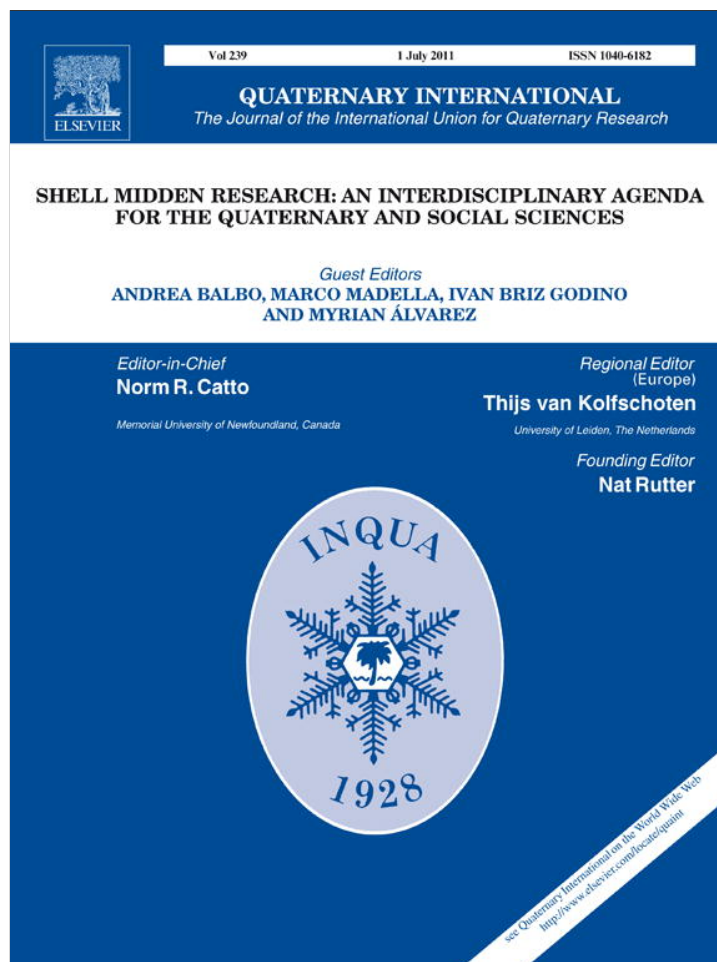


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## Littoral adaptation at the southern end of South America

Luis Abel Orquera<sup>a,\*</sup>, Dominique Legoupil<sup>b</sup>, Ernesto L. Piana<sup>c</sup><sup>a</sup>Asociación de Investigaciones Antropológicas, Bartolomé Mitre 1131, Floor 7°, Dept. "G", 1036 Buenos Aires City, Argentina<sup>b</sup>UMR 7041, Centre National de Recherche Scientifique, France<sup>c</sup>CONICET, Centro Austral de Investigaciones Científicas, B. Houssay 200, Ushuaia, Argentina

## ARTICLE INFO

## Article history:

Available online 3 March 2011

## ABSTRACT

The southwestern fringe of Patagonia and the Fuegian Archipelago constitute an area characterised by a very irregular coast and dense forests. From 6400 BP to the nineteenth century AD, a human adaptation intensively oriented to the exploitation of littoral and maritime resources developed there. This specialization is perceived in subsistence and technology. Nevertheless, in spite of the challenging climate, the material toolkit and social organization were very simple, a feature that frequently puzzled the European voyagers. Archaeological research shows that there were changes along time as well as geographical variations, but the dominant impression is of a homogeneous, durable and stable system. Given the peculiar environmental conditions, dominated by a highly oceanic climate, the mentioned instrumental and social simplicity was the preferable human behaviour.

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## 1. Introduction

The southern portion of South America, Patagonia, is divided into two clearly different areas by the Andes Cordillera, which generally trends north–south, extending eastward in Isla Grande de Tierra del Fuego. Towards the east and the north are plateaus and lowlands with grassland vegetation. Towards the west and the south, a narrow, rainy and densely forested strip with a strong slope ends in an irregular coast, next to numerous islands and archipelagos. This geographical distinction also influenced human population distribution. Towards the east and north of the mountains, guanaco terrestrial hunter-gatherers established their territory; towards the west and south were the canoe hunter-gatherer-fishers, strongly dependent on littoral resources. The latter constituted an interesting example of maritime shores foraging, and will be the topic of this article.

The ethnographic sources refer to these hunter-gatherer-fishers with names such as yámanas or yaghanes, alacalufes and chonos. To the European observers, the exoticism of living in such distant lands was increased with the surprise of seeing them facing strong climatic conditions with very scarce material equipment. They were almost naked notwithstanding the cold weather, they had no complex social organization above the family ties, and they seemed not to have any religion. It should not be surprising that Darwin (1839) described them in an unfavourable manner, and that until

the 20th century his followers considered the Fuegian inhabitants as living fossils, stagnated in primitive levels of human evolution.

Ethnographic information was abundant (Hyades and Deniker, 1891; Gusinde, 1937; Empeaire, 1955; Gusinde, 1974). However, the gathering of archaeological data was delayed for some time. Pioneer works were those of Bird (1938) on Navarino Island and Empeaire and Laming (1961) on Englefield Island. Research was not systematic until 1975, when a project, still ongoing, started on the Argentinean shore of the Beagle Channel (Orquera and Piana, 1999, 2009). A little later, Legoupil (1989, 1997, 2003) started similar research along Otway Sound and other places in Chile. Other initiatives include those by Ortiz Troncoso (1979), and Ocampo and Rivas (2000, 2004), also in Chile.

