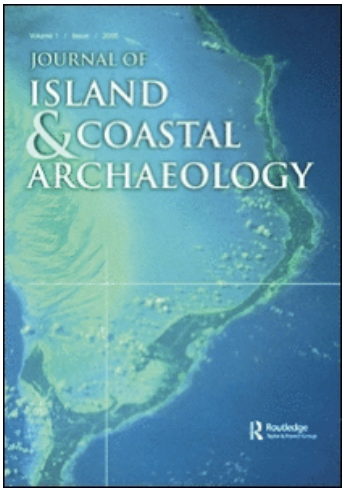

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Sea Nomads of the Beagle Channel in Southernmost South America: Over Six Thousand Years of Coastal Adaptation and Stability

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ABSTRACT

At the southern tip of South America, the archaeology of the Beagle Channel-Cape Horn region documents a clear specialization on the exploitation of littoral and nearshore resources that began at least 6400 years ago. The use of marine resources varied through space and time, but the main staple was pinnipeds. To regularly obtain these marine mammals it was essential to use canoes and harpoons with detachable points. This paper explores two aspects of this interesting maritime sociocultural system: its success, which occurred despite its simple social and technological organization; and its stability, which spanned over six millennia up to the nineteenth century AD.

Keywords littoral adaptations, Cape Horn, Tierra del Fuego, pinnipeds, Holocene

South America's Southwestern Littoral Area extends from Chiloé to Cape Horn (Figure 1). It includes the Beagle Channel-Cape Horn region, which ranges from the Isla Grande de Tierra del Fuego southern shore to Cape Horn (55° to 56° South). There are two reasons why this region is anthropologically interesting. First, although the archaeology of the area is rarely mentioned, there was a clear adaptation by humans to littoral environments here, well known through voyagers and ethnographers. The influential accounts of Darwin (1839) and Gusinde (1937) and descriptions by Hyades and Deniker (1891) are among the most prominent (see Orquera and Piana 1996, 1999a). Second, littoral adaptations typically offered opportunities for economic intensification and resulted in increased levels of sociocultural complexity (e.g., Moss and Erlandson 1995; Perlman

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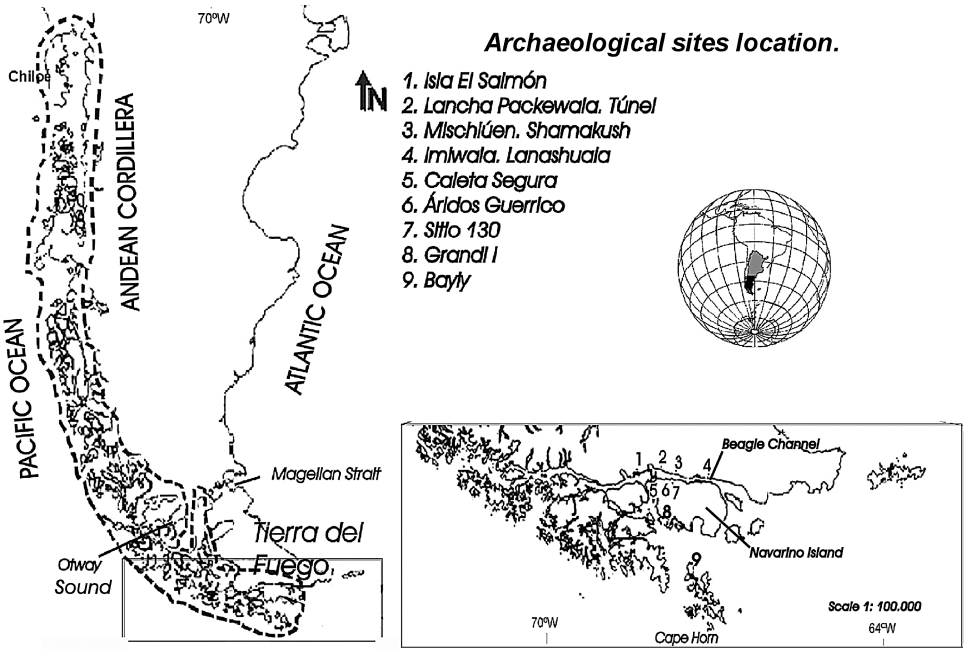


Figure 1. *South American Southwestern Littoral Area map; Beagle Channel-Cape Horn Region amplified below.*

1980:285; Quilter and Stocker 1983; Renouf 1988; Yesner 1980). Nevertheless, in the Beagle Channel-Cape Horn region, the integration and efficiency achieved more than six millennia ago were not substantially modified up to the nineteenth century AD. This long stability, with few changes in the degrees of complexity, is an infrequent phenomenon among Holocene hunter-gatherers. It is therefore useful to understand, by contrast, the littoral adaptations that occurred in other parts of the world.

We agree with Lyman (1991) that it is necessary to differentiate between the sporadic or opportunistic use of littoral resources and their specialized exploitation, which entails the development of a technology designed to achieve a more predictable and efficient use of these resources. Nevertheless, the inhabitants of South America's southwest coast do not fit in any of the categories defined by Lyman. It is necessary to develop an intermediate category, for which the term "littoral" is more appropriate than in the case of Lyman's (1991) first category. Therefore, we distinguish between "coastal" adaptations (Lyman's "littoral" adaptations), "littoral" (by which we mean societies that depended on coastal resources and navigated intensively along the coasts but rarely in open ocean waters), and "maritime" (*sensu* Lyman). Ethnographic and archaeological data suggest that the natives of the whole South American Southwestern Littoral Area are included in the second ("littoral") category (Orquera and Piana 1999b, 2006a).

GEOGRAPHICAL CHARACTERIZATION

South America's southwest coast, from Chiloé towards the south (Figure 1), is in close proximity to the Andes. Hence its labyrinth-like configuration (with innumerable fjords, channels, and islands), abrupt slopes, and steep bathymetry near the littoral zone. As Erlandson (2001:322) noted, "Only

Figure 2. *Beagle Channel: Mountains, woods, and sea.*

one trait . . . seems to link the early coastal localities: steep bathymetry." The southernmost Beagle Channel-Cape Horn region (Figure 2) is cold, relatively rainy (500 to >1000 annual mm, depending on the location), stormy, and windy. It has one of most oceanic climates in the world (Tuhkanen 1992), however, which reduces extreme variations. Consequently, the daily and seasonal mean temperature variation is low: 9.3°C in January and 1.1°C in July. Frequent winds increase the chill sensation and hinder navigation by raising storms and waves, but rarely exceed 60 km/hour.

The region is covered by dense woods of tall trees, mainly two *Nothofagus* species (*N. betuloides* and *N. pumilio*) and the Winter's Bark (*Drimys winteri*). The only terrestrial animals useful for humans are guanacos (*Lama guanicoe*) and some birds. In contrast, the marine fauna is diverse and abundant, including two pinniped species (*Otaria flavescens* and *Arctocephalus australis*), numerous local (e.g., cormorants) and migratory birds (e.g., penguins), local and migratory fish, and substantial colonies of mussels (*Mytilus edulis*) and other mollusks. Both large and small cetaceans (at least 17 taxa; see Piana 2005) also occasionally venture into the region.

