number of ancient stone fish traps occupying a series of rocky terraces 90 feet below the high water line of Lake Cahuilla, California were in fact house depressions rather than fish traps. All the features were consistent with similar evidence of house depressions elsewhere. Local Cahuilla Indian stories of how the traps were operated were believed to be of white origin, which the Native American community found amusing to pass on. This illustrates two points, firstly that features can easily be misinterpreted; secondly such misinterpretations can be absorbed in the stories of local indigenous peoples and can be difficult to debunk later. Caution should be practiced when advocating the antiquity of features such as these without strong evidence.

This should particularly be borne in mind in areas of colonial expansion where indigenous groups have been wiped out completely or assimilated into the dominant culture. In the case of the Cape coastal fish traps, one of the main problems has been that fish traps were regarded as ‘static’ features, as artefacts ‘captured’ in time. As a result their perceived antiquity was taken at face value and has never been independently investigated through archaeological methods.

It is possible that future research will identify pre-colonial midden(s) that preserve evidence of the use of fish traps. On the basis of the evidence we have at present, however, these traps are much more strongly associated with historic communities. This scenario provides opportunities for future research. First, to investigate how this method of fishing came to the Cape. Was it an idea imported by slaves, who came from many countries or by European settlers? Why is there such a high density of these features along the south coast, between Cape Agulhas and Still Bay? What were the historical processes that led to their development and proliferation along this particular part of the coastline? These and many other questions remain to be answered.

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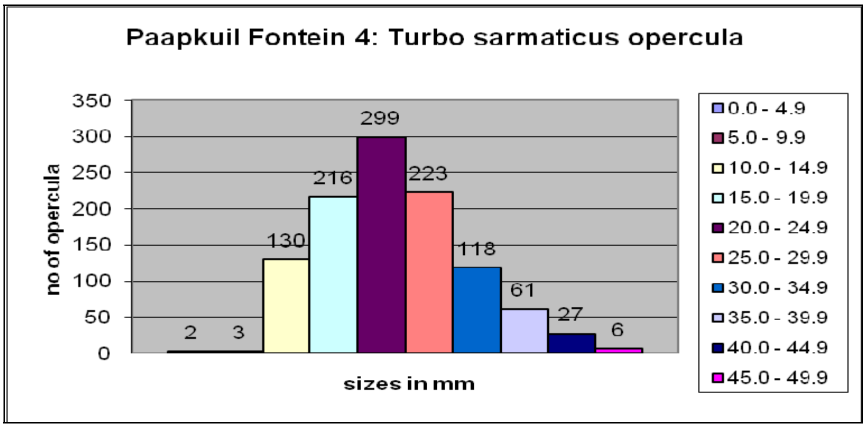
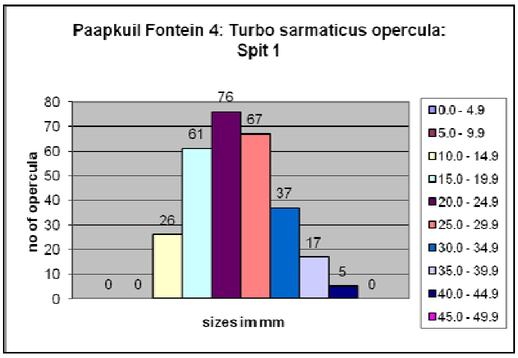
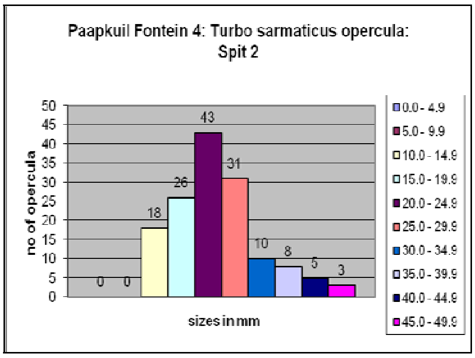
Appendix A

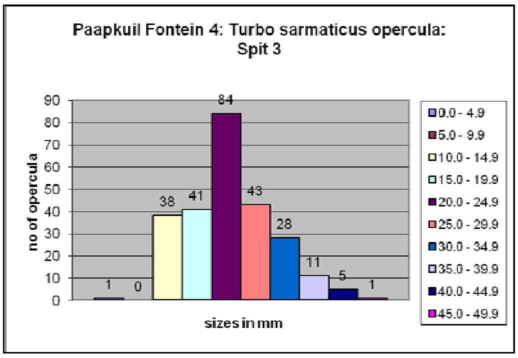
Size distribution of *Turbo sarmaticus* opercula

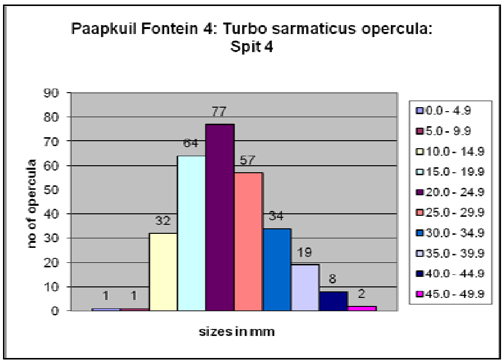
from the Paapkuilfontein middens and Still Bay 2

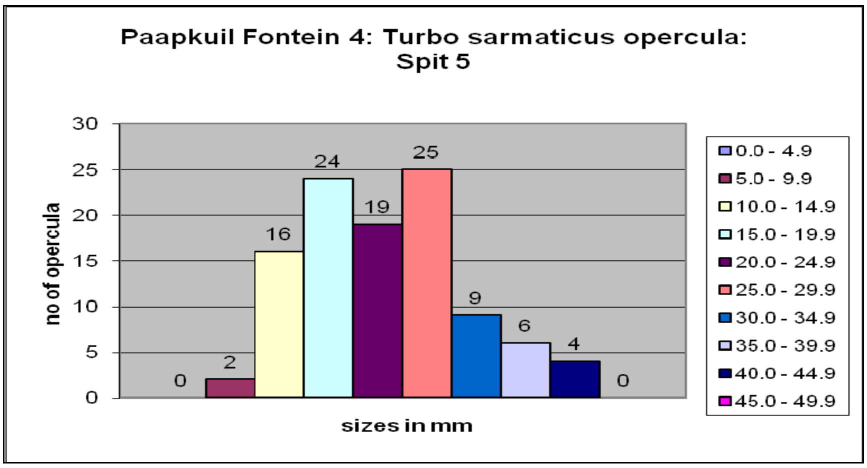

Paapkuil Fontein 4: Turbo sarmaticus opercula
no of opercula
sizes in mm
350
300
250
200
150
100
50
0
2
3
130
216
299
223
118
61
27
6
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9


Paapkuil Fontein 4: Turbo sarmaticus opercula:
Spit 1
no of opercula
sizes im mm
0
0
26
61
76
67
37
17
5
0
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9


Paapkuil Fontein 4: Turbo sarmaticus opercula:
Spit 2
no of opercula
sizes in mm
0
0
18
26
43
31
10
8
5
3
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9


Paapkuil Fontein 4: Turbo sarmaticus opercula:
Spit 3
no of opercula
sizes in mm
1
0
38
41
84
43
28
11
5
1
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9


Paapkuil Fontein 4: Turbo sarmaticus opercula:
Spit 4
no of opercula
sizes in mm
1
1
32
64
77
57
34
19
8
2
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9


Paapkuil Fontein 4: Turbo sarmaticus opercula:
Spit 5
no of opercula
sizes in mm
30
25
20
15
10
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0
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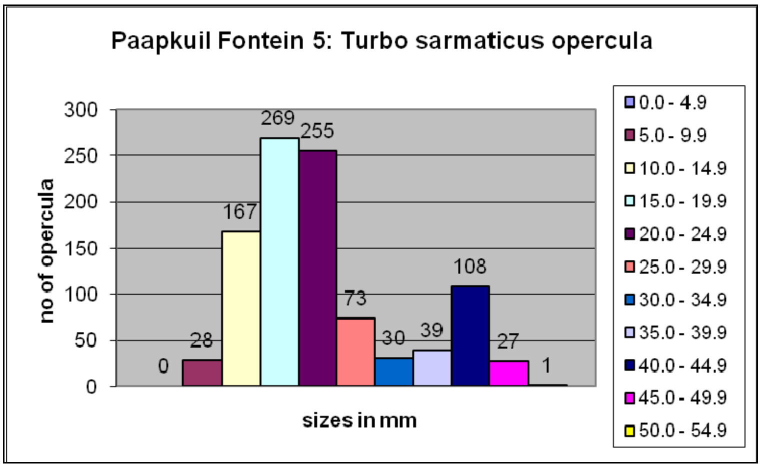
2
16
24
19
25
9
6
4
0
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9


Paapkuil Fontein 5: Turbo sarmaticus opercula
no of opercula
sizes in mm
300
250
200
150
100
50
0
0
28
167
269
255
73
30
39
108
27
1
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
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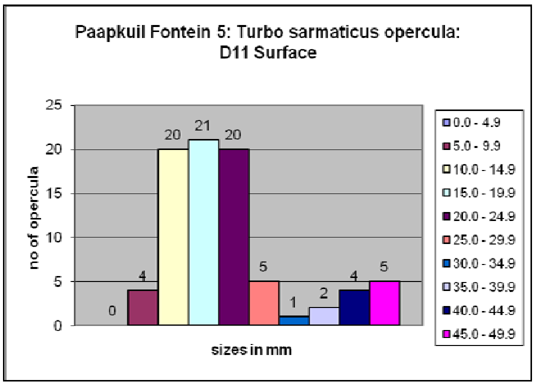
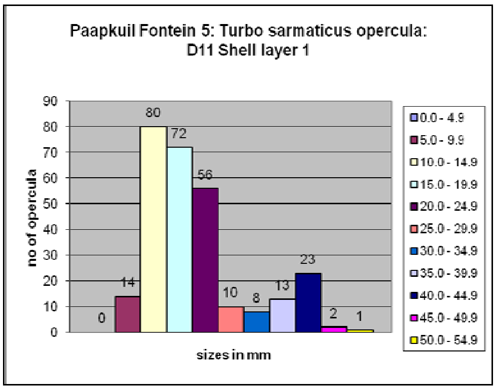
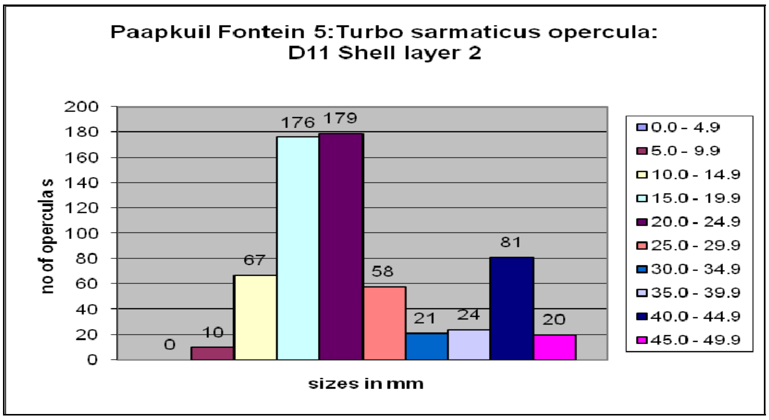
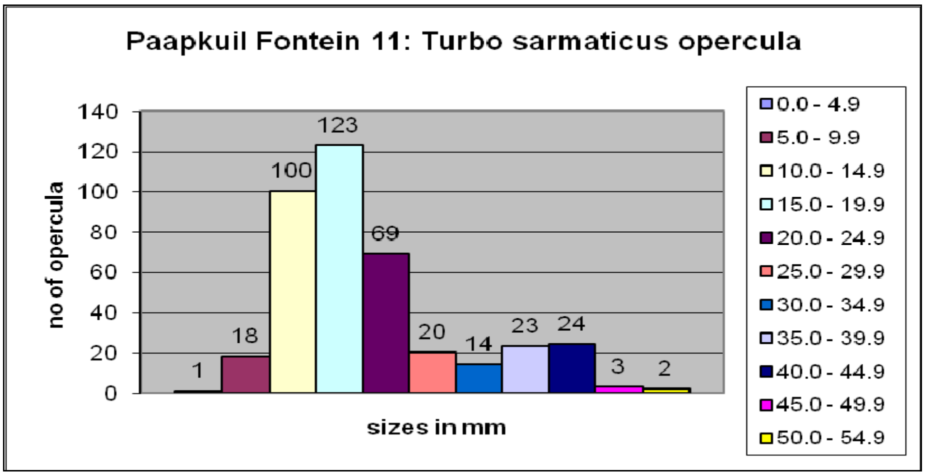
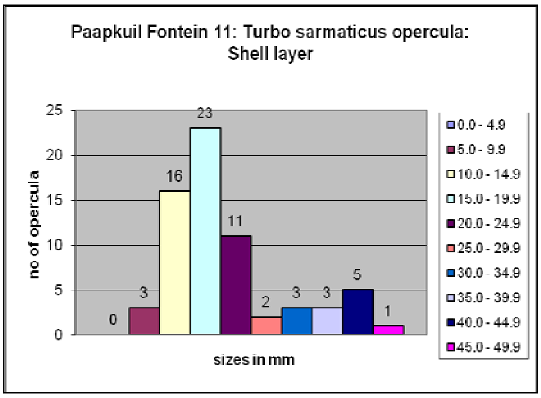
45.0 - 49.9
50.0 - 54.9