This paper will try to offer a state of the art of shell midden archaeology and the maritime coasts exploitation in Southern South America. Due to space limitations, several topics will be directly quoted from other publications.

This paper will focus on the area between Chiloé, at approximately 42°S, and Cape Horn, at 56°S (Fig. 1). The weather is cold; rain and snowfalls can vary between 550 and 7000 mm annually. Nevertheless, given the influence of the adjacent surfaces of Pacific and Atlantic Oceans, temperature variations have little magnitude, and woods and coastal fauna have a continuous and quite uniform distribution. Small micro-environmental variations made it easier or more advantageous to exploit some resources more intensively than others, but without hindering the procurement of nearly all of them. Along all seashores or at short distances it was possible to find pinnipeds, marine birds, fish, mussels, fresh water, wood, bark,

\* Corresponding author.

E-mail address: [laorquera@gmail.com](mailto:laorquera@gmail.com) (L.A. Orquera).

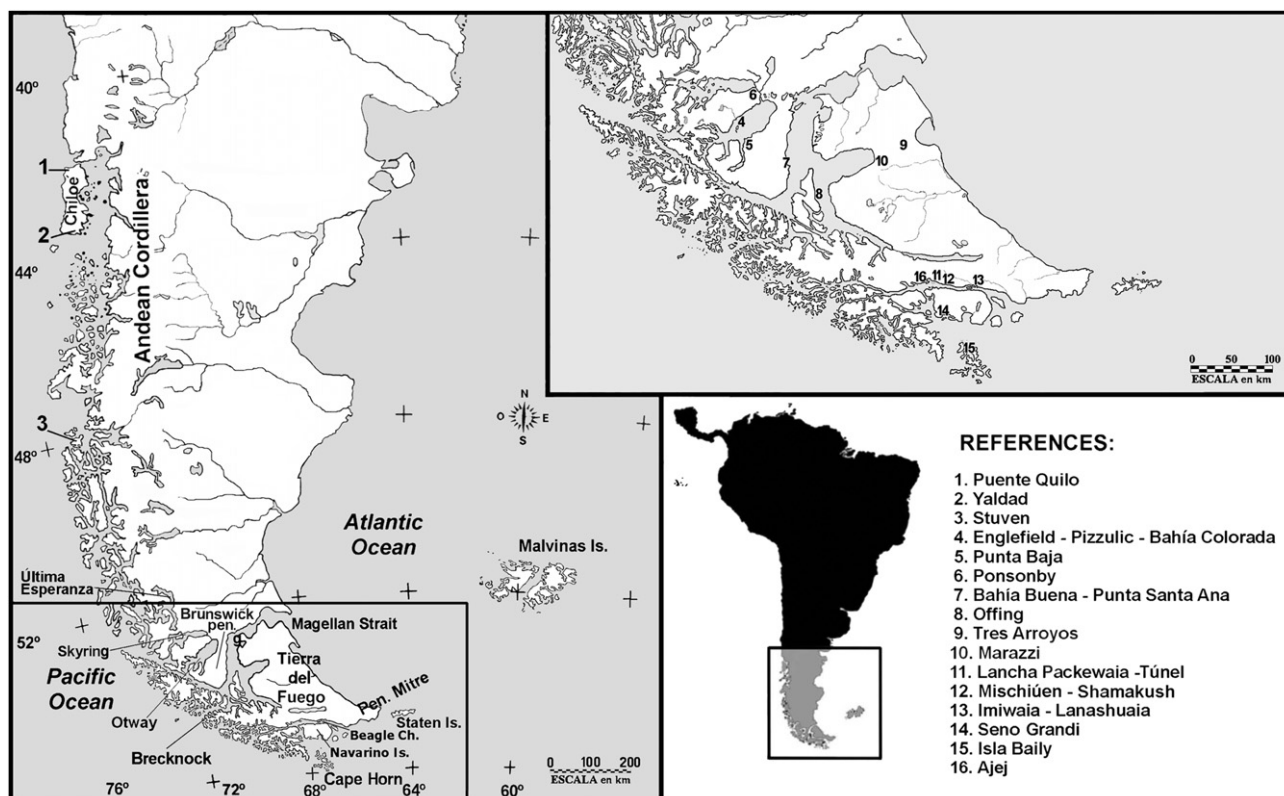


Fig. 1. Geographical location of the main sites mentioned in the text.

lithic raw materials to knap tools, and, eventually, stranded cetaceans; the encounter rates might be variable, but all these resources were always abundant. The only exception was the guanacos, restricted to part of the northern shore of the Beagle Channel and Navarino Island.

Due to its geographical location, after the last deglaciation the Tierra del Fuego climate was largely influenced by the surrounding vast ocean waters. Isotopic analyses of the  $^{16}\text{O}/^{18}\text{O}$  content of archaeological *Mytilus* shell samples indicate that the average annual temperature of the sea surface varied less than  $1^\circ\text{C}$ , except during the Medieval Climatic Anomaly and the Little Ice Age, when it reached  $2^\circ\text{C}$  (Obelic et al., 1998). Palynology confirms that during the last six thousand years the conditions of the vegetation did not differ significantly from the current ones (Heusser, 1984, 1990; references in Orquera, 2005).

Notwithstanding the previous data, it is possible to differentiate regions where the native peopling acquired a certain individuality – the Beagle Channel region, the Otway and Skyring Sounds plus the eastern portion of Brunswick Peninsula (central portion of Magellan Strait), and Chiloé Island and its surroundings. However, both ethnographic and archaeological data indicate that the intermediate spaces were also populated.