Except for guanacos, which inhabit only part of the region, these species have a very abundant presence and wide and overlapping distributions. There are no patches in this region that offer radically different or complementary resources: pinnipeds, birds, fish, mussels, wood, bark, abundant fresh water, and lithic raw materials to knap tools could be easily found all along the coast. Of course, there are some microenvironmental differences: geological or geomorphologic contexts may have influenced the cost or risk of procuring certain resources, but even these relative differences never prevented peoples from exploiting them over the long term.

Research suggests that this environment was very stable during the Holocene. The current Beagle Channel is an ancient glacial valley which was inundated by the sea ~8000 years ago (Rabassa et al. 1986). *Nothofagus* recolonized the region about 5500 years ago and perhaps earlier, with few later variations (Heusser 1989, 1998). Sea surface temperature has also remained fairly stable over the last 6000 years, even during the last millennium (Obelic et al. 1998). The archaeofaunal data show variations in the intensity of exploitation of some species, but had neither new arrivals nor extinctions (Piana

and Orquera 2007). A combination of glacial isostasy and tectonics gradually lifted the coastal zone, reaching 10–11 m in some sectors during the same period (Rabassa et al. 2003).

ARCHAEOLOGICAL SITES

Flat, dome-like or ring-shaped shell middens are the most characteristic archaeological features in the region. On the Argentinean shore of the Beagle Channel alone, we have located more than 500 sites, formed by one or many domes which can cover anywhere from a few square meters to (exceptionally) more than a hectare (Piana and Orquera 2006). A similar site density has been recorded on Navarino Island (Ocampo and Rivas 2004). On the Argentine coast, domes are usually a meter high or less, and several meters in diameter. More than 90% are less than 300 m from the current shoreline; most are located at less than 10 m above current mean sea level. Statistical analysis of 318 shell middens does not show a strong correlation with fresh water sources or wind protection (Barceló et al. 2002). These shell middens were mainly garbage-zones adjacent to huts, but also likely provided a certain amount of protection (intentionally sought or not) from the wind and running water from rain or melting snow. The reasons for initial occupation of these sites, and subsequent population growth, have been discussed elsewhere (Piana and Orquera 2006) and analysis of their faunal composition (40–60% shells) has been presented by Orquera and Piana (2001–2002). In contrast to assertions by Bird (1938) and Yesner (1990), no true pit-houses appear to have been constructed in the region (Orquera and Piana 1991, 1997, 1999b).

The mounds grew fast due to the high deposition rate of mollusk refuse. Nearly all shell middens show occupation discontinuities and internal changes in the loci where refuse was laid (see Bailey 1977:135)—a likely result of the mobility of site inhabitants. The evidence for resettlement is abundant: sometimes short intervals are denoted between events while in other cases they are separated by centuries or millennia. All of this has produced a complex depositional history (Figure 3), but with a very high level of chronological and spatial resolution. To resolve the *temporal* and *meaning palimpsest* of shell middens (Bailey 2007), we have developed an excavation technique of *microscopic tendency,* which allows us to separate multiple formation events (Orquera and Piana 1992).

There are also living floors not associated with shell middens, places of lithic procurement and knapping, and, of course, isolated finds. However, their visibility is much lower due to abundant vegetation. Rock shelters are not abundant and seem to have been used more for funerary purposes than for domestic use (Barceló et al. 2002; Piana et al. 2006).

ARCHAEOLOGICAL RESEARCH

Only one major archaeological investigation, carried out by Junius Bird (1938), was conducted in the Beagle Channel–Cape Horn region prior to 1970. A later survey was done by Ortiz Troncoso in Lauta in 1971—regrettably discontinued. Our excavation of the Lancha Packewaia site in 1975 (Orquera et al. 1978) developed into a long-term research program and has continued uninterrupted to the present (see Álvarez 2006; Fiore 2001; Mansur-Franchomme et al. 1989; Orquera and Piana 1999b; Schiavini 1993; Zangrando 2003).[1] Investigation at Lancha Packewaia was jointly carried out with Arturo Sala and Alicia Tapia (Orquera et al. 1978); research on the Túnel VII and Lanashuaia sites was part of a joint venture with Assumpció Vila and Jordi Estévez (Estévez and Vila 1995; Piana et al. 2000).[2]

Other archaeological projects in the region include the excavation of Isla El Salmón sites (Figuerero and Mengoni 1986), Playa Larga (Yesner 1990), and the works of Legoupil (1994) and Ocampo and Rivas (2000, 2004) on Navarino and other islands. Due to space limitations, we do not discuss here research projects in the other regions of the South American Southwestern Littoral Area, like the Otway Sound-West Magellan Strait and Chiloé Island (see Emperaire and Laming 1961; Legoupil 1989, 1997,

Figure 3. *Shellmidden profile (Túnel I site).*

2003; Ocampo and Rivas 2004; Orquera and Piana 2006a; Ortiz Troncoso 1979; Piana and Orquera 2007).

Research in the Beagle Channel has already provided a detailed sequence which serves as a reliable basis for reconstructing the region's peopling and their subsequent adaptations. This sequence is chronologically anchored by more than 150 radiocarbon (^{14}C) dates, and numerous archaeofaunal, techno-typological, functional (microscopic), and other data. All ^{14}C dates mentioned in this paper are uncalibrated and obtained from wood charcoal. Although the local magnitude of the reservoir effect is known (Albero et al. 1986, 1988), we do not mention ^{14}C dates obtained from shells or other marine samples.

EARLY SETTLEMENT

More than 10,000 years ago, the northern part of what is today the island of Tierra del Fuego (which was then attached to the continent) was already populated by humans (Massone 2003). However, in the Beagle Channel there are no archaeological sites with ^{14}C dates earlier than 7840 ± 50 BP (bed S of Imiwaia I site: AA 78551). Here and in the First Component of the Túnel I site (6680 ± 210 BP: Orquera and Piana 1999b) the toolkits seem typical of inland hunters, but the latter assemblage includes some artifacts (rhomboidal lithic points and unifacial *tranchets* with polished bevels) unknown in Fell and other sites from continental Patagonia (Orquera and Piana 1999b).

The first manifestations of a littoral adaptation in the region are those of the Second Component of the Túnel I site (TISC) and the Lower Component of the Imiwaia I site (IILC), both of which are located along the northern shore of the Channel. TISC includes evidence from an excavated area of 66.4 m^3 in layers D (shell midden), E, and upper F (silt). Sixteen ^{14}C dates place TISC between 6400 and 4600 BP (Orquera and Piana 1999b:table II). IILC includes layers K through R (15.2 m^3); six dates range from 6390 ± 50 BP (AA-78549) to 4900 ± 120 (AC-1730).[3] Other sites in this region, known only from test-pits

Figure 4. *Steep coast near the Túnel sites.*

and profile examinations, are dated between 6120 and 5000 BP (Legoupil 1994; Ocampo and Rivas 2000; Orquera and Piana 1999b, 2006a).