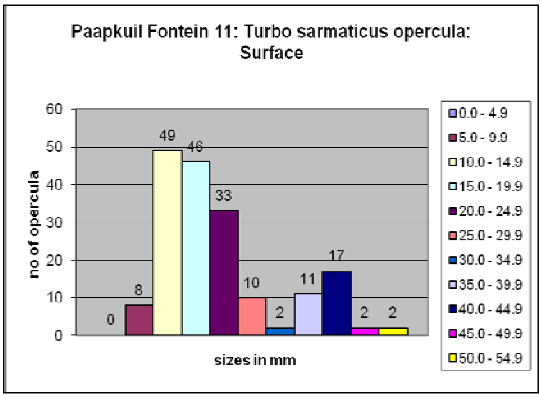

Paapkuil Fontein 5: Turbo sarmaticus opercula:
D11 Surface
no of opercula
sizes in mm
25
20
15
10
5
0
0
4
20
21
20
5
1
2
4
5
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9

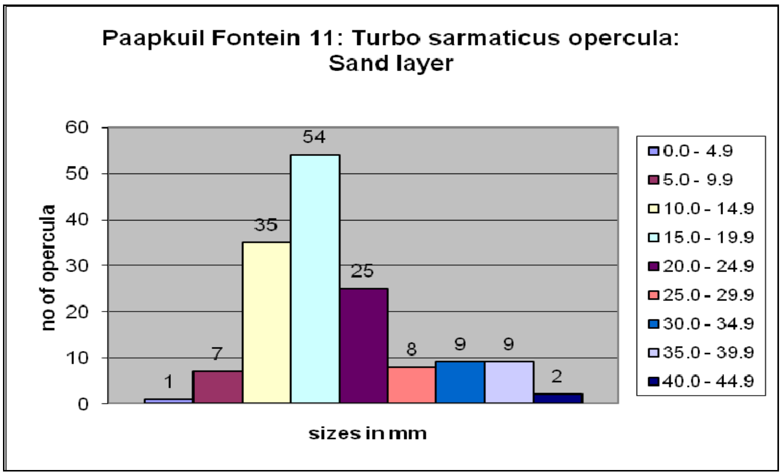

Paapkuil Fontein 5: Turbo sarmaticus opercula:
D11 Shell layer 1
no of opercula
sizes in mm
90
80
70
60
50
40
30
20
10
0
0
14
80
72
56
10
8
13
23
2
1
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9
50.0 - 54.9

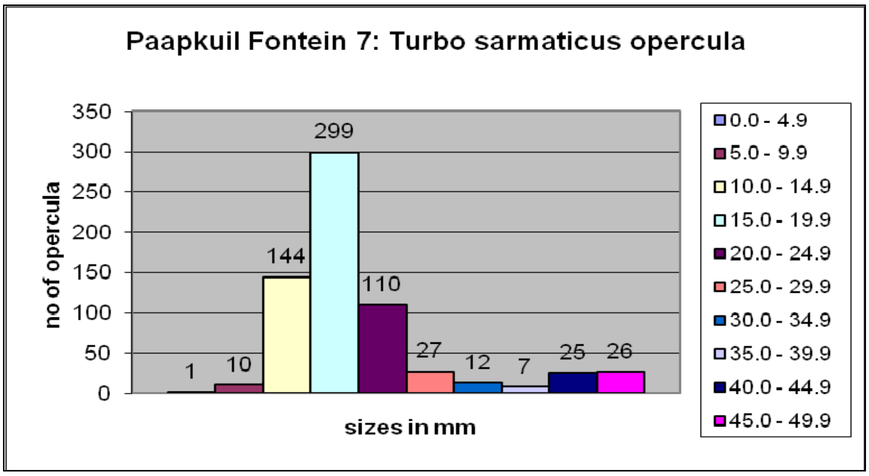

Paapkuil Fontein 5:Turbo sarmaticus opercula:
D11 Shell layer 2
no of operculas
sizes in mm
200
180
160
140
120
100
80
60
40
20
0
0
10
67
176
179
58
21
24
81
20
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9

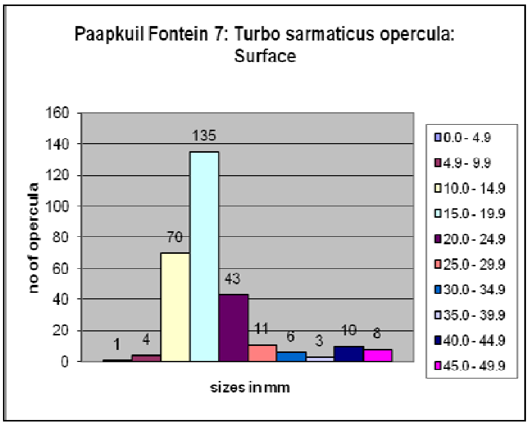

Paapkuil Fontein 11: Turbo sarmaticus opercula
no of opercula
140
120
100
80
60
40
20
0
1
18
100
123
69
20
14
23
24
3
2
sizes in mm
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9
50.0 - 54.9

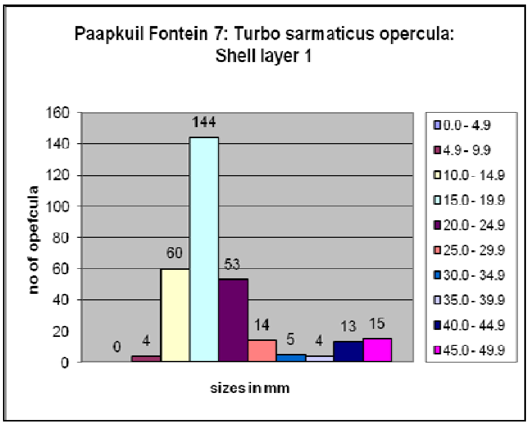

Paapkuil Fontein 11: Turbo sarmaticus opercula:
Shell layer
no of opercula
25
20
15
10
5
0
0
3
16
23
11
2
3
3
5
1
sizes in mm
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9

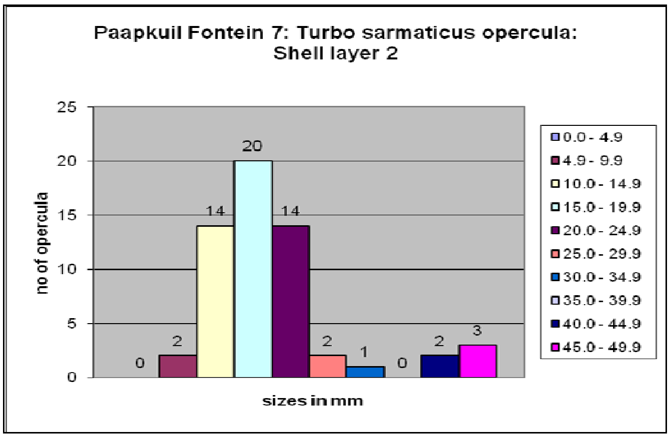

Paapkuil Fontein 11: Turbo sarmaticus opercula:
Surface
no of opercula
60
50
40
30
20
10
0
0
8
49
46
33
10
2
11
17
2
2
sizes in mm
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9
50.0 - 54.9

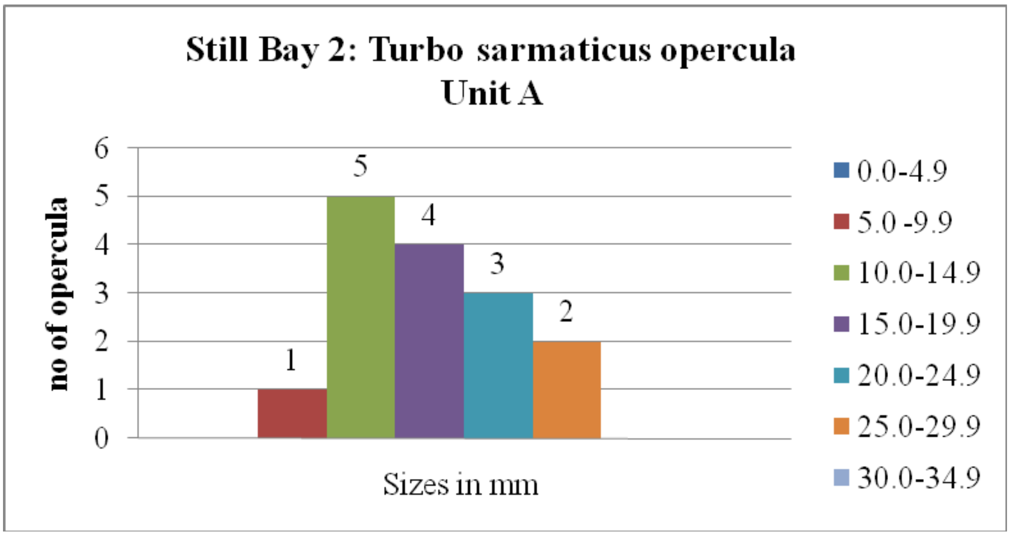

Paapkuil Fontein 11: Turbo sarmaticus opercula:
Sand layer
no of opercula
60
50
40
30
20
10
0
1
7
35
54
25
8
9
9
2
sizes in mm
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9

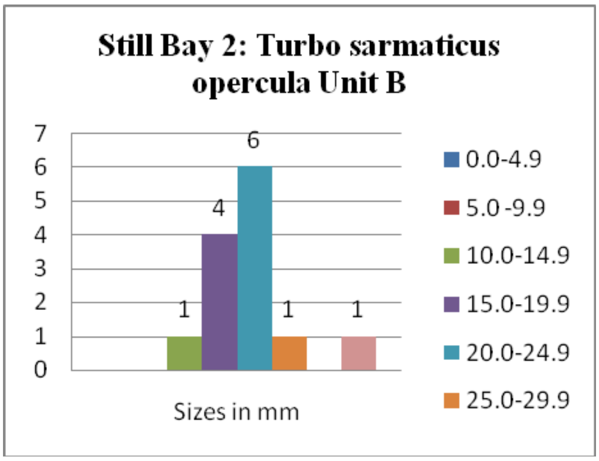

Paapkuil Fontein 7: Turbo sarmaticus opercula
no of opercula
350
300
250
200
150
100
50
0
299
144
110
1
10
27
12
7
25
26
sizes in mm
0.0 - 4.9
5.0 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9

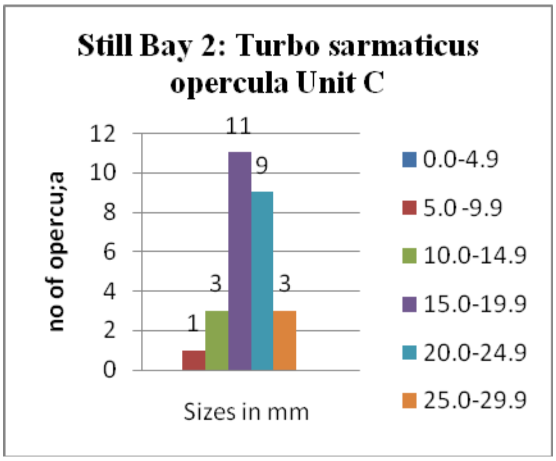

Paapkuil Fontein 7: Turbo sarmaticus opercula: Surface
no of opercula
160
140
120
100
80
60
40
20
0
135
70
43
1
4
11
6
3
10
8
sizes in mm
0.0 - 4.9
4.9 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9

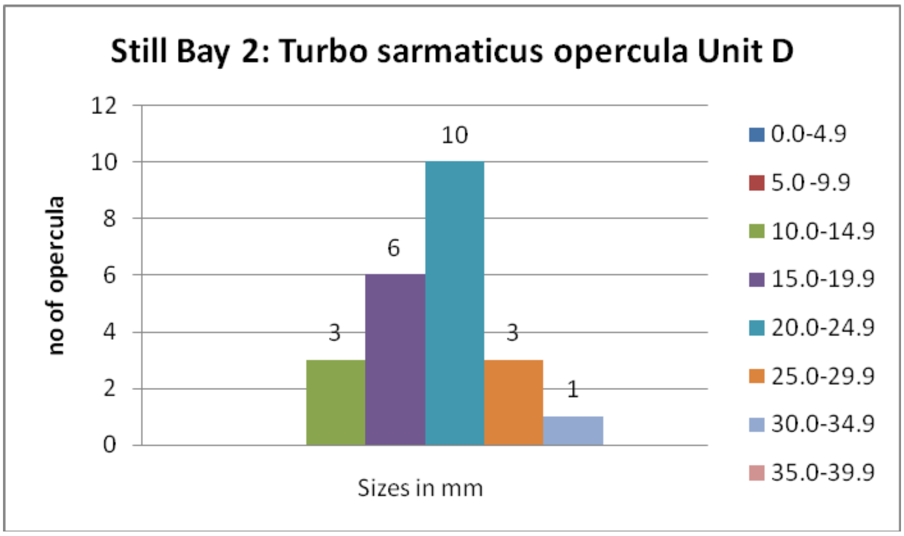

Paapkuil Fontein 7: Turbo sarmaticus opercula: Shell layer 1
no of opercula
160
140
120
100
80
60
40
20
0
144
60
53
0
4
14
5
4
13
15
sizes in mm
0.0 - 4.9
4.9 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9