All the cited radiocarbon dates in this paper are non-calibrated and, unless specified, obtained from charcoal samples.

## 2. Shell middens

The most conspicuous archaeological features of the area are the shell middens. This is related to the intense consumption of littoral resources carried out by native people. Their importance for archaeology is well known. First of all, their great contents of  $\text{CaCO}_3$  provide a medium with neutral or basic pH (along the Beagle Channel: between 7 and 7.3; Orquera and Piana, 2000). This allows

for the conservation of objects which usually decay, and even for the self-conservation of the shell middens. Secondly, consumption of relatively small quantities of shellfish produces voluminous shell accumulations. If the site occupations are long or repeated, this generates a very high speed of accumulation in shell middens, which in turn can produce finer chronological differentiations than in other types of sediment. Nevertheless, shell middens are often difficult to excavate due to their extremely complex stratigraphy.

### 2.1. Southern region

The composition of shell middens in the Beagle Channel region was analysed in 167 samples taken in columns or via random selection in seven different sites (Orquera and Piana, 2000, 2001). Volume measures indicate a predominance of shells between 40 and 58%, 33–63% of fine sediments (earth carried by the wind or powder produced by shell decomposition), between 1 and 15% small pebbles (many of which might have reached the sites attached to the mussels' byssus), up to 8% charcoal and small proportions of bones and knapping debris. Out of the total number of shells, between 83 and 99.4% are mussels (*Mytilus* sp., *Aulacomya* sp. and *Perumytilus* sp.) and 0.4–7.7% are limpets (*Nacella* sp. and *Fissurella* sp.). It has been possible to distinguish between the collection of shells in bunches (in rocky intertidal zones) and the selection of individual specimens (on muddier beaches).

Many shell middens have a dome shape, but in this region they frequently were formed surrounding huts and therefore had an annular shape. The depressed centre, 3–4 m diameter, shows the place where the hut had been placed (Fig. 2). They usually reach a 1 m or less in height, but there are thinner lenses. On the slopes, they are sometimes affected by overflows (Orquera and Piana 2009). Near Cape Horn, there are shell middens which are more than 1 m high (Baily 1: Fig. 3a; Legoupil, 1995).



Fig. 2. Excavation of an annular shell midden: the Imiwaia I site.

Along the Beagle Channel shores, the shell middens appear practically everywhere in any place reachable by canoes, no matter how small. In the Argentinean portion of the shore, more than 500 sites along almost 200 km of coast have been recorded (Piana and Orquera, 2010); in a 48 km long stretch of coast the density of sites rise to 4.6 sites/km. Most of the sites are between a few meters and 300 m from the shore (Barceló et al., 2002) and between 2 and 20 m above sea level. In northern Navarino Island, the panorama is similar (Ocampo and Rivas, 2004). Many sites consist of isolated middens, but more frequently they are grouped in clusters that may cover up to 1 ha. These clusters do not represent villages and rarely imply simultaneous occupations (e.g. when a whale beached on shore) – the aggregation of many people would have rapidly depleted neighbouring mussel's banks and other resources. When stratigraphic relationships between two adjacent middens could be

observed, successive overlaps of different layers were found, indicating their alternative formation and precluding simultaneity.

It is likely that the first occupation of a locality occurred randomly over the land surface. Nevertheless, soon some of these different localizations started to be preferentially re-occupied. This accelerated the growth of the surrounding midden, which in turn increased the appeal of that special place for new re-occupation. Various factors were behind this process:

- 1) according to ethnographic data, each hut was occupied for few days but it was not dismantled when left – they were left behind for re-use in a following occasion, for which only with minor repairs would be needed (Hyades and Deniker, 1891; Gusinde, 1937, 1974; for the western shore: Emperaire, 1955), and this practice might have happened also in previous times.

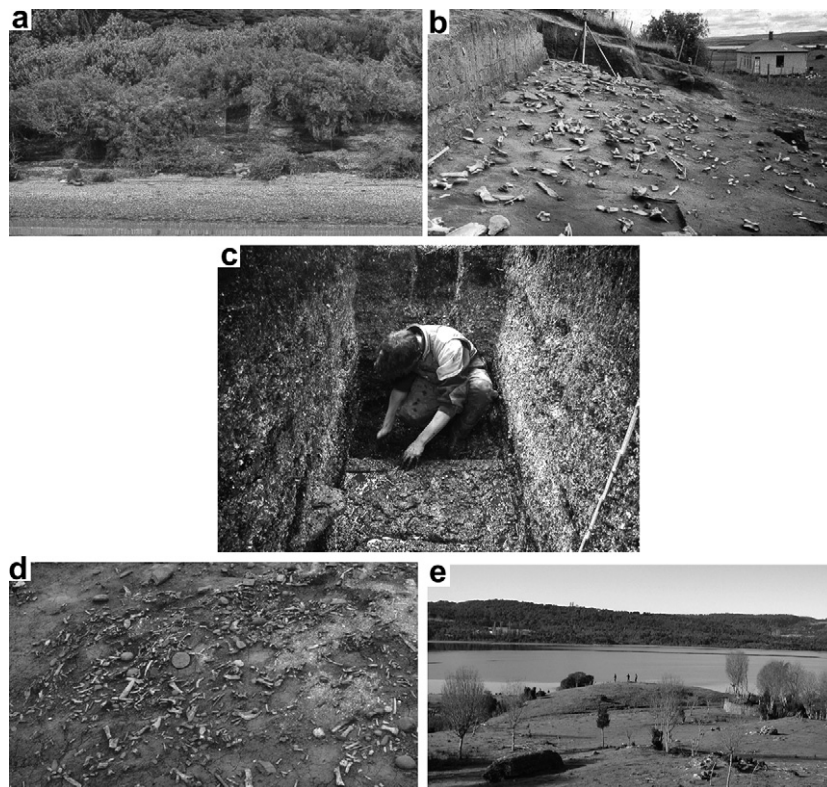


Fig. 3. Western Region sites: a: Baily 1; b: Ponsonby; c: Stuvén; d: Bahía Colorada; e: Chiloé.