By this time, forest already covered the Beagle shores (Heusser, in Orquera and Piana 1988a, 1988b, 1999b:Table V). Túnel I is located on a rocky cliff portion of the coast, and Imiwaia I is a morainic environment of smoother topography and muddy beaches (Figures 4–5). Both sites functioned then as repeatedly occupied base camps, where a diversity of animals were butchered and eaten, stone knapped, weapons repaired, hide and bone worked, basketry probably woven, and personal ornaments produced. The quantities of dietary remains found between discontinuities in the shell

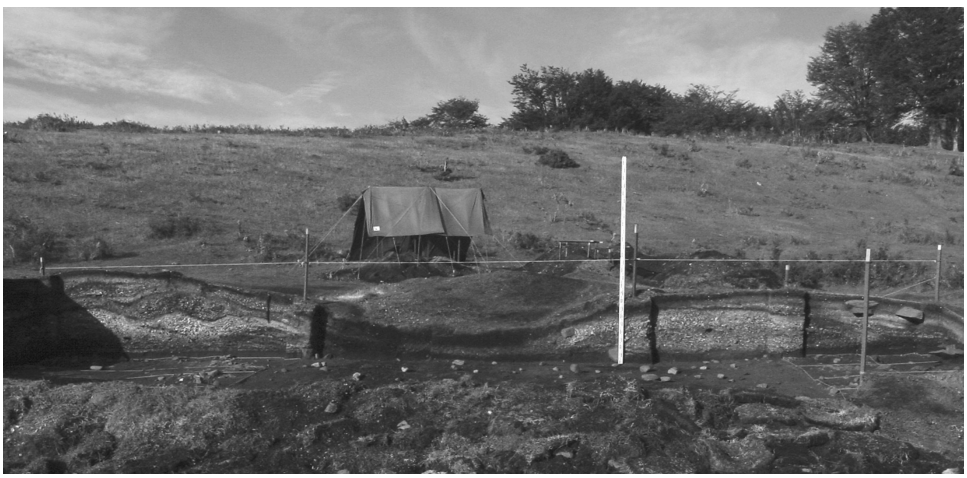


Figure 5. *Smooth slopes and park-type vegetation around the Imiwaia I site.*

midden suggest that occupation events were probably short, but hundreds of separate occupations have been identified. At both sites the shell middens were ring-shaped, presumably formed around circular huts. In TISC, windbreaks were also probably used.

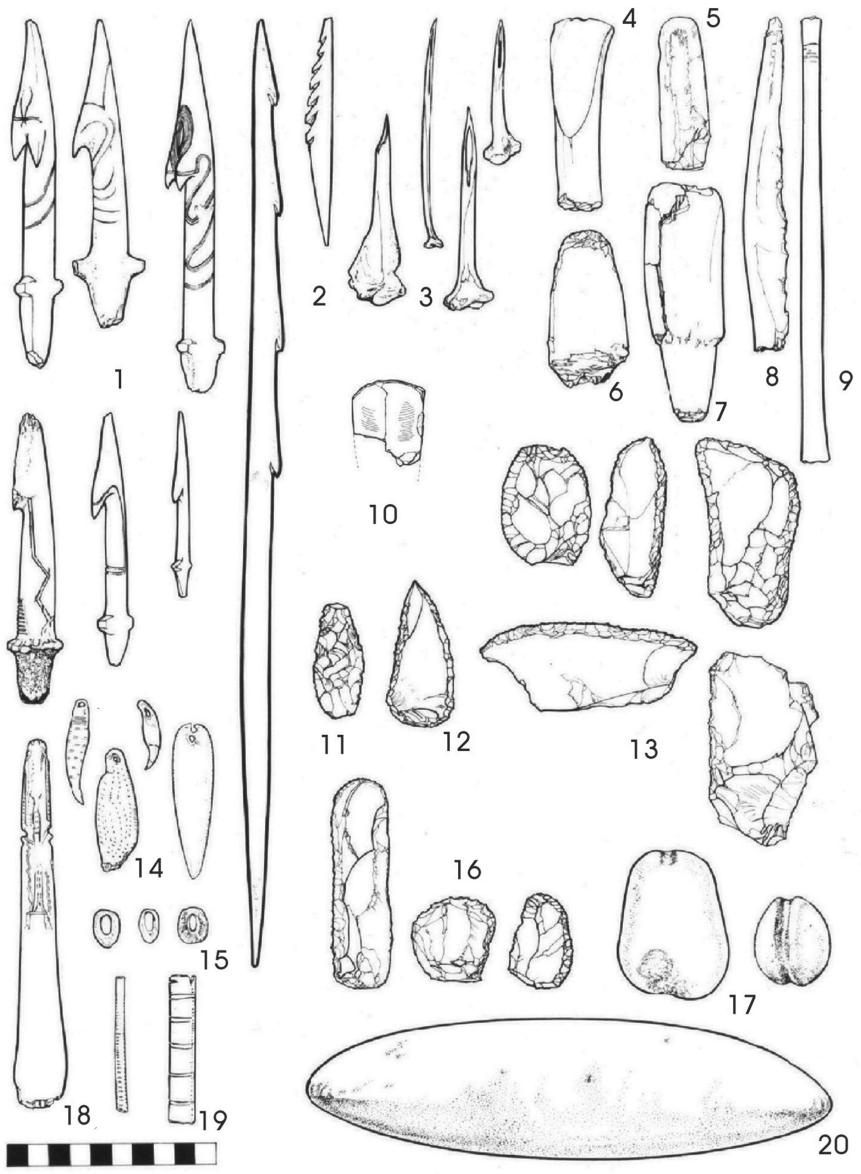
In the excavated portion of TISC, the remains of 331 *Arctocephalus*, 9 *Otaria* and 2–3 Phocidae have been identified, along with at least 23 guanacos, 22 small cetaceans, 300–350 shags, 60–70 penguins, 50–60 other birds, 259 fishes, more than 5,500,000 mussels, and numerous baleen whale bones (Orquera and Piana 1999b). In IILC the species representation is generally similar, although no definite figures are available yet. Pinnipeds aged from a few months to 17 years old (but not newly born) were hunted. Thin sections of upper maxillary canines indicate that the great majority of pinnipeds from TISC were captured between the southern autumn and spring; in IILC and in other later assemblages, however, some animals killed during the summer have been also found (Schiavini 1993 and personal communication).