Paapkuil Fontein 7: Turbo sarmaticus opercula: Shell layer 2
no of opercula
25
20
15
10
5
0
20
14
14
0
2
2
1
0
2
3
sizes in mm
0.0 - 4.9
4.9 - 9.9
10.0 - 14.9
15.0 - 19.9
20.0 - 24.9
25.0 - 29.9
30.0 - 34.9
35.0 - 39.9
40.0 - 44.9
45.0 - 49.9

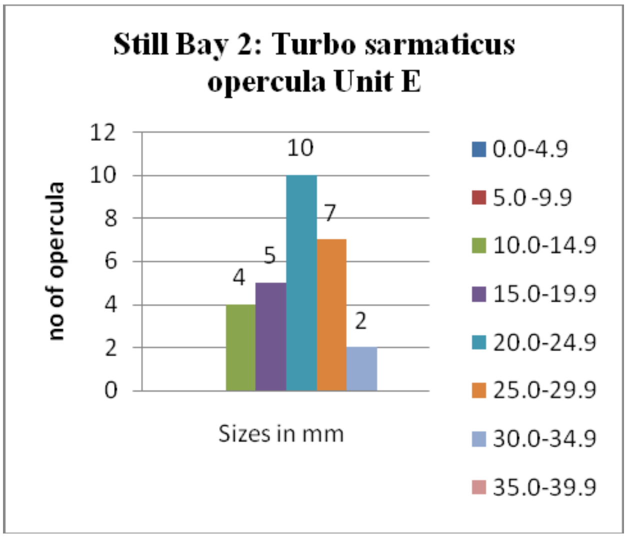

Still Bay 2: Turbo sarmaticus opercula Unit A
no of opercula
6
5
4
3
2
1
0
1
5
4
3
2
Sizes in mm
0.0-4.9
5.0 -9.9
10.0-14.9
15.0-19.9
20.0-24.9
25.0-29.9
30.0-34.9


Still Bay 2: Turbo sarmaticus opercula Unit B
7
6
5
4
3
2
1
0
1
4
6
1
1
Sizes in mm
0.0-4.9
5.0 -9.9
10.0-14.9
15.0-19.9
20.0-24.9
25.0-29.9

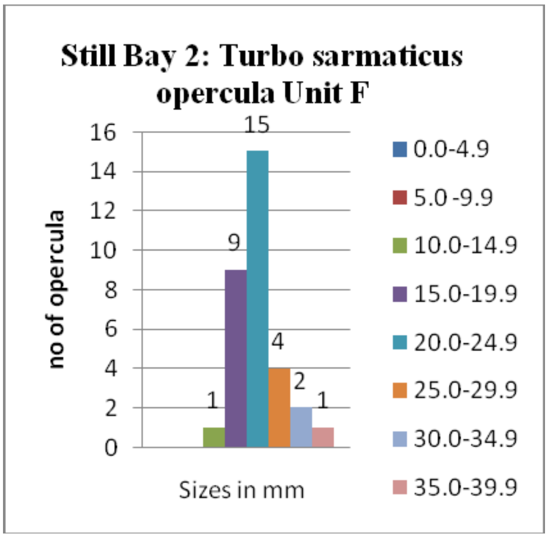

Still Bay 2: Turbo sarmaticus opercula Unit C
no of opercu;a
12
10
8
6
4
2
0
1
3
11
9
3
Sizes in mm
0.0-4.9
5.0 -9.9
10.0-14.9
15.0-19.9
20.0-24.9
25.0-29.9



Still Bay 2: Turbo sarmaticus opercula Unit D
no of opercula
Sizes in mm
0
2
4
6
8
10
12
3
6
10
3
1
0.0-4.9
5.0 -9.9
10.0-14.9
15.0-19.9
20.0-24.9
25.0-29.9
30.0-34.9
35.0-39.9



Still Bay 2: Turbo sarmaticus opercula Unit E
no of opercula
Sizes in mm
0
2
4
6
8
10
12
4
5
10
7
2
0.0-4.9
5.0 -9.9
10.0-14.9
15.0-19.9
20.0-24.9
25.0-29.9
30.0-34.9
35.0-39.9



Still Bay 2: Turbo sarmaticus opercula Unit F
no of opercula
Sizes in mm
0
2
4
6
8
10
12
14
16
1
9
15
4
2
1
0.0-4.9
5.0 -9.9
10.0-14.9
15.0-19.9
20.0-24.9
25.0-29.9
30.0-34.9
35.0-39.9

Appendix B

Kolmogorov-Smirnov comparisons of *Turbo sarmaticus* sizes

Table 1. Kolmogorov-Smirnov test on opercula of T. sarmaticus Paapkuil Fontein 4 and 5.

Category	Paapkuil Fontein 4	f	Paapkuil Fontein 5	F	Cumulative 1	Cumulative 2	Difference
0.0 - 9.9	5	0.004	28	0.028	0.004	0.028	0.024
10.0 - 14.9	130	0.120	167	0.168	0.124	0.196	0.072
15.0 - 19.9	216	0.200	269	0.270	0.324	0.466	0.142
20.0 - 24.9	299	0.275	255	0.255	0.599	0.721	0.122
25.0 - 29.9	223	0.206	73	0.073	0.805	0.794	0.011
30.0 - 34.9	118	0.109	30	0.030	0.914	0.824	0.090
35.0 - 39.9	61	0.056	39	0.040	0.970	0.864	0.106
40.0 - 44.9	27	0.025	108	0.108	0.995	0.972	0.023
45.9 - 49.9	6	0.005	27	0.027	1.000	0.999	0.001
50.0 - 54.9	0	0.000	1	0.001	1.000	1.000	0.000
Total	1085	1	997	1			

Significance level: 0.05

$1.36 \sqrt{((n1 + n2)/(n1 \times n2))}$

$1.36 \sqrt{((1085 + 997)/(1085 \times 997))} = 0.06$

$0.142 > 0.06$

Thus reject H0 that there is no significance difference between Paapkuil Fontein 4 and Paapkuil Fontein 5

Table 2. Kolmogorov-Smirnov test on opercula of T. sarmaticus Paapkuil Fontein 4 and 11.

Category	Paapkuil Fontein 4	f	Paapkuil Fontein 11	F	Cumulative 1	Cumulative 2	Difference
0.0 - 9.9	5	0.004	19	0.048	0.004	0.048	0.044
10.0 - 14.9	130	0.120	100	0.252	0.124	0.300	0.176
15.0 - 19.9	216	0.200	123	0.310	0.324	0.610	0.286
20.0 - 24.9	299	0.275	69	0.174	0.599	0.784	0.185
25.0 - 29.9	223	0.206	20	0.050	0.805	0.834	0.029
30.0 - 34.9	118	0.109	14	0.035	0.914	0.869	0.045
35.0 - 39.9	61	0.056	23	0.058	0.970	0.927	0.043
40.0 - 44.9	27	0.025	24	0.060	0.995	0.987	0.008
45.9 - 49.9	6	0.005	3	0.008	1.000	0.995	0.005
50.0 - 54.9	0	0.000	2	0.005	1.000	1.000	0.000
Total	1085	1	397	1			

Significance level: 0.05

1.36 √((n1 + n2)/(n1 x n2))

1.36 √((1085 + 397)/(1085 x 397)) = 0.08

0.286 > 0.08

Thus reject H0 that there is no significant difference between Paapkuil Fontein 4 and Paapkuil Fontein 11

Table 3. Kolmogorov-Smirnov test on opercula of T. sarmaticus Paapkuil Fontein 4 and 7.

Category	Paapkuil Fontein 4	f	Paapkuil Fontein 7	f	Cumulative 1	Cumulative 2	Difference
0.0 - 9.9	5	0.004	11	0.017	0.004	0.017	0.031
10.0 - 14.9	130	0.120	144	0.218	0.124	0.235	0.119
15.0 - 19.9	216	0.200	299	0.452	0.324	0.687	0.363
20.0 - 24.9	299	0.275	110	0.166	0.599	0.853	0.254
25.0 - 29.9	223	0.206	27	0.041	0.805	0.894	0.089
30.0 - 34.9	118	0.109	12	0.018	0.914	0.912	0.002
35.0 - 39.9	61	0.056	7	0.010	0.970	0.922	0.048
40.0 - 44.9	27	0.025	25	0.038	0.995	0.960	0.035
45.9 - 49.9	6	0.005	26	0.040	1.000	1.000	0.000
Total	1085	1	661	1			

Significance level: 0.05

1.36 √((n1 + n2)/(n1 x n2))

1.36 √((1085 + 661)/(1085 x 661)) = 0.07

0.363 > 0.07

Thus reject H0 that there is no significant difference between Paapkuil Fontein 4 and Paapkuil 7

Table 4. Kolmogorov-Smirnov test on opercula of T. sarmaticus Paapkuil Fontein 5 and 11.

Category	Paapkuil Fontein 5	f	Paapkuil Fontein 11	f	Cumulative 1	Cumulative 2	Difference
0.0 - 9.9	28	0.028	19	0.048	0.028	0.048	0.020
10.0 - 14.9	167	0.168	100	0.252	0.196	0.300	0.104
15.0 - 19.9	269	0.270	123	0.310	0.466	0.610	0.144
20.0 - 24.9	255	0.255	69	0.174	0.721	0.784	0.063
25.0 - 29.9	73	0.073	20	0.050	0.794	0.834	0.040
30.0 - 34.9	30	0.030	14	0.035	0.824	0.869	0.048
35.0 - 39.9	39	0.040	23	0.058	0.864	0.927	0.063
40.0 - 44.9	108	0.108	24	0.060	0.972	0.987	0.015
45.9 - 49.9	27	0.027	3	0.008	0.999	0.995	0.004
50.0 - 54.9	1	0.001	2	0.005	1.000	1.000	0.000
Total	997	1	397	1			

Significance level: 0.05

$1.36 \sqrt{((n1 + n2)/(n1 \times n2))}$

$1.36 \sqrt{((997 + 397)/(997 \times 397))} = 0.08$

$0.144 > 0.08$

Thus reject H0 that there is no significant difference between Paapkuil Fontein 5 and Paapkuil Fontein 11

Table 5. Kolmogorov-Smirnov test on opercula of T. sarmaticus Paapkuil Fontein 5 and 7.

Category	**Paapkuil Fontein 5**	**f**	**Paapkuil Fontein 7**	**f**	**Cumulative 1**	**Cumulative 2**	**Difference**
0.0 - 9.9	28	0.028	11	0.017	0.028	0.017	0.011
10.0 - 14.9	167	0.168	144	0.218	0.196	0.235	0.066
15.0 - 19.9	269	0.270	299	0.452	0.466	0.687	0.221
20.0 - 24.9	255	0.255	110	0.166	0.721	0.853	0.132
25.0 - 29.9	73	0.073	27	0.041	0.794	0.894	0.1
30.0 - 34.9	30	0.030	12	0.018	0.824	0.912	0.078
35.0 - 39.9	39	0.040	7	0.010	0.864	0.922	0.058
40.0 - 44.9	108	0.108	25	0.038	0.972	0.96	0.012
45.9 - 49.9	27	0.027	26	0.040	0.999	1.000	0.001
50.0 - 54.9	1	0.001	0	0.000	1.000	1.000	0.000
Total	**997**	**1**	**661**	**1**			

Significance level: 0.05

1.36 √((n1 + n2)/(n1 x n2))

1.36 √((997 + 661)/(997 x 661)) = 0.07

0.221 > 0.07

Thus reject H0 that there is no significant difference between Paapkuil Fontein 5 and Paapkuil Fontein 7

Table 6. Kolmogorov-Smirnov test on opercula of T. sarmaticus Paapkuil Fontein 11 and 7.

Category	Paapkuil Fontein 11	f	Paapkuil Fontein 7	f	Cumulative 1	Cumulative 2	Difference
0.0 - 9.9	19	0.048	11	0.017	0.048	0.017	0.031
10.0 - 14.9	100	0.252	144	0.218	0.300	0.235	0.065
15.0 - 19.9	123	0.310	299	0.452	0.610	0.687	0.077
20.0 - 24.9	69	0.174	110	0.166	0.784	0.853	0.069
25.0 - 29.9	20	0.050	27	0.041	0.834	0.894	0.06
30.0 - 34.9	14	0.035	12	0.018	0.869	0.912	0.043
35.0 - 39.9	23	0.058	7	0.010	0.927	0.922	0.005
40.0 - 44.9	24	0.060	25	0.038	0.987	0.960	0.027
45.9 - 49.9	3	0.008	26	0.040	0.995	1.000	0.005
50.0 - 54.9	2	0.005	0	0.000	1.000	1.000	0.000
Total	397	1	661	1			

Significance level: 0.05

$1.36 \sqrt{((n1 + n2)/(n1 \times n2))}$

$1.36 \sqrt{((397 + 661)/(397 \times 661))} = 0.09$

$0.077 < 0.09$

Thus accept H0 that there is no significant difference between Paapkuil Fontein 11 and Paapkuil Fontein 7

Table 7. Kolmogorov-Smirnov test on sizes opercula of T. sarmaticus. Intra-site comparisons at Paapkuil Fontein 5.