Modern replicas of native huts indicate that they could be used for four or more years. As a consequence, debris pursued being built up on the same place;

- 2) the initial construction of a hut would have provided protection against the wind and would have favoured the maintenance of hearths lit inside it. Subsequently, the surrounding accumulation of shells and other debris increased such protection and reduced the penetration of water from rain or molten snow. Therefore, places where there already existed this protection were preferred for re-occupation. Nevertheless, shell middens growth ended up imposing limits on site re-occupations. As the hut could not be indefinitely enlarged without provoking tension on its branch structure, if the same site is re-occupied, a new hut had to be erected nearby, around which new shell accumulations started to grow (Piana and Orquera, 2010).

In the shell middens, layers and internal lenses usually have little extent, often plunge more or less abruptly and show multiple intricate overlaps. Such complexity makes excavation difficult, since the traditional methods risk mixing layers of very different chronologies. To overcome this problem, a new excavation method has been developed. The shells left by an occupation episode are reordered by the wind and the rain, becoming interlocked, and often covered by very thin earth layers. An abandoned shell midden is totally covered by grass in a very few years, but even in less time shells and other remains of new occupations are no longer mixed with those of previous ones (unless trampling or other kinds of site disturbance occur). This sedimentological process generates internal discordances of lower resistance to the trowel or spatula, which can be felt with the hand when the excavation tool is handled properly (Orquera and Piana, 1992). This method was experimented between 1984 and 1986, and applied ever since in the Beagle Channel excavations. It works very well in shell middens with numerous mytilidae, since their shells are flat; in some sites it has been possible to distinguish hundreds of different sedimentation episodes and to thus reconstruct with precision the real site formation sequence. Nevertheless, it is not certain that the method will work well in shell middens where molluscs of sub-spherical shape predominate.

## 2.2. Central and western region

In the central portion of the Magellan Strait and along the shores of the Otway and Skyring Seas the settlement was more scattered and apparently less dense. Along some 100 km of the eastern shore of the Brunswick Peninsula, only around twenty sites have been recorded (San Román and Morello, personal communication). However, many sites might have been lost as a result of the construction of an old coastal road. In Otway Sound, surveys carried out by Emperaire and Laming, Ortiz Troncoso, Johnson, Legoupil and San Román only recorded 25 sites along more than 200 km of shore, including those of Englefield Island (Fig. 1). In Skyring Sound, more systematically explored, around sixty sites have been recorded, most of which are ephemeral (Legoupil, 2000). The total site density is about 0.2/km of shore, much less than in the Beagle Channel shores.

These sites do not extend over all the available coastal space in this ecotone between the steppe and the archipelagos. The coasts are not very rocky, except towards the south and the west; maritime terraces, with very open spaces, border long beaches with cobbles and sometimes sand. Thus, topography is less restrictive for the selection of camping locations and their greater dispersion provoked less re-use of sites than along the Beagle Channel. Thus, shell middens usually do not exceed 50–60 cm height and are not as visible as the annular middens of the Beagle or the great middens of Chiloé.

Moreover, not all dwelling sites of this region include shell middens. In Ponsonby (Fig. 3b), both maritime and terrestrial species were exploited but shellfish are practically absent. In Bahía Colorada (Fig. 3d), mollusks represent a very marginal resource in spite of the fact that the economy was exclusively maritime. It is possible that in this site as in all surficial places long time exposed to environmental agents and due to a low natural or anthropic sedimentation, there may have been a greater shell disintegration than in other sites. In any case, the low salinity rate of the interior seas and the natural substrate (made of gravel or sand) along the Magellan Strait shores do not favor the development of mytilidae and limpets colonies. This might explain the limited role of shellfish in human diet at these locations, in comparison to those of other parts of the archipelago.

Farther, in the western section of the Magellan Strait and the western archipelagos, sites are scarcer, of low visibility and rarely dating to before 2000 BP. The region is not well known: the impenetrable vegetation (favored by the great magnitude of rain) probably masks the sites. The shores, frequently rocky, offer few terraces which are favorable for human settlement. Often, the huts were set in the border of the Magellan forest, which made them invisible to the sailors' eyes. Nevertheless, the few known sites known in Carlos III and Wellington islands (Curry, 1991; San Román, personal communication) and Stuken Island (Legoupil, 2005) are true shell middens, in the last two cases more than 1 m thick (Fig. 3c).

Finally, the biggest shell middens of the area are undoubtedly on Chiloé Island (Fig. 3e). They form visible mounds across the landscape, up to 2 or 3 m in height and more than 50 m in diameter, similar to other shell midden sites in the Puerto Montt region.