In contrast, fish consumption could have been greater in summer, when shoals of sardines (*Clupeidae* sp.) and tailed hakes (*Macruronus magellanicus*) ventured to the Beagle Channel, were intensively exploitable, and sometimes ended up in massive beachings. A total of 760 hake bones/m^3 of shell midden were recorded in IILC, against only 69 in TISC. This difference may be due to the fact that Imiwaia is closer to the open sea and its shores are more prone to strandings. Nevertheless, the Notothenidae, which are not seasonal and occupy a different habitat, are also more abundant in IILC (107.5 bones/m^3) than in TISC (32 bones/m^3; Zangrando 2003).

Among the mollusks, 99% in TISC and 90% in IILC are mussels (*Mytilus edulis*). Twenty percent of the mussel shells of TISC and 2% of IILC are 30 mm long or less, hence their dietary value was minimal. This probably indicates gathering in clusters beside the rocky and steep shore of Túnel I, and more selective choosing on the shallow beaches of Imiwaia. Excluding these small specimens, the average lengths (44.4 ± 8.7 mm in TISC, 49.8 ± 10.2 mm in IILC) are smaller than those obtained from current samples (57.3 ± 6.3 mm), but they do not imply overexploitation because the variation between sub-layers is not correlated with their chronologies. More likely, these variations reflect different time intervals between successive visits to a single mussel bank (Orquera and Piana 2001–2002), as an over-exploited colony can recover in a year or less.[4]

Notwithstanding their high potential dietary value, little can be said about the cetacean remains due to their fragmentary state. Their meat and grease could be introduced in the camps detached from the bones and, conversely, many bones could have been brought for technological rather than nutritional reasons (Orquera and Piana 1999b:103; Piana 2005; see also Smith and Kinahan 1984).[5] If cetaceans are excluded, we calculated that approximately 2/3 of the calories consumed by the TISC occupants came from pinniped meat and grease, one fourth from mussels, and only 5% from guanacos. These estimates were made after the analyses of more than 100,000 bones and bone fragments, and shellfish remains from 39 shell midden samples. As expected from the micro-environmental features, in IILC the guanaco remains are more abundant than in TISC, but are not a dominant part of the assemblage.

In TISC, the artifacts include 1100 tools (complete or fragmented): 672 lithic, 420 bone, and eight shell tools. There are also 1057 ornamental objects (Figure 6). In IILC, 260 tools (131 lithic and 129 of bone) and 597 ornaments have been found. The tool-kit is varied, but, except for the weapons, generally involved little labor investment. A very noticeable trait is the abundance of bone tools (38.2% in TISC, 49.6% in IILC), which is a consequence of good preservation conditions offered by the shell middens and the intentional use of bones for very diverse functions. In this tool-kit, two kinds of harpoon points are noteworthy. One type, detachable from the haft, has a cross-shaped base and one or two successive or parallel barbs. The other has a long non-detachable base and multiple barbs (Orquera and Piana 1988b, 1999b:108; Orquera et al. 1987). No foreshafts or spear-throwers were found.



1 Cross-like base harpoon heads; 2 Multibarbed harpoon heads; 3 Hollow awls; 4 Chisel; 5 Spatula-like tool; 6 Wedge; 7 Stemmed wedge; 8 Rod; 9 Sucking tube; 10 Shell knife; 11 Lithic point; 12 Borer; 13 Side scrapers; 14 Pendants on bone and canines; 15 Shell necklace beads; 16 End scrapers; 17 Fishing line sinkers; 18 Non utilitarian decorated rib; 19; Bone necklace beads; 20 Pecked axe

Figure 6. *Representative tools and ornaments of TISC. Drawings: Diana Alonso.*

Numerous hollow awls were made from bird bones (146 in TISC and 12 in IILC), possibly for use in making baskets (Piana 1984). Guanaco bones were used to make solid punches, pressure flakers, and spatulas with one narrow end (which may have been used to work on bark). Cetacean bones were used to make wedges (possibly to split wood) and pinniped ulnas were shaped to produce chisel-like tools. The production process for bone tools from these early assemblages has been discussed by Álvarez (2003) and Scheinsohn et al. (1992).

The stone tools are not as typologically and functionally distinctive as those from bone. Approximately 90% of these were made from meta-volcanic rocks that outcrop in the hinterland mountains (Lemaire Formation) but can be found along the shore near the settlements, carried there by glaciers and streams (Terradas 1995). Rhyolite was most frequently used, although cinerite had a better quality for retouch. These early assemblages do not include blade technology and intensive bifaciality; edge retouch was only marginal or ultra-marginal (Álvarez 2004).

Side-scrapers constitute 47.8% of the lithic tools from TISC and 49.2% in IILC; used flakes with unretouched edges constitute 27.4% and 26.2% respectively. Poorly standardized end-scrapers amount to 5.0% and 8.2% of these assemblages, respectively (Orquera and Piana 1988b, 1999b). Microscopic analyses indicate that, independently from the edge shape or its location relative to the percussion axis, both side-scrapers and non-retouched edges were used to process varied resources (hide, bone, wood, meat, etc.), cutting/sawing, or scraping/burnishing. In contrast, all end-scrapers were used to work hide. Quantities indicate a nearly identical typological composition of both assemblages, but bone work dominated in TISC over soft materials of animal origin and wood work, while in IILC soft materials of animal origin were processed more frequently than bone and hide (Álvarez 2003, 2004, 2006).

Given that these assemblages are attributable to hunter-gatherers, it is notable that only one lithic point was found (made of exotic obsidian) at TISC and none in IILC. Instead, smoothed or pecked tools (mallets, possible fishing-line weights, etc.) constitute 9% of the lithic tool-kit in TISC and 15% in IILC. These were made from basalt rocks or hornblendite (Mansur-Franchomme et al. 1989; Orquera and Piana 1999b, 2005).

In TISC the decoration of bone tools is more abundant than in IILC; it was applied especially to detachable harpoon points in the first case, and to bone beads in the second case. The designs are not figurative and are mostly composed of curved or straight lines and carefully done by incision and other less frequent techniques. A total of 152 bone beads and 835 shell beads have been found in TISC, while 134 bone beads and 466 shell beads have been recorded in IILC. These were made by segmenting hollow bird bones or cutting and polishing the naturally perforated apex of *Fissurella* shells (Fiore 2001; Orquera and Piana 1999b:58–59).

ADAPTIVE FACTORS

In the Southwestern South American Littoral Area—the Beagle-Cap Horn region included—several factors stimulated the development of a littoral way of life: the mountainous terrain adjacent to the coast, the difficulties for human mobility, the abundance of predictable staples of high energetic value along the coast, and the scarcity of plant and animal resources in the forest (Orquera and Piana 1999b:20). From 6400 BP onward, natives intensively exploited these resources, used raw materials available only in the littoral zone, and created techniques and tools that were not useful in other environments, but were very efficient in this region. In other words, their survival became dependent on littoral adaptation and specialization.