Category	Surface + Shell Layer 1	f	Shell Layer 2	f	Cumulative 1	Cumulative 2	Difference
0.0 - 9.9	18	0.050	10	0.015	0.050	0.015	0.035
10.0 - 14.9	100	0.277	67	0.105	0.327	0.120	0.207
15.0 - 19.9	93	0.257	176	0.276	0.584	0.396	0.188
20.0 - 24.9	76	0.210	179	0.281	0.794	0.677	0.117
25.0 - 29.9	15	0.041	58	0.091	0.835	0.777	0.058
30.0 - 34.9	9	0.025	21	0.033	0.860	0.810	0.050
35.0 - 39.9	15	0.041	24	0.037	0.901	0.847	0.054
40.0 - 44.9	27	0.074	81	0.127	0.975	0.974	0.001
45.9 - 49.9	7	0.020	20	0.031	0.995	1.005	0.010
50.0 - 54.9	1	0.002	0	0.000	0.997	1.005	0.008
Total	361	0.997	636	0.996			

Significance level: 0.05

$1.36 \sqrt{((n1 + n2)/(n1 \times n2))}$

$1.36 \sqrt{((361 + 636)/(361 \times 636))} = 0.00018$

$0.207 > 0.00018$

Thus rejecct H0 that there is no significant difference betwen the Surface + Shell layer 1 and Shell layer 2

Table 8. Kolmogorov-Smirnov test on sizes opercula of T. sarmaticus. Intra-site comparisons at Paapkuil Fontein 11.

Category	Surface	f	Sand Layer	f	Cumulative 1	Cumulative 2	Difference
0 - 9.9	8	0.044	8	0.050	0.044	0.050	0.066
10.0 - 14.9	49	0.272	35	0.220	0.316	0.270	0.046
15.0 - 19.9	46	0.255	54	0.339	0.571	0.609	0.038
20.0 - 24.9	33	0.183	25	0.157	0.754	0.766	0.012
25.0 - 29.9	10	0.055	8	0.050	0.809	0.816	0.007
30.0 - 34.9	2	0.011	9	0.056	0.82	0.872	0.052
35.0 - 39.9	11	0.061	9	0.056	0.881	0.928	0.047
40.0 - 44.9	17	0.094	9	0.056	0.975	0.984	0.009
45.0 - 49.9	2	0.011	2	0.012	0.986	0.996	0.010
50.0 - 54. 9	2	0.011	0	0.000	0.997	0.996	0.001
Total	180	0.997	159	0.996			

Significance level: 0.05

$1.36 \sqrt{((N1+N2)/(N1 \text{ X } N2))}$

$1.36 \sqrt{((180 + 159)/(180 \text{ x } 159))} = 0.148$

$0.066 < 0.148$

Thus accept H0 that there is no significant difference between the Surface and Shell layer

Table 9. Kolmogorov-Smirnov test on sizes opercula of T. sarmaticus. Intra-site comparisons at Paapkuil Fontein 7.

Category	Shell Layer 1	f	Shell Layer 2	f	Cumulative 1	Cumulative 2	Difference
0 - 9.9	4	0.012	2	0.034	0.012	0.034	0.022
10.0 - 14.9	60	0.192	14	0.241	0.204	0.275	0.071
15.0 - 19.9	144	0.461	20	0.344	0.665	0.619	0.046
20.0 - 24.9	53	0.170	14	0.241	0.835	0.860	0.025
25.0 - 29.9	14	0.044	2	0.034	0.879	0.894	0.015
30.0 - 34.9	5	0.016	1	0.017	0.895	0.911	0.016
35.0 - 39.9	4	0.012	0	0.000	0.907	0.911	0.004
40.0 - 44.9	13	0.041	2	0.034	0.948	0.945	0.003
45.0 - 49.9	15	0.048	3	0.051	0.996	0.996	0.000
Total	312	0.996	58	0.996			

Significance level: 0.05

$1.36 \sqrt{((N1+N2)/(N1 \times N2))}$

$1.36 \sqrt{((312 + 58)/(312 \times 58))} = 0.194$

$0.071 < 0.194$

Thus accept H0 that there is no significant difference between Shell layer 1 and Shell layer 2

Appendix C

Weights of countable shells + fragments, i.e. whole shells, apices of gastropods, hinges of bivalves.

Table 10 Weights of the different shellfish excavated at Paapkuil Fontein4 square H9.

		Spit 1		Spit 2		Spit 3		Spit 4		Total
Species	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**
Scutellastra cochlear	36	110.2	1	2.8	3	10.6	1	1.9	41	125.5
Scutellastra longicosta	35	337.9	38	358.7	93	1016.5	126	1220.5	292	2933.6
Scutellastra Barbara	12	214.1	2	46.4	11	190.7	19	398.2	44	849.4
S. babara/longicosta?	–	–	–	–	8	107.3	8	107.7	16	215
Scutellastra argenvillei	–	–	–	–	1	23.6	1	11.4	2	35
Cymbula oculus	19	175.7	15	184.5	27	277.2	51	544.8	102	1182.2
Cymbula miniata	–	–	–		2	23.8	–	–	2	23.8
Dinoplax gigas	1	40.8	1	14.6	1	31.1	1	28.2	4	114.7
Limpet spp.	20	100.2	5	7.3	21	63.8	5	15.1	51	186.4
Turbo sarmaticus	57	536	58	731.6	112	2196.8	132	2253	239	1298.7
Turbo cidaris cidaris	2	6.8	–	–	1	8.2	1	3.9	4	18.9
T. sarnaticus opercula	182	557	37	129.8	73	245	82	366.9	374	1298.7
T. cidaris cidaris opercula	5	4	–	–	2	2	1	0.5	8	6.5
Oxystele tigrina	–	–	7	21.7	22	82.5	27	74.6	56	98.8
Oxystele sinensis	11	42.3	14	57.3	24	73.6	26	117.5	75	290.7
Oxystele variegata	–	–	1	0.8	–	–	–	–	1	0.8
Oxystele spp.	–	–	5	11.2	15	35.1	–	–	20	46.3
Haliotis midae	1	78.3	2	29.5	1	59	–	–	4	166.8
Burnupena spp.	14	72.5	5	27.4	7	91.9	25	123.5	51	315.3
Perna perna	–	–	–	–	1	5	–	–	1	5
Total	395	2275.8	191	1623.6	425	4543.7	506	5267.7	1387	9212.1

Table 11. Weights of the different shellfish excavated at Paapkuil Fontein 4 square H10.

		Spit 1		Spit 2		Spit 3		Spit 4		Spit 5		Total
Species	**no**	**weight**	**no**	**weight**	**no**	**weight**	**no**	**weight**	**no**	**weight**	**no**	**weight**
Scutellastra cochlear	37	107.3	5	11.5	1	9.2	2	6.3	–	–	45	134.3
Scutellastra longicosta	48	438.6	65	598.5	99	1076.1	118	1285.2	123	1171.9	453	4570.5
Scutellastra Barbara	11	191.8	11	160.9	17	307.3	22	350	13	333	74	1343
S. babara/longicosta?	7	77.5	–		15	203.8	13	201.2	9	124.1	34	606.6
Scutellastra argenvillei	–	–	–		2	23.4	1	25.1	–	–	3	48.5
Scutellastra granularis	–	–	–		1	6.4	–	–	1	2.9	2	9.3
Cymbula oculus	11	134.4	22	224.7	44	532.1	41	453.2	39	497.7	157	1812.2
Cymbula miniata	–	–	–		–	–	–	–	2	45.4	2	45.4
Dinoplax gigas			1	13.3			2	30.3	2	35.6	5	79.2
Limpet spp.	34	180.7	1	3.4	16	74.2	15	85.9	14	53.1	49	397.3
Turbo sarmaticus	42	1124.6	69	1233.5	152	2275.4	167	2434.9	123	1937.2	553	9005.6
Turbo cidaris cidaris	–	–	–		–	–	3	12.1	1	3.6	4	15.7
T. sarmaticus opercula	79	421.6	73	321.1	108	433	135	586.3	119	486.9	514	2248.9
T. cidaris cidaris opercula	1	1	–		2	1	3	0.8	2	0.7	8	2.5
Oxystele tigrina	8	24.9	26	68.8	27	92.4	40	98.6	25	75.5	126	360.2
Oxystele sinensis	14	52.2	17	44.1	23	72.5	42	110.9	27	74.9	123	354.6
Oxystele variegata	–	–	1	0.2	–	–	–	—	–	–	1	0.2
Oxystele spp.	8	25.7	15	17.5	29	38.8	–	–	19	25.7	71	107.7
Haliotis midae	–	–	4	190.6	2	46.3	–	–	1	8.1	7	245
Haliotis spadicea	–	–	–		–	–	1	1	–	–	1	1
Burnupena spp.	20	92.3	17	69.3	16	57.1	38	98.2	24	47.9	115	364.8
Total	320	2872.6	327	2957.4	554	5249	643	5780	544	4924.2	2343	21752.5

Table 12. Weights of the different shellfish excavated at Paapkuil Fontein 4 H11.

		Spit 1		Spit 2		Spit 3		Spit 4		Total
Species	**no**	**weight (g)**	**no**	**weight (g)**	**No**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**
Scutellastra cochlear	2	3.9	2	4.8	–	–	1	2	5	10.7
Scutellastra longicosta	20	150.9	43	330.2	61	698.4	45	472	169	1651.1
Scutellastra Barbara	1	48.6	5	92.6	11	213.9	7	168.1	24	523.2
S. babara/longicosta?	5	60.5	8	92.4	8	93.8	–	–	21	246.7
Scutellastra argenvillei	–	–	–	–	1	30.5	–	–	1	30.5
Cymbula oculus	11	107.2	8	76.8	22	240	36	375.9	77	799.9
Dinoplax gigas	1	18							1	18
Limpet spp.	30	174.1	7	31.3	12	67.7	–	–	49	273.1
Turbo sarmaticus	37	273.4	37	558.3	99	1472.8	87	1548.1	260	3851.8
Turbo cidaris cidaris	–	–	–	–	1	2.3	1	6.3	2	8.6
T. sarmaticus opercula	49	282	47	165	75	318.1	68	282.6	239	1047.7
T. cidaris cidaris opercula	2	0.7	–	–	2	0.8	5	2	9	3.5
Oxystele tigrina	–	–	11	29.9	11	53.2	7	27.4	29	110.5
Oxystele sinensis	12	39.8	10	28.2	17	61.4	16	75.6	55	205
Oxystele spp.	4	7.5	16	21.2	9	12.3	12	30.6	41	71.6
Haliotis midae	1	23	1	20.2	1	99.8	1	98.8	4	241.8
Haliotis spadicea	–	–	–	–	2	27.5	–	–	2	27.5
Burnupena spp.	6	41.8	5	12.9	8	48.7	8	42	27	145.4
Total	181	1231.4	200	1463.8	340	3441.2	294	3131.4	1015	9266.6

Table 13 Weights of the different shellfish species excavated at Paapkuil Fontein 4 square G10.

		Spit 1		Spit 2		Spit 3		Spit 4		Total
Species	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**
Scutellastra cochlear	–	–	2	1.8	1	2	1	4.3	4	8.1
Scutellastra longicosta	9	101.3	15	166.1	22	274.8	25	264.6	71	806.8
Scutellastra barbara	1	14.7	–	–	5	102.1	1	11.4	7	128.1
Cymbula oculus	1	10.9	6	47.3	8	95.4	12	120.4	27	274
Cymbula miniata	–	–	–	–	1	10.3	–	–	1	10.3
Dinoplax gigas	–	–	–	–	–	–	1	14.1	1	14.1
Limpet spp.	4	9.3	–	–	7	25.7	7	24.2	18	59.2
Turbo sarmaticus	8	204.6	18	408.1	30	598.1	28	402.6	84	1613.4
Turbo cidaris cidaris	–	–	1	1.8	1	1.2	–	–	2	3
T. sarmaticus opercula	10	32.6	11	60.1	29	137.2	40	166.7	90	296.6
T. cidaris cidaris opercula	–	–	1	0.5	1	0.7	2	0.4	4	1.6
Oxystele tigrina	–	–	6	12.4	13	2.7	13	26.6	32	91.7
Oxystele sinensis	4	15.5	4	8.2	12	36.6	14	28.5	34	88.8
Haliotis spadicea	–	–	–	–	1	10.6	–	–	1	10.6
Burnupena spp.	3	13.9	–	–	9	29.2	10	25.7	22	68.8
Total	40	402.8	64	706.3	140	1326.6	154	1089.5	398	3475.1

Table 14. Weights of the different shellfish species excavated at Paapkuil Fontein 5 square D11.