## 3. Beginnings of the maritime adaptation

Both central Chile and continental Patagonia were peopled by terrestrial hunter-gatherers around 12,000 years BP or earlier (see synthesis in Borrero, 2008). By then, the Magellan Strait was not entirely open and it was possible to walk from the continent to the current Isla Grande de Tierra del Fuego. Here, evidence of human presence from the 11th millennium BP has been found (Laming-Emperaire et al., 1972; Orquera and Piana, 1999; Massone, 2004; Orquera and Piana, 2009). Some of these sites were close or adjacent to maritime coasts but not associated with shell middens, and the use of littoral resources was not intensive there. Where zooarchaeological remains are preserved, guanaco seems to have been the staple. In the cases where no dietary remains were found, the toolkit shows either links to the terrestrial hunters from the hinterland, or attributes not found in the later occupations with a specialised littoral way of life.

In the Beagle Channel region, a noticeable change happened towards 6400 BP: the adoption of a way of life intimately linked to the exploitation of littoral resources (Orquera and Piana, 1999, 2009). Punta Santa Ana, on the Magellan Strait shores, has been recently dated to 6330 ± 50 BP (San Román, 2010). Along Otway Sound, the Englefield and Pizzulic 2 sites are older than 6000 BP (Legoupil, 1988; San Román, 2005). Several other sites have dates older than 5000 BP (Ortiz Troncoso, 1979; Legoupil, 1997; Orquera and Piana, 1999; Table IX; Ocampo and Rivas, 2000). The excavated assemblages indicate an already well-developed adaptation towards the intensive use of littoral resources, including specific technology for such exploitation. If there had been an experimentation stage, it must have been previously, but so far no traces of it have been found.

It is unlikely that, if previous sites attributable to this adaptive tradition had existed, they have been covered by the post-Pleistocene sea rise. In other areas this undoubtedly happened, but during

the Holocene southern Patagonia and Tierra del Fuego underwent isostatic-tectonic uplift. This event paralleled the sea rise before 5500 BP and continued afterwards (in parts of the Beagle Channel, the rise reached 9–10 m in the last 5500 years: Rabassa et al., 2003). As the shores of this area generally have abrupt slopes, huts would be frequently located some meters above sea level. Any site at such an altitude would not have been reached by the sea level rise. During its first occupation, Túnel I would have been about 10 m a.s.l., 5500 years ago the marine transgression would have left it around 6 m a.s.l., and the later uplift has taken it to 14 m a.s.l. Something similar may have happened to Englefield.

Towards the north, in Chiloé, Yaldad 2 was dated  $5950 \pm 80$  BP (Legoupil, 2005), through shell analysis without Reservoir Effect correction. Other nearby sites are earlier than 5000 BP, but evidence of resource exploitation is not clear enough yet (Orquera and Piana, 2005). According to Legoupil (2005), the first inhabitants of Yaldad 2 could have been more gatherers of shellfish than marine hunters. Indirect indicators (presence of ear osteoma in human skulls due to diving) in the lower level of Puente Quilo ( $5030 \pm 170$  BP, Ocampo and Rivas, 2004) might infer a greater engagement with the littoral way of life.

The earliest shell midden dates and specific economic, technological and behavioral adaptation to littoral life have so far been obtained in the Beagle Channel Region. Nevertheless, the issue about where the adaptation really started is still open to discussion (Orquera and Piana, 2005). According to Legoupil and Fontugne (1997), this way of life could have started on the shores of the Magellan Strait-inner seas or in the Beagle Channel, because both were more open and less rainy littoral environments than the archipelagos and were close to terrestrial territories. Nevertheless, they do not preclude the possibility that the first human groups might have reached the southernmost lands from Chiloé or its surroundings, developing in the southern zone this new adaptation model. From there, groups with great mobility could have spread it much later to other places in the archipelagos' exterior fringe.

Orquera and Piana (1999, 2005, 2009) estimate that the Beagle Channel alternative is less likely. In spite of the fact that the most ancient manifestations of a littoral adaptation in both regions were roughly coetaneous (the radiocarbon uncertainties overlap partially), in order for a littoral adaptation to develop it was necessary to have forests with tall trees which could provide wood and bark for the canoes and harpoon hafts, and in the Beagle Channel region this did not happen until after 6700 BP (C. Heusser, report in Orquera and Piana, 1999). Moreover, the tool differences between the first manifestations of littoral adaptation in the Beagle Channel shores and their predecessors, apparently terrestrial hunter-gatherers of lower F bed of Túnel I and S layer of Imiwaia I (Orquera and Piana, 1999 and unpublished data), are too large to be a product of a local transformation process of less than three hundred years, and therefore they suggest population replacement. Instead, near the Magellan Strait and the Otway Sound, the transit to and from the interior was easy, and recolonization by the forests happened before 7980 BP (Heusser, 1984). Finally, although in recent times there were great differences in stature and body postures between the terrestrial hunter-gatherers and the canoe people, the cranium-facial features indicate a very close kinship (Cocilovo and Di Rienzo, 1984–1985) and the data can be interpreted as showing a population divide in southern Patagonia.

According to Ocampo and Rivas (2004), the different modes of development between the north and the south of the area suggest independent origins: one in Chiloé and its surroundings, and another in the more southern regions. Orquera and Piana (2006) include another possible interpretation: that Chiloé may have been effectively first populated by people from central Chile that used the local resources opportunistically, but that they were later

displaced or absorbed by southern groups, well adapted to littoral life.