The most important technical elements were canoes and harpoons with detachable points. The great quantity of pinniped remains found in the early components (and also in later ones), and the concentration of kills between autumn and spring (when these animals spend less time on land), indicate that an efficient method to hunt them in the sea existed from the beginning. Part of this strategy consisted of using bone harpoon points

with cross-shaped bases: their short and thick stems suggest that they were detachable. As we have explained elsewhere (Orquera and Piana 1999b:106–107; Orquera et al. 1987; Piana 1984:54–55), these detachable harpoons points were specifically designed to hunt pinnipeds (or even dolphins) in water (although pinnipeds on land and other prey may have occasionally been killed with them), with a low percentage of failures. In contrast, multibarbed harpoon points, with long and narrow stems, must have been fixed to the harpoon hafts and possibly used to capture guanacos, penguins, or large fish.

Although no boat remains have been found thus far, probably because of their perishable nature, there is little doubt that some kind of seaworthy craft was used in the region by at least 6000 years ago. Navarino Island was already settled ca. 6160 ± 110 BP (Legoupil 1994; other sites dated by Ocampo and Rivas [2000] are somewhat later), and canoes or rafts were necessary to reach it. Faunal data also indicate the regular hunting of pinnipeds during months in which their behavior is more aquatic (an impossible task using simple rafts), and the fact that *all* of their bones are represented in the domestic sites in quite even proportions[6] hint specifically at the use of seaworthy boats. Indeed, whole pinniped skeletons have been recovered at the sites, including their fins even though they provide minimal dietary value. Had they been transported by land, their weight and shape would have probably required butchering near the kill site and the abandonment of less valuable portions, but the transport of whole carcasses in canoes would have been less difficult.

In contrast, only certain portions of the guanacos (whose bodies would have been transported on foot) reached the sites. Analyses by Vázquez (2007) indicate that the frequencies of their remains have a low relationship with the economic yield indices determined by Borrero (1990) and Lyman (1992, 1994). For that reason, there must have been another selection factor, such as the greater ease of transporting certain parts over others (Orquera and Piana 1999b:108–109; Orquera et al. 1987; Piana 1984:63).

It is likely that canoes were constructed with wooden frames and lined with bark, such as those observed by European travelers in the seventeenth–nineteenth centuries AD. *Nothofagus* are the only trees in the region that are of adequate size to build canoes. Their wood is attacked by the shipworm (*Bankia martensi*) and our experiments indicate that this material may lose up to 35% of its weight within 10–12 weeks; a boat made with this wood would be unusable in a shorter period of time. The bark, although fragile, is not attacked by shipworms, which allows the craft to have a larger lifespan (Piana and Orquera 1998:435–437).

Arctocephalus australis specimens can provide between 32,000 and 108,000 kcal, dependent upon their age and sex. The average for specimens found in TISC is 64,130 ± 25,200 kcal (Schiavini 1993). Excluding potential waste, this would represent enough food for a group of 6–7 people for three or four days (Orquera 2000). An adult guanaco could provide the same amount of food as an *Arctocephalus*, or slightly more, but they do not inhabit the whole region, and only in winter are they frequently found near the shore. The exploitation of big cetaceans depended on their stranding, too random an event to rely on them as a staple. Birds and fish are numerous in the region, but they are individually small: they were only significant to the diet when it was possible to catch them in great numbers.

Mussels were eaten in great quantities, but their nutritional yield was low (Erlandson 2001; Meehan 1977). One mussel of average size from the Beagle shore shell middens (43 mm long) yields only 1.45 kcal on average, considering seasonal differences. To reach the nutritional value of a pinniped of average size, an individual would need to eat around 45,000 mussels (Orquera 2000; Orquera and Piana 1999b). Given the abundance of pinniped meat, the role of mollusks as protein source (Erlandson 1988; Glassow and Wilcoxon 1988) in the region was secondary. Nevertheless, their availability is predictable, their gathering lacks complications (see Bailey and Parkington 1988; Meehan 1977; Yesner 1980), and they may have functioned as a "security valve"

covering circumstantial insufficiencies from other resources (Orquera 2000).

Isotopic analyses of human bones (though of uncertain date) confirm the orientation of peoples toward the exploitation of maritime foods (Panarello et al. 2006); although two anomalous cases reported by Guichón et al. (2001) suggesting a great proportion of terrestrial resources still require explanation.

DISCUSSION

Neither TISC nor IILC reflect an exploratory or experimental stage: the adaptation was already well structured and adjusted to the environment over which it developed for the next millennia. So far, findings from archaeological sites in the Beagle Channel are the earliest found along the southwestern South American Coast. Nevertheless, it is not likely that this adaptation process started in this region. Before the technology made this adaptation viable, it must have been necessary to maintain economic and demographic contacts with the Fuegian hinterland; the Fuegian Cordillera was not unsurpassable, but was a considerable obstacle to such contacts. In addition, in this area a littoral adaptation required three previous conditions: abundant maritime fauna, waters protected from the violent Antarctic waves, and availability of forested areas with tall trees that provided not only abundant timber for heating, but also raw materials for making canoes and harpoon hafts (Orquera and Piana 1988a:153–157, 1999b:111; Orquera et al. 1987). The development of such a littoral economy could not have happened in the Beagle Channel before the ancient lake opened towards the sea around 8000 years ago, but it could have occurred earlier in other coastal locations within the region. Nevertheless, the third condition makes it improbable that such an economy would have started earlier than the already known dates: the forests were not prominent until ca. 5500 BP (Heusser 1989, 1998), although they were already present earlier around the Túnel sites. It is also unlikely that earlier sites have been covered by rising sea level during the early Holocene (Orquera and Piana 1988a:151–152) since the land has experienced isostatic-tectonic uplift of nearly 10 m in the last 8,000 years (Bujalesky et al. 2004). Twenty years ago we suggested a maximum possible age of approximately 6500 ^{14}C years for the beginning of the sea littoral adaptation in the region (Orquera and Piana 1988a), and so far older dates have not been found.

Other regions seem to have been more appropriate for the start of the specialized littoral life: maybe Chiloé, but most likely the Otway Sound-Western portion of the Straits of Magellan. Here, the hinterland-coast communication was not hindered by mountains (which must have favored group survival at the beginning when the population was still low) and forests recolonized the land earlier from their Pleistocene refuges. Moreover, there are similarities—though not conclusive—with lithic tools at that time made in eastern Patagonia. Cranial and facial analyses of human skeletal remains suggest close genetic affinities between modern Fuegian canoemen and southern continental Patagonia pedestrian hunters, notwithstanding other great physical differences (Orquera and Piana 1999b:114; 2006a; Orquera et al. 1987). In any case, whatever the region of origin, the expansion of the population and new lifestyles initiated within the area was probably rapid (Orquera and Piana 2006b).