	Surface		Shell Layer 1		Shell Layer 2		Total	
Species	**no**	**weight**	**no**	**weight**	**no**	**weight**	**no**	**weight**
Shell fragments	–	4532.7	–	16399.9	–	26106.3	–	47038.9
Scutellastra longicosta	7	48.1	49	516.9	87	1029.6	143	1594.6
Scutellastra Barbara	2	27.6	–	–	–	–	2	27.6
Barbara/Longicosta?	–	–	–	–	7	117.5	7	117.5
Scutellastra argenvillei	–	–	12	347.4	26	1139	38	1486.4
Scutellastra cochlear	–	–	7	23	8	34.3	15	57.3
Scutellastra granularis	2	7.3	5	35.9	9	57.5	16	100.7
Scutellastra granatina	–	–	–	–	1	20.8	1	20.8
Scutellastra compressa	–	–	–	–	2	11.7	2	11.7
Cymbula oculus	6	30.2	126	954.2	246	2406.2	378	3390.6
Dinoplax gigas	7	211	47	1612.7	82	2965.2	136	4788.9
Limpets spp.	6	22	38	141.7	58	227.6	102	391.3
Turbo sarmaticus	71	290.8	278	1762.7	493	4154.8	842	6208.3
Turbo cidaris cidaris	–	–	–	–	2	11.6	2	11.6
Turbo sarmaticus opercula	94	508.5	329	1396.6	736	4558.7	1159	7622.8
Turbo cidaris cidaris opercula	–	–	–	–	3	1.7	3	1.7
Oxystele sinensis	148	169.8	245	368.6	360	940.1	753	1478.5
Oxystele tigrina	95	119.6	1137	1063.3	2121	2369.2	3353	3552.1
Oxystele variagata	–	–	3	5.3	–	–	3	5.3
Oxystele spp.	101	68.5	307	91.5	356	147.6	764	307.6
Haliotis midae	2	6.2	7	693.8	20	848.4	29	1548.4
Haliotis spadicea	1	0.5	–	–	–	–	1	0.5
Burnupena spp.	40	127.6	71	216.3	72	292.1	183	636
Donax serra	–	–	–	–	1	18.1	1	18.1
Crepidula porcellena	–	–	1	0.3	8	4.9	9	5.2
Nassaruis kraussianus.	–	–	–	–	1	0.2	1	0.2
Total	582	6170.4	2662	25630.1	4699	47463.1	7943	80422.6

Table 15. Weights of the different shellfish species at Paapkuil Fontein 11 square K10 and K11.

	K 9						K 10							
		Surface		Shell layer		Sand layer		Surface		Shell layer		Sand layer		Total
Species	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**
Shell fragments	–	635.4	–	1761.9	–	3859.9	–	573	–	3842.9	–	3842.9	–	14516
Scutellastra concolor	–	–	2	0.7	1	1.5	1	0.3	–	–	–	–	4	2.5
Scutellastra cochlear	–	–	1	0.6	1	2.9	–	–	–	–	2	4.9	4	8.4
Scutellastra longicosta	–	–	–	–	–	–	–	–		–	1	12.6	1	12.6
Scutellastra argenvillei	–	–	3	194.2	–	–	–	–	–	–	2	132.1	5	326.3
Cymbula oculus	1	11.5	2	5.5	2	9.4	–	–	–	–	5	51.9	10	78.3
Cymbula granatina	–	–	–		–	–	–	–	–	–	2	21	2	21
Dinoplax gigas	1	16.2	1	52.6	3	148.3	1	17.7	1	62.9	2	106.6	9	404.3
Limpet spp.	2	7.8	–	–	6	18.2	1	3	6	17.5	8	22.3	23	68.8
Turbo sarmaticus	13	393.1	29	373.3	94	1677.1	9	29.7	30	260.2	113	1559.8	288	4293.2
Turbo cidaris cidaris	–	–	1	2.5	8	20.6	–	–	–	–	6	22.1	15	45.2
T. sarmaticus opercula	30	234.7	41	340.1	100	624.9	13	140.5	54	353.4	110	687.2	348	2380.8
T. cidaris cidaris opercula	1	0.6	–	0.4	3	3.1	–	–	–	–	8	6.4	12	10.5
Oxystele tigrina	7	8.1	38	37.3	137	156.8	10	10.2	36	33.3	165	202.1	393	447.8
Oxystele sinensis	2	6.8	6	20.5	32	70.6	–	–	12	16.6	38	49.1	90	163.6
Oxystele variegata	–	–	1	0.4	–	–	3	2.3	–	–	1	0.9	5	3.6
Oxystele spp.	3	1.3	15	6.2	43	16.8	6	2.7	23	8.8	29	9.3	119	45.1
Haliotis midae	–	–	2	164.4	4	361.4	–	–	1	53.3	2	4.4	9	583.5
Burnupena spp.	8	40.7	10	26.4	39	108.9	4	13.5	17	50.4	37	126.2	115	366.1
Crepidula porcellana	–	–	1	0.3	2	0.5	1	–	–	–	7	2.3	11	3.1
Fissurellidea aperta	1	0.6	1	0.7	4	3.5	–	–	3	0.9	–	–	9	5.7
Total	69	1356.8	154	2988	479	7084.4	49	792.9	183	4700.2	538	6864.1	1472	23786.4

Table 16. Weights of the different shellfish species excavated at Paapkuil Fontein 11 square J9, J10, K11 and J11.

	J 9		J 10		K 11		J 11			
	Surface		Surface		Surface		Surface		Total	
Species	**no**	**weight (g)**	**no**	**weight (g)**	**No**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**
Shell fragments		3405.8		2159.2		4270.1		801.3		10636.4
Scutellastra cochlear	–	–	–	–	–	–	2	4.6	2	4.6
Scutellastra longicosta	2	22.7		–		–		–	2	22.7
Scutellastra argenvillei	6	277.3	–	–	1	86.5	–	–	7	363.8
Scutellastra granularis	1	2.5	–	–	–	–	2	6.3	3	8.8
Cymbula oculus	10	77.2	4	16.1	6	26.7	5	74.8	25	194.8
Dinoplax gigas	4	160.9	3	136.9	2	81	1	10.3	10	389.1
Limpet spp.	4	20.2	6	14.1	6	16.1	2	7.3	18	57.7
Turbo sarmaticus	91	2054.9	67	2067.6	174	1836.8	26	1013.8	358	6973.1
Turbo cidaris cidaris	1	2.8	1	4.4	7	35	2	14	11	56.2
T. sarmaticus opercula	109	724.3	62	507.8	71	619.9	18	109.2	260	1961.2
T. cidaris cidaris opercula	5	2.8	5	3.6	7	6	1	1.1	18	13.5
Oxystele tigrina	91	125	52	58.3	175	231.2	19	27.9	337	442.4
Oxystele sinensis	15	39.3	8	15.5	38	121.4	7	24.7	68	200.9
Oxystele variegata	–	–	–	–	1	0.3	2	1.7	3	2
Oxystele spp.	39	11.6	13	7	36	10.2	4	1.8	92	30.6
Haliotis midae	1	48.8	3	130.6	2	33.3	–		6	212.7
Burnupena spp.	33	98.8	27	70.1	29	82.4	6	1.8	95	253.1
Crepidula porcellana	–	–	1	0.2	7	5.7	–	–	8	5.9
Fissurellidea aperta	4	2.3	6	4.3	5		1	1.8	6	8.4
Total	*416*	7077.2	*258*	5195.7	*567*	7462.6	*98*	2102.4	1329	21837.9

Table 17. Weights of the different shellfish species excavated at Paapkuil Fontein 7 square A4 and A5.

	A 4				A 5							
		Surface		Shell Layer		Surface		Shell Layer 1		Shell Layer 2		Total
Species	**no**	**weight**	**no**	**weight**	**no**	**weight**	**no**	**weight**	**no**	**weight**	**no**	**weight**
Shell fragments	–	5724.6	–	2969.7	–	1375.2	–	9026.1	–	2975	–	22070.6
Scutellastra cochlear	–	–	2	12.1	1	16.6	–	–	–	–	3	28.7
Scutellastra longicosta	4	56.6	2	19.2	2	–	4	52.5	1	15.2	13	143.5
Scutellastra barbara	2	54.3	1	33.8	2	47.7	2	34.1	–	–	7	169.9
Scutellastra argenvillei	1	77.1	–	–	3	128.6	8	463.6	4	230.7	16	900
Scutellastra granularis	–	–	–	–	–	–	–	–	–	–	–	–
Cymbula oculus	17	138.9	21	124.4	7	91.3	5	28.4	14	146.8	64	390.9
Cymbula miniata	–	–	–	–	–	–	2	14.6	–	–	2	14.6
Cymbula granatina	1	16.5	–	–	–	–	–	–	1	38.8	2	55.3
Dinoplax gigas	2	83.2	1	36.3	1	49	3	55.8	1	46.7	8	271
Limpet spp.	–	–	9	26	3	10.3	11	38.3	12	37.7	35	112.3
Turbo sarmaticus	159	2711	167	2530	63	1133.3	322	9457.9	125	2396.9	836	18229.1
Turbo cidaris cidaris	3	8.6	2	16.2	–	–	2	9.9	2	9.9	9	44.6
T. sarmaticus opercula	177	756.5	124	487.3	50	298.8	115	685.3	78	324.4	544	2552.3
T. cidaris cidaris opercula	1	0.7	2	1.7	–	–	7	7.6	2	3.8	12	13.8
Oxystele tigrina	143	315.6	115	213.9	41	88.5	118	267.9	68	149	485	1034.9
Oxystele sinensis	42	159.5	38	126.1	13	49.9	50	196.3	25	97.3	58	629.1
Oxystele variegata	–	–	1	1.5	–	–	–		–	–	1	1.5
Oxystele spp.	–	–	22	20.6	14	16.8	54	39.8	29	14.4	119	91.6
Haliotis midae	2	25.6	6	77.9	–	–	5	18.7	3	22.2	16	144.4
Burnupena spp.	14	165.7	41	153.9	18	86.7	32	139.8	18	65.4	123	611.5
Crepidula porcellana	–	–	1	0.9	1	3.7	8	4.9	5	6.5	15	16
Total	568	10294.4	555	6851.5	219	3396.4	748	20541.5	388	6580.7	2368	47525.6

Table 18. Weights of the different shellfish species excavated at Paapkuil Fontein 7 Z4 and Z5.

	Z 4				Z 5					
	Surface		Shell Layer		Surface		Shell Layer		Total	
Species	**no**	**weight**	**no**	**weight**	**no**	**weight**	**no**	**weight**	**no**	**weight**
Shell fragments	–	1633.7	–	3733.4	–	3261.4	–	4190.6	–	12819.1
Scutellastra cochlear	–	–	2	2.4	–	–	1	1.8	3	4.2
Scutellastra longicosta	1	13.3	2	17.8	4	40.3	2	28.5	9	99.9
Scutellastra barbara	1	16	1	18	–	–	–	–	2	34
Scutellastra argenvillei	2	129.9	1	35.4	–	–	1	46.1	4	211.4
Scutellastra granularis	–	–	1	2	–	–	–	–	1	2
Cymbula oculus	7	61.6	11	79.7	8	55.7	7	42.7	33	239.7
Cymbula miniata	–	–	–	–	–	–	–	–	–	–
Cymbula granatina	–	–	–	–	–	–	–	–	–	–
Dinoplax gigas	–	–	1	15	2	58.9	1	25.8	4	99.7
Limpet spp.	2	17.4	11	32.6	7	36	6	20.5	26	106.5
Turbo sarmaticus	70	968.8	147	2297.5	94	1133	144	2082.6	455	6481.9
Turbo cidaris cidaris	–	–	2	4.7	–	–	3	7.3	5	12
T. sarmaticus opercula	70	394.5	171	859.6	93	429	79	398.5	413	2081.6
T. cidaris cidaris opercula	5	4.6	4	3.3	5	3.6	3	2.6	17	14.1
Oxystele tigrina	50	95.7	60	117.8	40	100.2	64	128	214	441.7
Oxystele sinensis	30	94.1	32	97.1	16	61.9	31	100	109	353.1
Oxystele variegata	1	3.6	–	–	–	–	–	–	1	3.6
Oxystele spp.	17	12	19	11.3	16	9.3	34	13.5	86	46.1
Haliotis midae	2	61.1	20	130.5	2	6.3	9	36.5	33	234.4
Burnupena spp.	22	68.9	46	167	5	44	20	55.6	93	335.5
Crepidula porcellana	1	1.4	–	–	2	1.3	5	1.6	8	4.3
Total	281	3576.6	531	7625.1	294	5240.9	410	7182.2	1516	23624.8

Table 19. Weights of the different shellfish species excavated at Still Bay 1.

	3 mm		1.5 mm		Total	
Species	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**
Shell fragmensts	–	2992.5	–	238.4		3230.9
Scutellastra cochlear	18	9.0	1	0.42	19	9.42
Scutellastra longicosta	9	23.8	–	–	9	23.8
Cymbula oculus	2	2.9	–	–	2	2.9
Dinoplax gigas	1	1.5	1	3.11	2	4.6
Limpet spp.	57	112.3	1	0.80	58	113.1
Turbo sarmaticus	4	5.0	–	–	4	5.0
Turbo sarmaticus opercula	4	16.9	1	0.60	5	17.5
Oxystele tigrina	29	8.2	–	–	29	8.2
Oxystele sinensis	34	19.9	–	–	34	19.9
Oxystele spp.	38	7.9	–	–	38	7.9
Perna perna	10	7.2	2	0.06	12	7.26
Total	206	3207.1	6	243.39	212	3450.4

Table 20. Weights of the different shellfish species excavated at Still Bay 2.