Not every maritime resource consumption entails “adaptation” to littoral life or a specialization in this type of subsistence, since this can happen opportunistically within generalized economies. For example, on the Patagonian and Fuegian Atlantic coast, maritime resources were consumed but no special tools or strategies were created for this purpose. In the southern and western littoral, instead, the adaptation had two key technological innovations: harpoons with detachable points and canoes. The former were less efficient on land, but very adequate to capture pinnipeds in an aquatic medium (Orquera and Piana, 1999: 106–108). Canoes contributed to the latter process, but also facilitated general mobility and other ends. These innovations produced evident advantages: 1) they provided predictability and reliability of pinniped capture, which produced large numbers of prey that provided humans many more calories than those derived from terrestrial herbivores; 2) they allowed people the access to the rich sea and islands resources, which were out of the reach of terrestrial hunter-gatherers. Already before 6000 BP, both implements were in use: there are direct and indirect archaeological proofs of the utilization of detachable harpoons, while there are only indirect but convincing proofs of the possession of canoes (Orquera and Piana, 1999, 2009).

Independently of the geographic origin where these transformation and technological innovations had begun, the initial expansion of the new mode of life along the southwestern South American shores would have been very fast. In principle, this would be suggested by the small chronological difference among the earliest sites, in spite of their being separated by hundreds of kilometers. Besides, there are theoretical reasons that likely resulted in a fast demographic increase: 1) the speed of such growth is high when an unoccupied area is peopled for the first time and its carrying capacity limits are clearly beyond the group's needs; 2) maritime nourishment and transport offer possibilities which diminish the lapse between births with successful survival, making it shorter than usual among terrestrial hunter-gatherers (Orquera and Piana, 2006).

As a consequence, the most favorable places for human settlement would have been soon occupied or visited in a constant manner. From there, the growing human population would have expanded to less favorable places. Based on those theoretical reasons, Orquera and Piana (2006) think that such marginal expansion must have occurred early. Legoupil (1995, 2005) instead, stresses the almost non-existence of concrete data prior to the Christian era in zones like Cape Horn, Staten Island, and the exterior islands of the Western Archipelago.

#### 4. Peopling sequence on the western shore

The first early maritime site in Patagonia recognized was Englefield (Empereire and Laming, 1961). Later discoveries confirmed the existence of a maritime adaptation during middle Holocene: in the Magellan Strait, Bahía Buena and Punta Santa Ana (Ortiz Troncoso, 1979); in Otway Sound, Bahía Colorada (Legoupil, 1997) and Pizzulic 1 and 2 (San Román, 2005). All these ancient sites are located over terraces between 10 and 16 m a.s.l. and, except for Bahía Colorada, they are shell middens. Their economy was based on pinniped and bird hunting, shellfish gathering and some fishing. In the two sites where diet has been studied in detail, Bahía Colorada (Legoupil, 1997) and Bahía Buena (San Román, 2004), it has been confirmed that adult *Arctocephalus australis* hunting provided most of the consumed calories. Regarding the bird fauna, cormorants represented more than 98% of the numerous remains in Bahía Colorada, Bahía Buena and Englefield, and 75% in Punta Santa Ana,

showing a much higher proportion than penguins (Lefèvre, 1989, 1997).

This assemblage, collectively named the “Englefield culture” (Legoupil, 1997), varies chronologically between approximately 6350 BP (Punta Santa Ana) and 5500 BP (Bahía Buena and Bahía Colorada). All these sites are characterized by a lithic industry produced on green obsidian, and a rich bone industry (Fig. 4: Early Period). The use of obsidian is a strong marker of Englefield culture in ancient times. The location of the quarry is not yet known, but it is very likely that it was south of Otway Sound (Stern, 2004). Archaeological sites are very rich, with more than 4000 remains of obsidian found in Bahía Colorada and more than 2000 in Englefield (Schidlowsky, 2001).

Sites along the Magellan Strait are poorer in this respect. Outside this zone, obsidian becomes scarce. However, it has been found at large distances, as in Fell cave, Cerro Castillo (Morello et al., 2004), on the Beagle shores and in Navarino Island, indicating long-scale exchanges. The industry was oriented towards knapping of flakes (used with natural or retouched edges), side scrapers and end scrapers, and also to the production, with the aid of soft percussion and pressure, of bifacial tools of very varied morphologies, sometimes with points but without stem. Nevertheless, the technical intention was visibly oriented towards the procurement of long knives, which in Englefield and Bahía Colorada make up the great majority of tools (Schidlowsky and Pigeot, 1997).

To manufacture bone tools, the ones of maritime mammals and birds were used, and, rarely, terrestrial mammals. The toolkit is made of single-barbed weapons (harpoons), multi-barbed weapons (spears) and beveled pieces (wedges or smoothers), of which the most characteristic are manufactured on pinniped ulnas. Harpoon points are sometimes decorated with geometric engravings and their cross-shaped base, symmetrical, is typical of this early period.

Terrestrial mammal bones were used to make scarce retouchers. Finally, bone industry on bird bone has little chronological meaning, since it consists of awls which have endured in the maritime sites of Patagonia until modern times.

Around four thousand years ago, a second range of tools appeared, characterized by large bifacial lithic points, very long and sometimes with dented borders (Fig. 2.: Middle Period) and by the almost total disappearance of obsidian. Ponsonby (layer B, dated between 4500 and 4100 BP) is separated from the continent by only a narrow channel. In spite of its insular context, the economy was mixed and the technological equipment shows both terrestrial and maritime features. Around ten sites with large points confirm the great diffusion of this cultural phase: along the Magellan Strait, over the eastern shore of Brunswick Peninsula (Rey Felipe, Km 44) and on Dawson Island (where a site on Offing Island is being excavated), also in Última Esperanza Sound, 300 km towards the north (Guzmán Island), and beside the Beagle Channel, 550 km or more to the south (Lancha Packewaia). This geographical distribution clearly reflects a nomadic and maritime way of life.