For over 6000 years, the specialized littoral adaptation had great continuity and stability. By the latter, we do not mean invariability but the conservation of general patterns, without marked directional changes (see Piana and Orquera 2007). Due to length restrictions, we cannot fully discuss later assemblages (Figure 7; see Orquera and Piana 1999b), but there were changes in some tool types or the resources exploited. The main innovations were lithic points: large lanceolate and standardized spear points (10–17 cm long) were common around 4000 BP, triangular middle-sized (4–8 cm) and some larger around 2700 BP, and arrow heads (<3 cm) from 1400 BP to nineteenth century AD. About 3000 BP, the cross-based bone harpoon points were replaced by others with lateral tenons, also detachable. Other bone

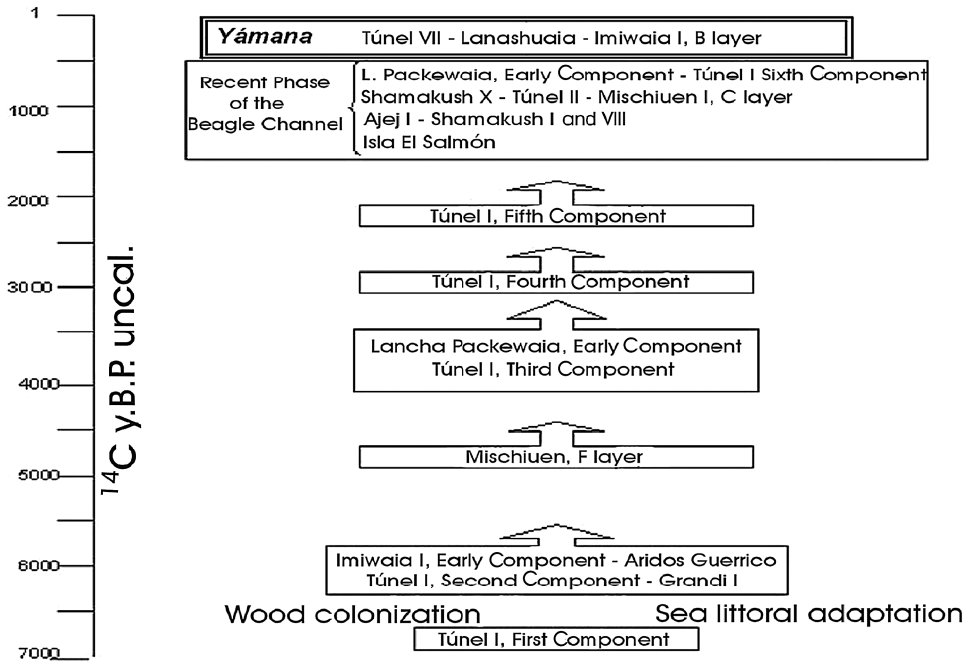


Figure 7. *The Beagle Channel-Cape Horn Region archaeological sequence.*

and stone tools (i.e., wedges, hollow awls, side-scrapers, end scrapers) were kept unaltered and their frequencies within the total records show no significant or directional changes (Figures 8–9; Piana and Orquera 2007).

The inclusion of weapons with chipped stone points did not imply an exploitation of more taxa. In the beginning, it coincided with a proportional rise in guanaco consumption, but in later assemblages the number of points continued to increase while guanaco bones dropped to very low numbers (at least in the camp-sites). Except for the weapons mentioned above, the Recent Component of the Lancha Packewaia site (ninth to eighteenth centuries AD: Orquera et al. 1978; Orquera and Piana 1995, 1999b) or Túnel VII site (nineteenth century AD: Estévez and Vila 1995) are very similar to the early assemblages in their tool and faunal composition.

Over a period of 6000 years, the archaeological tool-kits and settlement patterns known were kept simple. In addition, dwellings, clothing, and social organization described by nineteenth century European observers were scantily elaborated. This does not mean that cultural behaviors were "primitive", as was stated in the nineteenth century, but that their relation with the environment was sustainable enough and no external or internal pressures forced them to modify it. Under such circumstances, more complex modalities would have been economically self-defeating, increasing the costs without producing benefits.

As mentioned previously, the highly oceanic environment (Tuhkanen 1992) reduces the ranges of variation and allows the great majority of flora and fauna to have an even distribution in time and space. There were no massive migrations of animals, no extreme abundances of food (except when whales or sardines are stranded), and no long-term scarcity. Winter and the start of spring are usually periods of scarcer resources (Speth 1990), but this does not appear to have been the case in the Beagle Channel-Cape

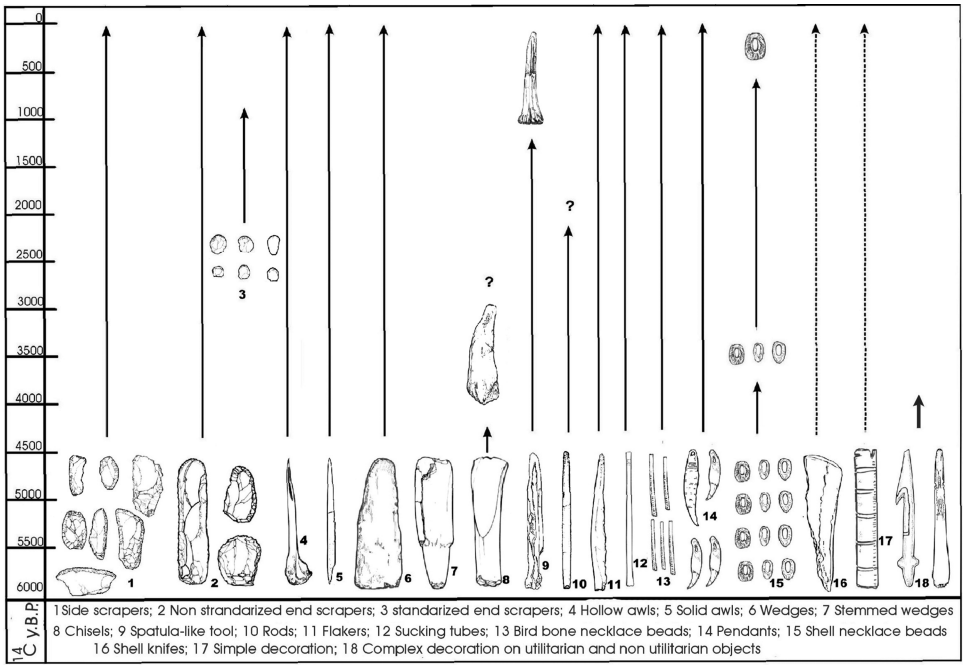


Figure 8. *Processing tool-kit and ornaments: Perdurations and changes.*

Horn region. In the summer, there was a greater diversity of resources (e.g., migratory birds and fish, eggs, berries), but in winter the species of a higher nourishment rank (pinnipeds and guanacos) were obtained, and shellfish were available all year round (Orquera 2005). In such circumstances, people reduced procurement costs and achieved the best yields with the greatest sustainability by dispersing in small and very mobile groups that traveled frequently (not necessarily at great distances). Each time yields declined in the immediate surroundings of a camp, it was more convenient to move to a less exploited patch than to intensify their exploitation (Bettinger 2001; Smith 1983; Winterhalder 1981).