	Lens A		Lens B		Lens C		Lens D		Lens E		Lens F		Total	
Species	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**	**no**	**weight (g)**
Shell fragments	–	1185.4	–	873.1	–	2682.3	–	1057.1	–	1616.2	–	961.4	–	8375.5
Scutellastra cochlear	17	73.2	7	32.6	7	45.3	6	20.9	2	8.7	5	31.4	130	212.1
Scutellastra longicosta	41	246.8	78	296.6	26	198.2	68	679.6	284	883.4	18	137.7	827	2442.3
Scutellastra barbara	2	27.8	–	–	2	18.6	2	30.2	–	–	–	–	6	76.6
Scutellastra barbara/longicosta?	2	24.7	6	99.8	–	–	22	329.2	6	97.2	–	–	45	550.9
Cymbula oculus	6	14.7	8	58.9	5	17.5	1	13.3	3	17.3	1	7.6	44	129.3
Dinoplax gigas	–	–	–	–	1	1.0	–	–	–	–	–	–	1	1.0
Limpet spp.	2	35.8	12	33.9	4	4.7	8	69.1	3	4.1	2	6.5	124	154.1
Turbo sarmaticus	25	367.9	9	223.5	15	62.3	–	–	46	669.6	22	186	228	1509.3
Turbo sarmaticus opercula	18	37.4	22	71.5	32	55.3	24	53.7	31	83.8	34	88.6	275	387.6
Oxystele tigrina	4	4	27	29.9	53	28.3	13	6.3	39	25.2	30	17.6	224	11.3
Oxystele sinensis	13	41.7	5	6.5	11	11.8	8	6.4	17	13.3	7	6.7	113	86.4
Oxystele variegata	–	–	–	–	–	–	1	1.1	–	–	–	–	1	1.1
Oxystele spp.	7	3.5	5	1.6	77	20.3	41	7.6	54	9.8	37	9.9	285	52.7
Haliotis midae	–	–	1	0.9	–	–	–	–	2	2.8	1	1.4	5	5.1
Haliotis spadicea	2	6.4	–	–	–	–	1	1.3	4	3.4	–	–	12	11.1
Haliotis spp.	5	22.7	–	–	–	–	–	–	1	0.8	–	–	6	23.5
Burnupena spp.	2	3.5	2	7.7	–	–	–	–	1	3.7	–	–	6	14.9
Perna perna	12	29	3	1.7	4	3.7	–	–	–	–	–	–	33	34.4
Total	158	2124.5	185	1738.2	237	3149.3	195	2275.8	493	3439.3	157	1454.8	2365	14079.2

Appendix D

Plans of fish traps applied for in 1912

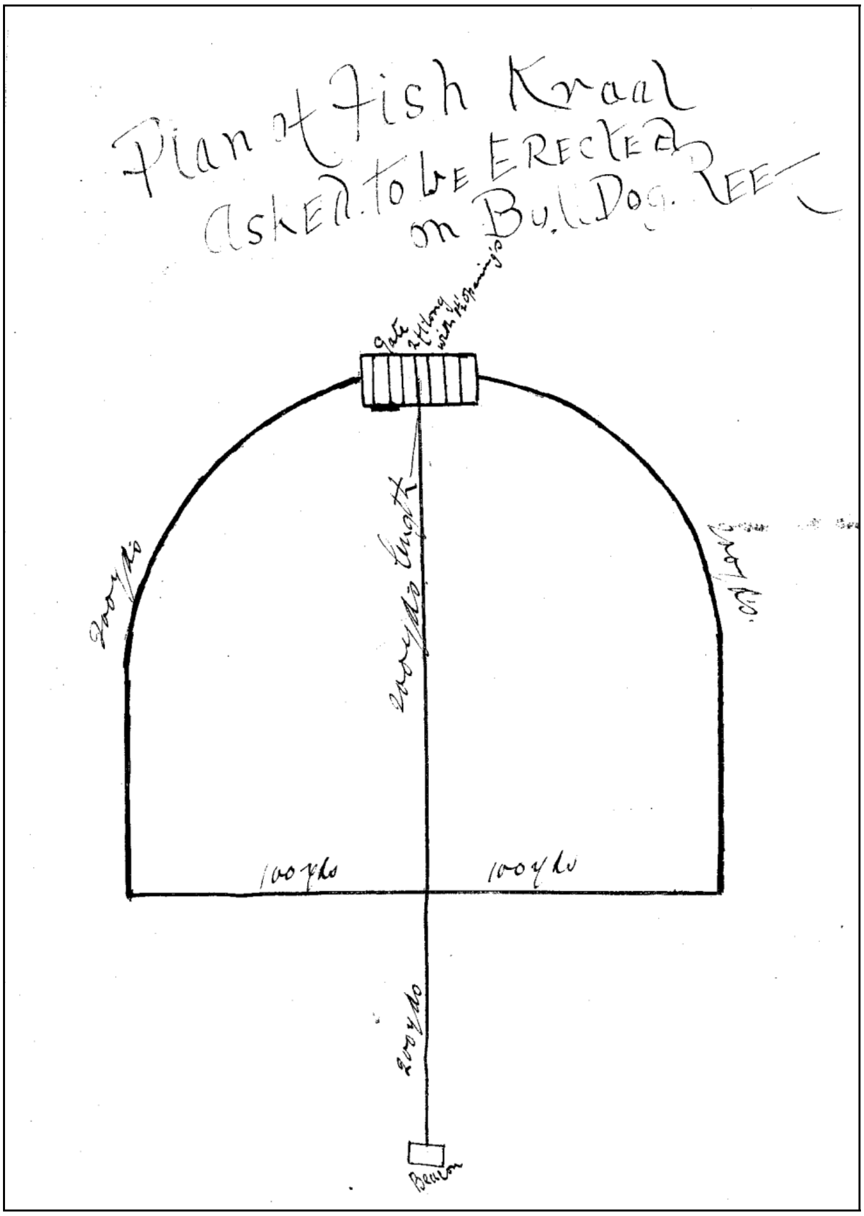


Figure 1. Sketch plan of Fish trap of Jan Newman at the beacon of Struis bay. Cape Archives. PAN 55. K13/10.

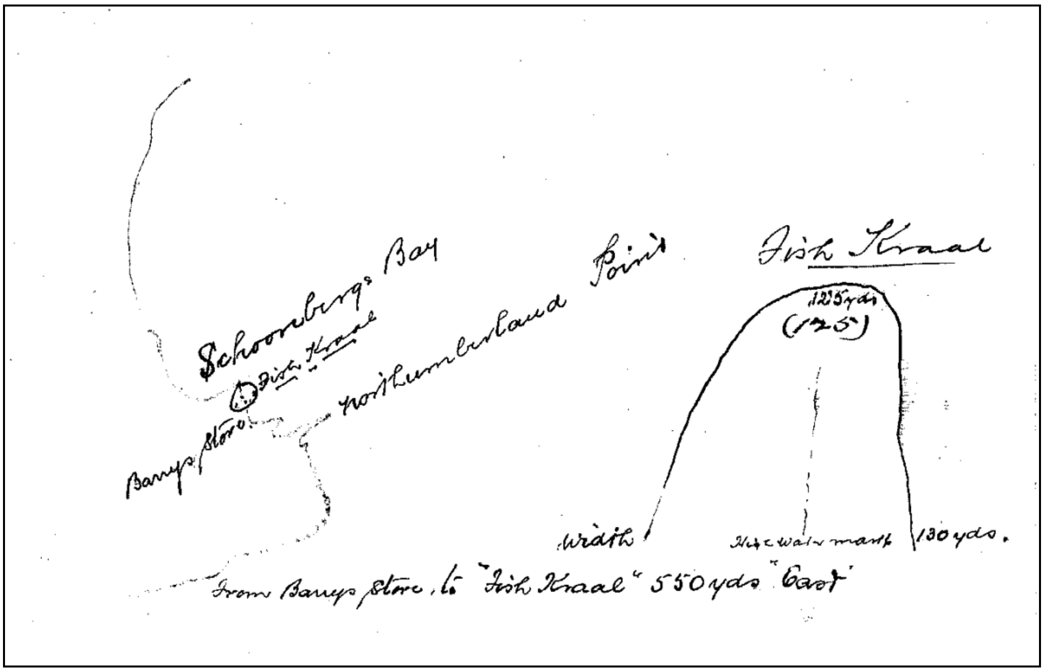


Figure 2. Plan of Fish trap of John Swart at Struis Bay. Cape Archives. PAN 55. K13/11.

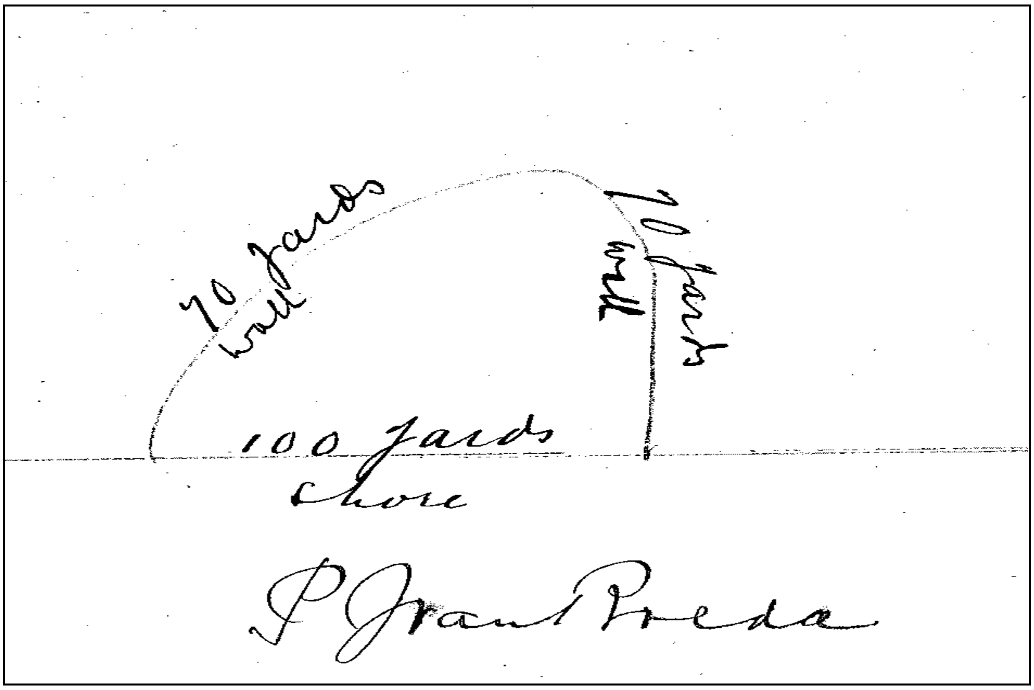


Figure 3. Plan of Fish trap of P. J. van Breda at Stuis Bay. Cape Archives. PAN 55. K13/13.

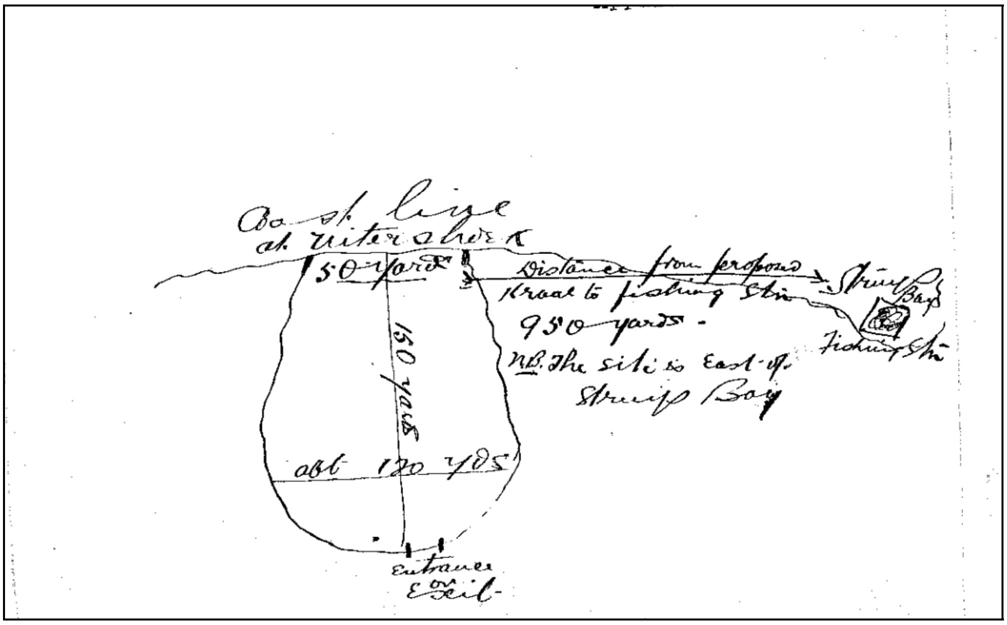


Figure 4. Plan of Fish trap of M. D. van Breda at Bilers Hoek, Struis Bay. Cape Archives. PAN 55. K13/12.