The bone industry of this phase is less rich and less standardized than in the early sites. The single-barbed harpoon points have very diverse sizes and shapes. The multiple-barbed harpoon points are always present but there is a new type of point, regrettably only represented by fragments: long bulky and circular shafts that might have constituted parts of spear heads. Tubes and tube-shaped beads made on bird bone frequently appear, engraved with transversal and spiral incisions.

Later, around the third millennium, there is a hiatus in the knowledge of this region. Numerous sites have been recorded, sometimes surveyed, but none of them have been excavated yet. Contrarily, for the late period, especially the post-Magellan times, there are archaeological data from Punta Baja, a site of the 17th

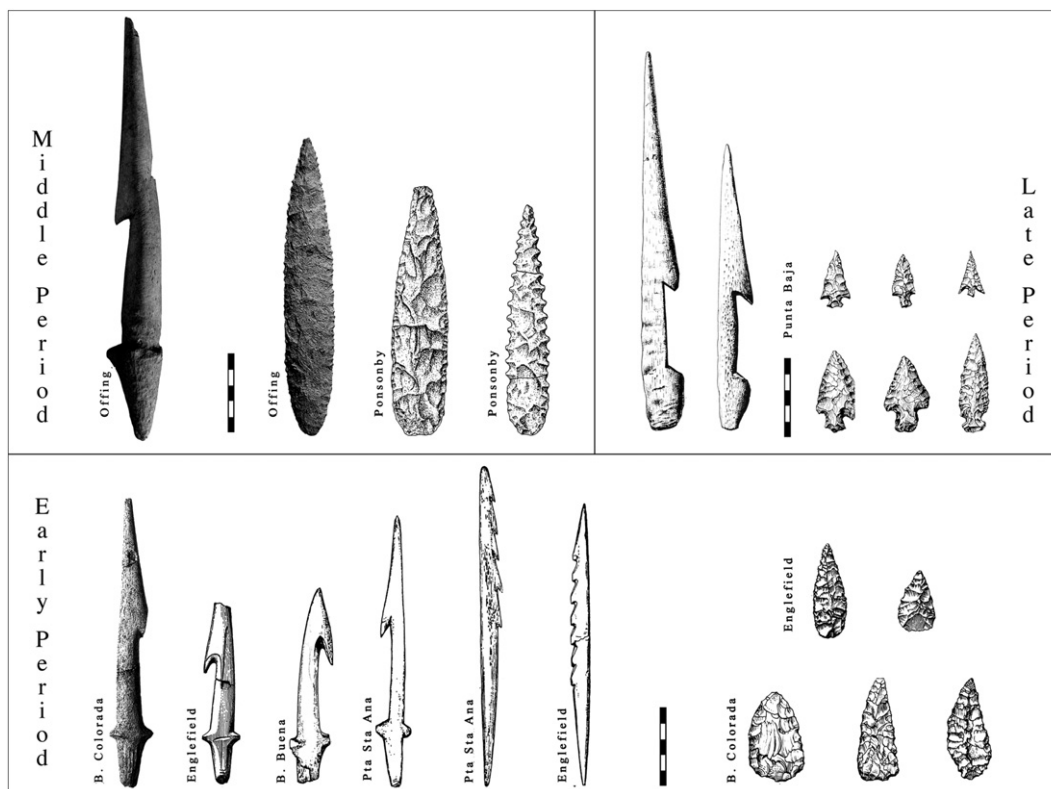


Fig. 4. Lithic and bone points of the different cultural phases of the inner seas and the Magellan Strait (drawings: Humbert in Emperaire and Laming, 1961; Ortiz Troncoso, 1979; R. Humbert and G. Tosello in Legoupil, 2003; G. Tosello in Legoupil, 1989, 1997). Scale in cm.

century A.D. excavated in Otway Sound (Legoupil, 1989) and much ethnohistoric information provided by sailors who crossed the Magellan Strait. The technological inventory and “know-how” of modern canoe people shows an astonishing continuity with early sites of the Otway and Skyring sounds and the Magellan Strait, which includes the production of two types of osseous projectile points, the preferential choice of tibiotarsi of a specific anatidae (*Tachyeres pteneres*) for making awls, the use of pressure technique in knapping bifacial points, and the reappearance of obsidian (Legoupil, 1992).

In Punta Baja, a seasonal site for young pinniped hunting during autumn, obsidian was used almost exclusively in the manufacture of bifacial points, chiefly stemmed (Fig. 4: Late Period). They are spread onto two morpho-metrical groups: on the one hand, objects that measure between 5 and 7 cm long and 3–13 g, possibly dart points or the short daggers described in ethnographic documents (Gusinde, 1974), on the other hand, pieces which are 2–3 cm long and 1–2 g, which probably were bow-thrown arrowheads. Nevertheless, the most common weapon in this late period was still harpoons, with one or two symmetrical teeth and a simple-tenon base. Numerous items of this class have been gathered by sailors, as well as multi-barbed spear points.