The risks of not finding supplies for several days or at short distances along the coast were low, so little or no effort to store food was justified. No such evidence appears in the archaeological record, and the ethnographic data only mention that small-scale storage was done to take advantage of cetacean strandings. This explains why the *Yámana* or Yaghan—the recent inhabitants of the Beagle Channel—constituted an exception, as Binford (1980:16) noted, to the correlation between lower values of "effective temperature" and increased storage activities (the *Yámana* case, however, confirms the link that Binford established in that paper between foraging strategies and little differentiated environments). The trade of goods or services to compensate for environmental deficiencies in the surroundings was not necessary beyond (perhaps) the sharing of food between relatives and neighbors or the importation of some specific goods that were sparse or nonexistent in the region (a European observer [Bridges 1883] pointed out that this was the case for pyrite to light fires). There were no great opportunities or reasons to control access to resources, accumulate individual wealth (giving occasion for social inequalities), or recognize leadership beyond personal prestige to coordinate collective tasks. All of this would raise subsistence costs without any perceivable benefits.

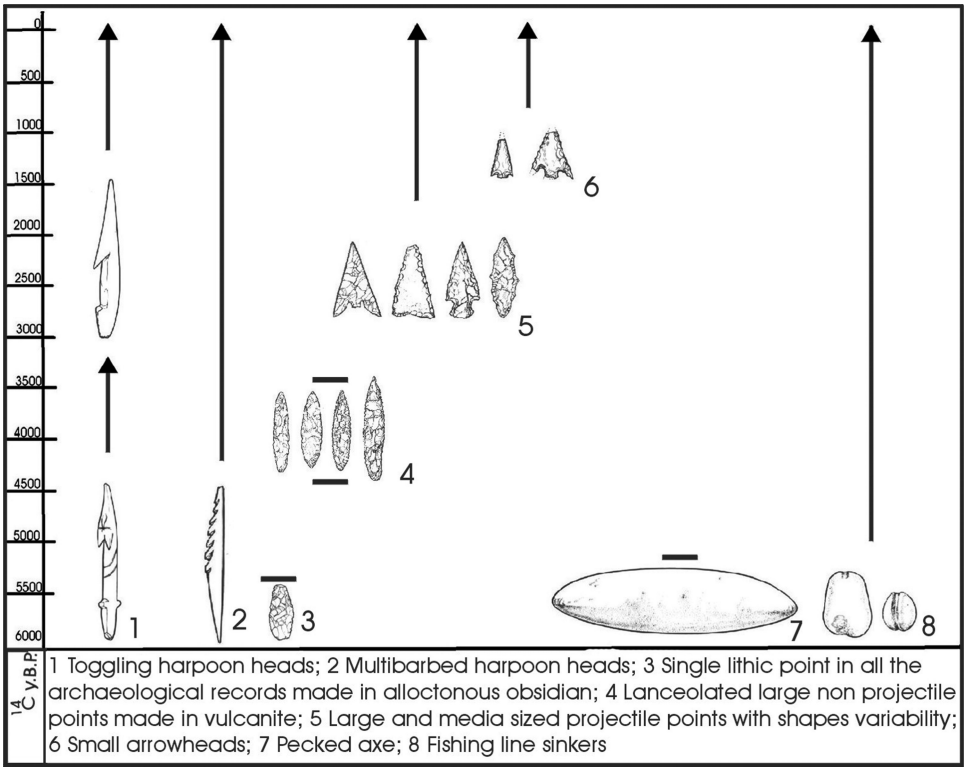


Figure 9. *Capture implements and smoothed-pecked tools: Perdurations and changes.*

Notwithstanding their relative simplicity, the subsistence strategies and economy of peoples in the region can be considered successful. This is suggested not only by the quantity of food remains found in archaeological sites we have examined—which provides a very different image to that popularized by Darwin (1839)—and the long stability of the system. It is also demonstrated by the fact that human remains studied by Pérez-Pérez (1996:figure 6) show only low to moderate rates of malnutrition, less than that recorded in other hunter-gatherer peoples such as the Bushmen (a case of a supposed *affluent original* society: see Sahlins 1972).

This way of life was referred to by Bettinger (2001; Bettinger and Baumhoff 1982) as a "traveler" and "time minimizing" foraging strategy. We agree that in the seventh or sixth millennium BP this was the most appropriate strategy for the environmental conditions in the region. However, why did it last until the nineteenth century AD, when much earlier other hunter-gatherers in the world saw themselves forced to adopt "processor", "energy-maximizing" (Bettinger) or "logistically organized" (Binford 1980) strategies, or had changed to "complex" littoral groups (Bailey and Milner 2002–2003)? It is likely that the answer involves several factors (Orquera 2005). First, there were no substantial changes, either in the terrestrial environment (Heusser 1989, 1998) or in sea surface temperatures (Obelic et al. 1998), where people were harvesting most of their food. Second, neighbors were constrained by the Andean barrier or had no interest in radically changing their tool-kits and lifeways to expand into an ecological niche that was very different to their own. Third, the actions of Fuegian littoral groups did not

jeopardize the renewal and abundance of resources. Although this state may not have been intentionally sought, it does appear to have led to long-term sustainability.

In the case of *Arctocephalus australis*, at TISC, 86% were male and, of these, only 31% had reached a reproductive age. No specimens (male or female) less than five months old have been found (Schiavini 1993). This indicates that hunting was not carried out in breeding colonies. In the Beagle Channel there are no good locations for large rookeries; in any case, had they been established here, human predation focused on pinnipeds born and fed only in the Beagle Channel would have destroyed such a population in a few years (Schiavini 1990). Currently, *A. australis* establish their breeding colonies in places such as the exterior arch of the islands and Staten Island (Schiavini 1990; Sielfeld 1983). Most of the adult animals are concentrated on these islands during the summer. When this season ends, females with offspring remain close by, but the geographical range of males is greater and they venture to places typically not reached by adult females. One of these locations was the Beagle Channel. Native peoples here received a continually renewed influx of *A. australis*, primarily composed by juvenile males (Figure 10). Given the polygamic habits of these pinnipeds, killing males did not provoke the overexploitation risks that would have derived from an intensive hunting of females (which entailed the death of suckling-offspring and the interruption of pregnancies).

In sum, if the human-pinniped relationship could be maintained for more than six millennia without provoking an irreversible crisis, it was because people profited locally from the biotic energy flux generated by the very productive waters that surround the southern end of South America and because the rookeries were out of hunting range. The intense pressure exerted over this resource happened in a "marginal" sector of the general ecosystem and did not endanger its survival (Schiavini 1990, 1993). This mechanism is different from that proposed by Lyman (2003), but the result was similar: the higher-value prey was not depressed by human populations.