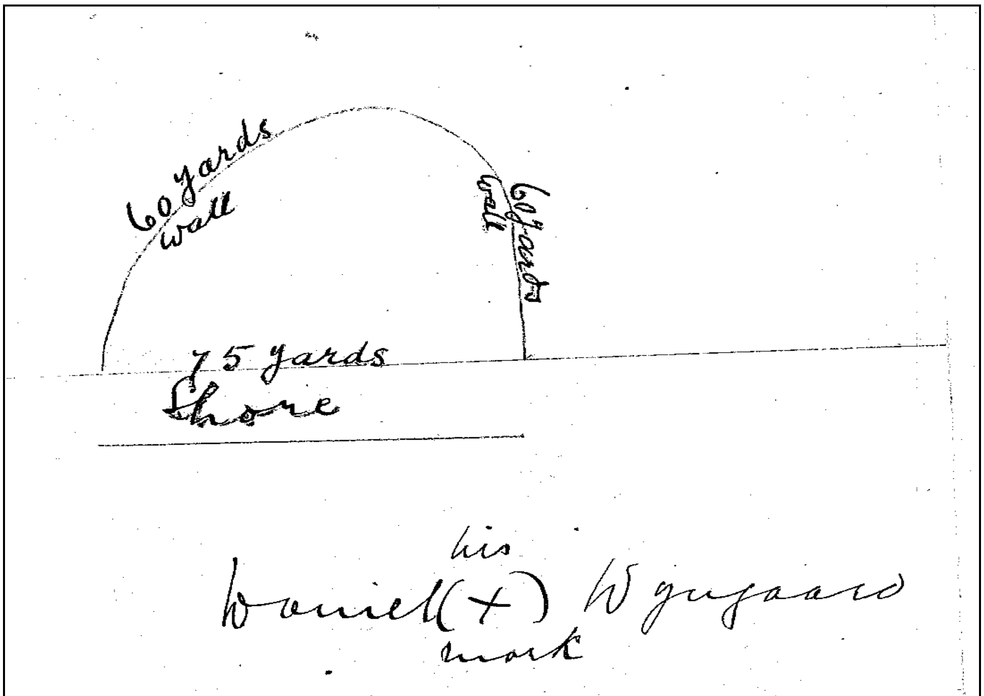


Figure 5. Plan of Fish trap of Daniel Wyngaard at Struis Bay. Cape Archives. PAN 55. K13/16

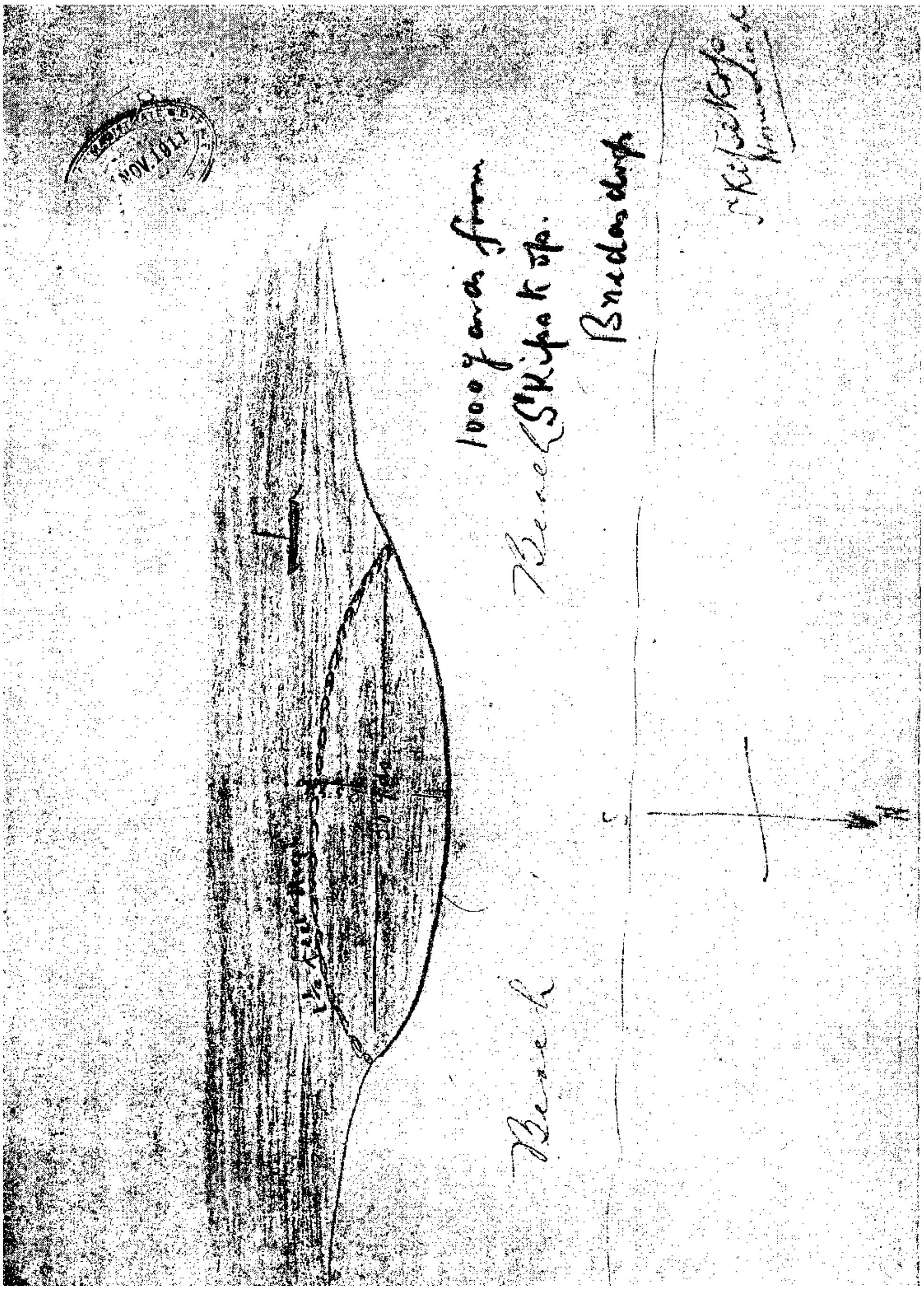


Figure 6. Plan of Fish trap of Tom Wilson at Skipskop. Cape Archives. PAN 55. K13/14.

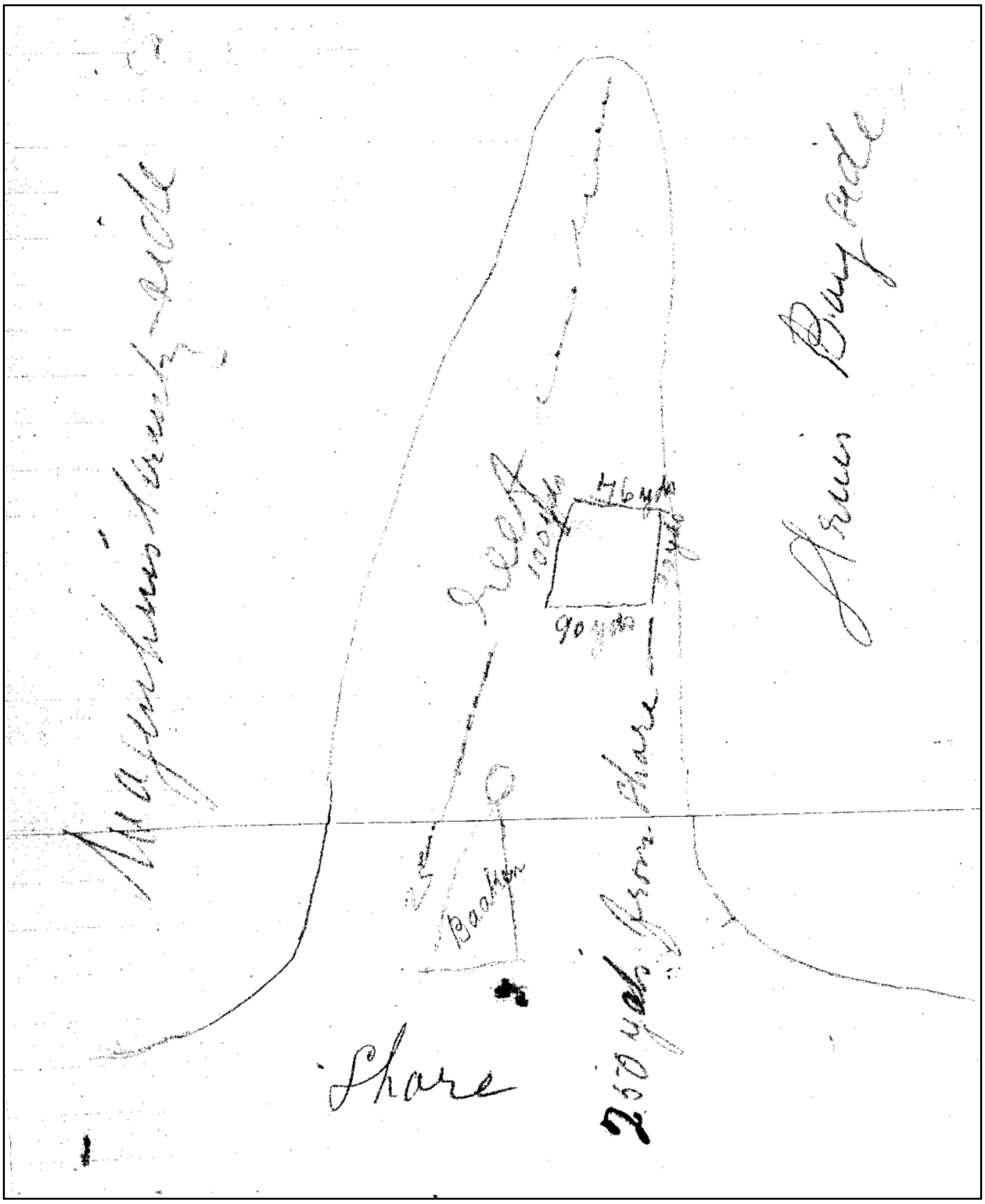


Figure 7. Plan of Fish trap of J. W. Myburgh at the beacon, Wagenhuiskrantz. Cape Archives. PAN 55. K13/18.

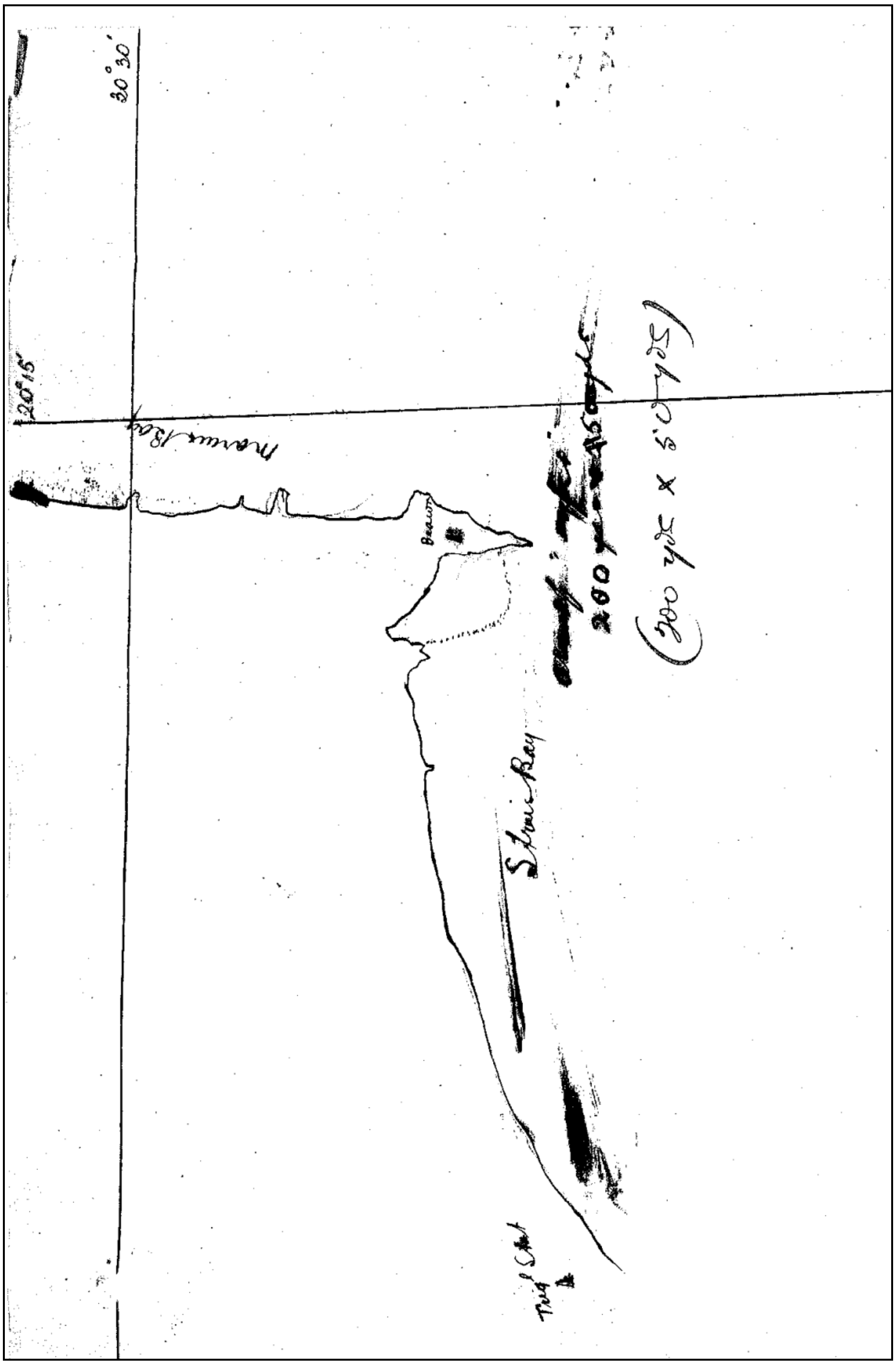


Figure 8. Plan of Fish trap of P. E. De Kock. Cape Archives. PAN 55. K13/19.