Since cetaceans also feed and breed outside the region, a similar harvesting from "imported" energy occurred. Guanacos spend most of the year and breed in a mountainous environment where the Beagle natives did not penetrate. Mussels live from the intertidal up to 15 meters deep, and even deeper; at such profundity they could recover from the partial depletion generated by human harvesting (which took place in the intertidal or less than two meters deep: see Orquera and Piana 1999b:117).

Of course, Fuegian natives were neither conservationists nor did they live in a "Garden of Eden." Undoubtedly they must have faced environmental pressures and stressful periods, but such difficulties would not have been irreversible. The relatively mild prior conditions would have returned after some time, and the stress would have decreased. This means that basic needs could still be satisfied with low levels of efficiency and integration. Diachronic modifications in the tool-kit may have been more directed to the maintenance of the system than to its improvement or change.

Nevertheless, the system was dangerous because it was overly simple. It depended entirely on these conditions remaining static. It did not foresee alternatives or feedback mechanisms to cope with strong resource stress situations. These were introduced by the end of the nineteenth century AD, not by internal causes, but as a byproduct of European and American commercial exploitation. In a few years, they destroyed the pinniped populations of southern waters, indiscriminately attacking males, females and offspring in breeding colonies. The Fuegian canoe-people almost immediately found themselves without their main source of food and were forced to survive with less nourishing and scarcer resources. Simultaneously, several infectious diseases for which they had no immunity ravaged populations (see Orquera 2002). As a result, they nearly became extinct, with only a handful of survivors left after 20 years.

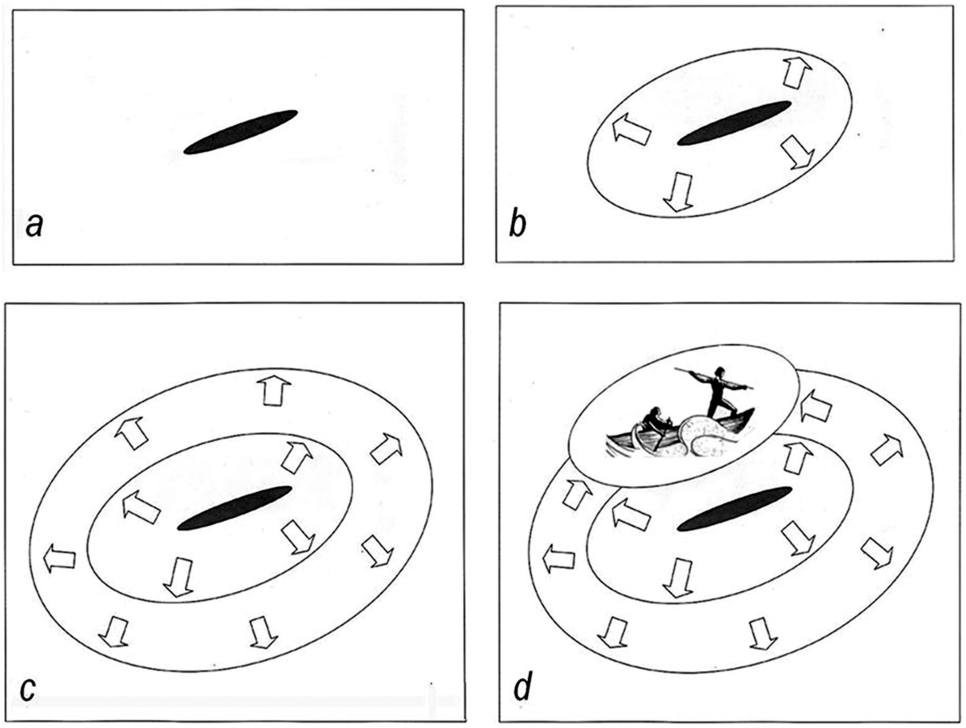


Figure 10. *Schematic representation of the relationship between pinniped and human foraging areas: a) location of breeding summer colonies; b) area through which females progressively expand, restrained by the care of their offspring; c) area covered by male individuals; d) since in the Beagle Channel-Cap Horn region human predation was restricted only to part of the pinniped feeding areas, a very high proportion of male individuals were consequently captured, as mentioned in the text.*

CONCLUSION

By the end of the nineteenth century and during the first half of the twentieth century, it was usually thought that the littoral peoples inhabiting Tierra del Fuego and the southern shore of Chile were stagnated in the initial stages of cultural development, or at most were living at a stage similar to that of the first inhabitants of America (e.g., Gusinde 1937; Lubbock 1865). Estimations of these people's antiquity were few and speculative (Orquera and Piana 1996).

In the last few decades, archaeology has added a verifiable history of more than six millennia in which the material culture changes do not seem to have been substantial. Nevertheless, archaeology also provides a foundation to develop different interpretations than the one mentioned above. Although people from South America's Southwestern Littoral Area used simple tools and behaviors, these were efficient for their particular environment, and apparently they were not pressured to adopt more complex solutions. The lack of substantial changes during such a long period is unusual in recent human history, but the explanation proposed here may be useful to better understand the variety of paths taken by humans in our relationship with the environment.

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END NOTES

1. *Science and Technology Secretary (Argentina): Resolution 994/1980. National Geographic Society: grants 2394/1981, 2735/1983, 2969/1984 and 3190/1985. CONICET (Argentina): PID 9020 (1986–1989); PID 30045 (1989–1991); PID 351 (1992–1994); PIP 4302 (1997–1999); PIP 2769 (2001–2004); PIP 6186 (2005–2007). National Parks of Argentina: Project 2004–2005.*
2. *Agreement CONICET (Argentina)-CSIC (Spain)*: PID 1143 (1987–1990). *European Union*: Project CI1*-CT93–0015 (1994–1997).
3. These two dates and the one for bed S at the Imiwaia I site are published for the first time here in this paper.
4. Mussels quickly grow during the first three or four years of their lifetime (Silva 1996) and individuals of different ages live together in a same colony. Even if humans would have exploited a mussel bed, *absolutely* eliminating *all* the individuals of profitable size (for the sake of argument, those which measure more than 30 mm), there would still remain a large quantity of smaller specimens which are not attractive for collectors because of their size. However, in a year or less, a high proportion of those individuals would have already reached an adequate size for human consumption. In the same sense, see Whittaker 2008.
5. One reviewer inquired whether there are specific data about rights to exclusive exploitation of stranded cetaceans in the Fuegian region, as those found in Northeast United States. There are no archaeological signs that support or deny this possibility, but there is abundant information from the nineteenth century that each stranding was announced by specific smoke-signals and generated intense sharing of meat and grease among non-related families, some of whom traveled up to 60 km (Orquera and Piana 1999b; Piana 2005).
6. Not all the bone beds found inside the Beagle Region shell middens represent palimpsests, because our excavation technique (Orquera and Piana 1992) can reasonably link them with very punctual accumulation events.

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