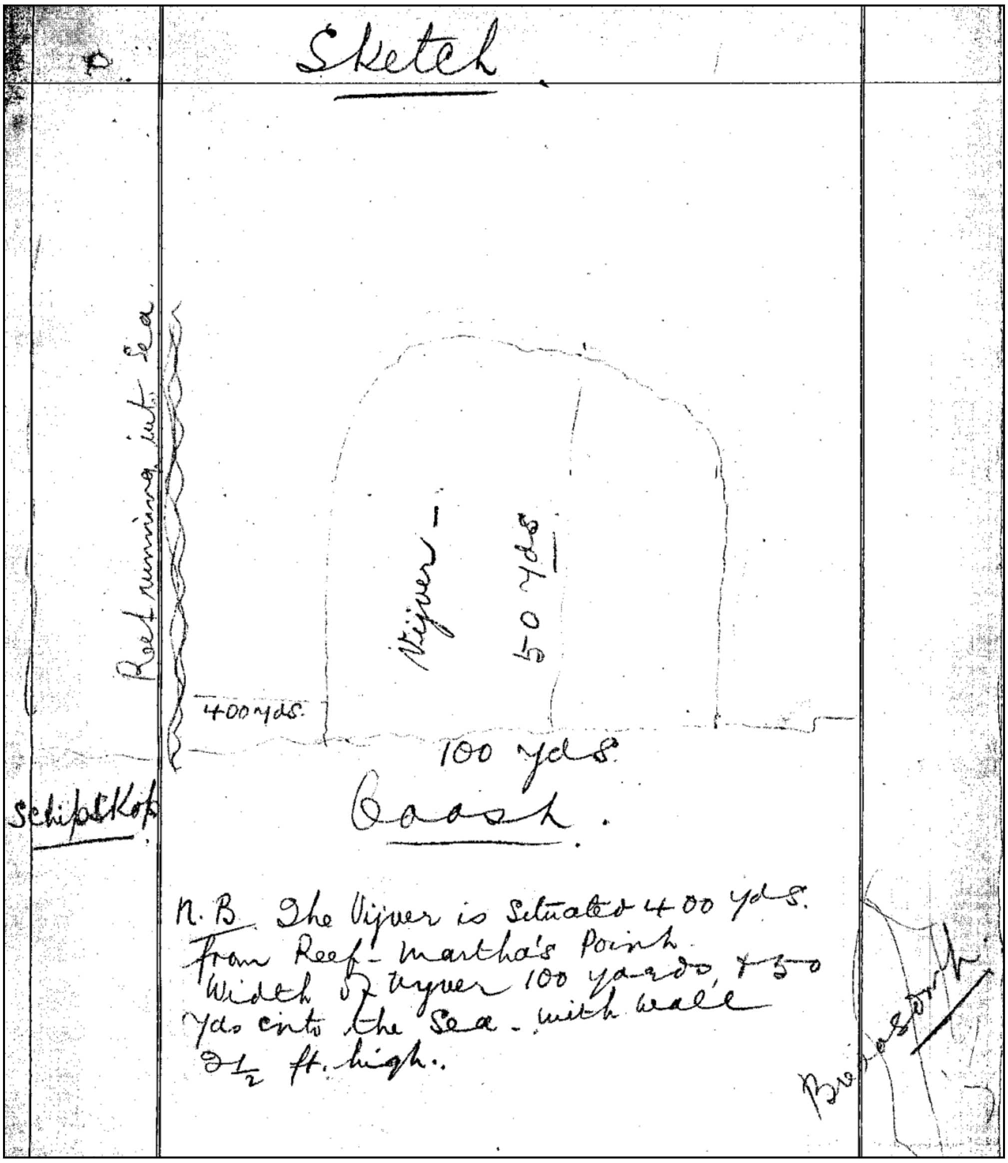


Figure 9. Plan of Fish trap of G. De Wet at Marthas Point, Skipskop. Cape Archives. PAN 55. K13/20.

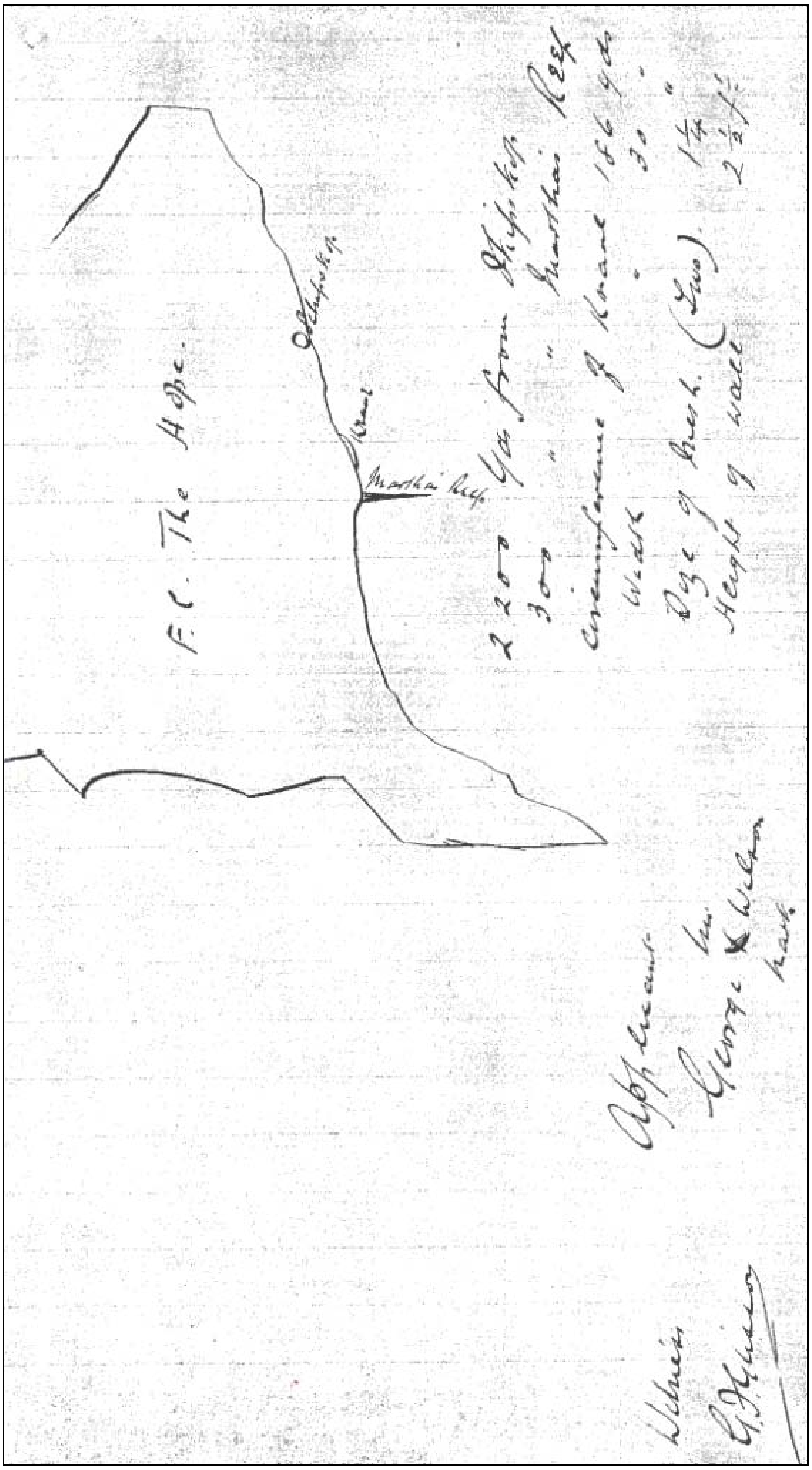


Figure 10. Plan of Fish trap of George Wilson at Marthas reef, Skipskop. Cape Archives. PAN 55. K13/15.

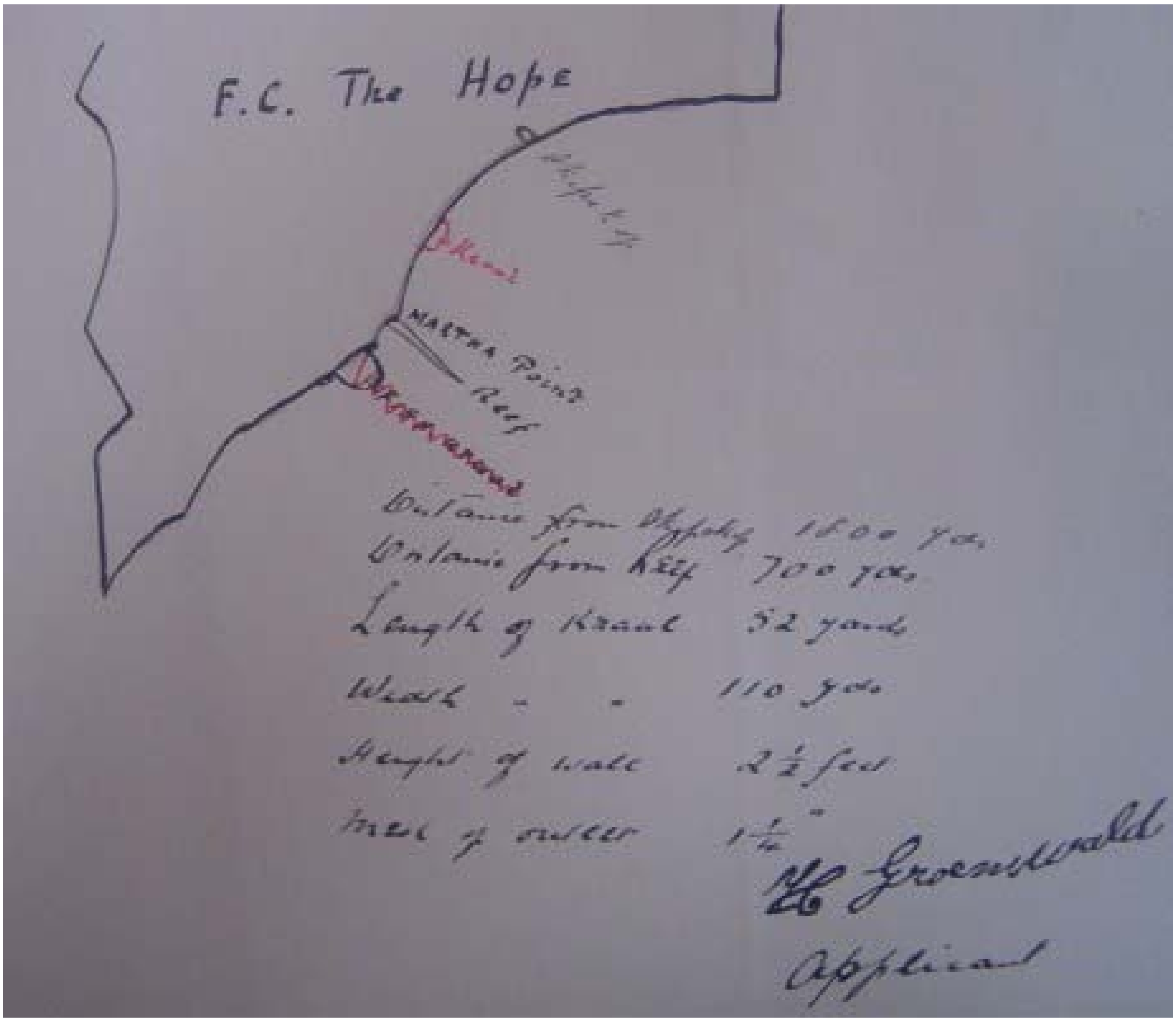


Figure 11. Plan of fish traps of H. Groenewald Cape Archives. PAN 54. K13/5.