### 5. Peopling sequence at the Beagle Channel and surroundings

In this region, the most representative assemblages of the littoral adaptation initial times are the Second Component of Túnel I (6400–4300 BP) and the Second Component of Imiwaia I (6400–5800 BP: Orquera and Piana, 1999, 2009) (Fig. 5: Early Period). The first of these contains more than 1100 tools and almost 140,000 faunal remains collected in a 152 m<sup>2</sup> excavation. It is noticeable in both: a) a high proportion of bone tools (38% in Túnel I, 49% in Imiwaia I), which indicates the good preservation properties offered by shell middens but also points to the intention to use maritime mammal bones to carry out more diverse tasks than the possibilities offered by the land mammals and bird bones of neighboring areas; b) the scarcity of knapped lithic weapon points (only one in the Túnel I Second Component and none in the Imiwaia I Second Component); c) the high percentages (9% and 15%) of lithic tools with smoothed or pecked surfaces, much higher than those in terrestrial hunter-gatherers assemblages.

Harpoon points with cross-shaped bases and one big tooth or two small parallel teeth are characteristic. There are also harpoon points with multiple barbs and fixed bases, as well as many other implements made with specific raw materials: cetacean bones for harpoon points and wedges (presumably used to split wood), pinniped ulnas for chisels, guanaco metacarpals or metatarsals for retouch-tools, and bird humeri, radii and tibiotarsi for hollow awls (possibly used in basket weaving).

The lithic knapped tools, although abundant, show little variation: side scrapers, flakes with natural cutting edges and few end scrapers. Many tools are well retouched but standardization is low; neither special efficiency nor a long tool use seem to have been searched for (Orquera and Piana, 1999, 2009). Rhyolite and cinerite were mainly used as raw materials. Tools made of smoothed stone include sub-spheres of hornblendite of unknown function, and potential fishing weights. The typological proportions are very similar between both assemblages, but the microwear analysis (Álvarez, 2006) indicates different uses for cutting and scraping tools: bone was mainly carved out in Túnel I, while meat, tendons and leather were mainly worked in Imiwaia I.

Much evidence of portable art and personal ornamentation have been found: carefully incised (non-figurative) decoration on harpoon points and other objects, pendants made with pinniped or guanaco teeth, and numerous beads made with bird bone segments or *Fisur-ella* shells. Bead decorative designs found on the Beagle Channel shores are very similar to those discovered in the western region, but the harpoon decorative designs bear lesser inter-regional resemblances (Orquera and Piana, 1999; Fiore, 2006).

Pinnipeds, with an MNI = 354 (97% *A. australis*) provided approximately 60% of kilocalories consumed in Túnel I by its human visitors. Mussels provided around 20%, fish 5–6%, guanacos 4% or less, dolphins and birds 2% each. At Imiwaia I, micro-environmental conditions allowed for a somewhat greater guanaco consumption. Among birds, shags and penguins predominate; within shellfish, the mytilidae were absolutely predominant.

Schiavini (1990, 1993) determined the sex, ages and death seasons of pinnipeds as well as their meat and grease yields according to age and sex. More than 80% of *Arctocephalus* eaten in Túnel I were male; about 30% of them were adults (8 years old or more). No remains of newly-born offspring were found. Maxillary canine teeth thin sections indicate that most *Arctocephalus* died

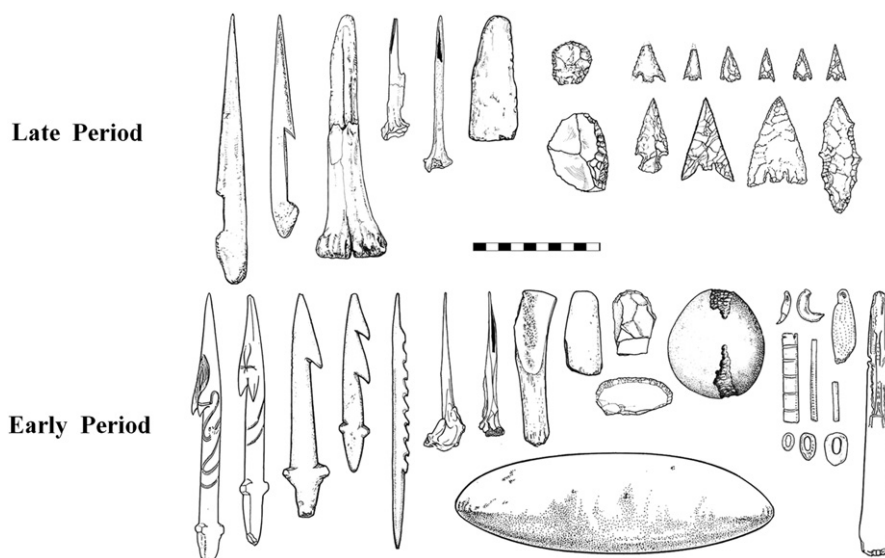


Fig. 5. Weapons and tools representative of initial and final moments of the littoral adaptation in the Beagle Channel (drawings: D. Alonso and M. Lamarca). Scale in cm.



between autumn and spring. Consequently, hunting did not occur on rockeries or during the reproduction season. Nevertheless, remains of juvenile bird squabs show that the sites were also occupied during the summer.

The later assemblages show many similar features, but also some changes. The middle times of the sequence are represented by the Early Component of Lancha Packewaia ( $4020 \pm 70$ : Orquera et al., 1977), the Fourth Component of Túnel I ( $2690 \pm 80$ : Orquera and Piana, 1999), layer D of Imiwaia I (3000 BP), and other minor assemblages. The first of these includes large spear points, too heavy to be shot, made with basic vulcanite; these points are similar to those of Chiloé and Ponsonby, although very uncommon in other sites of the Beagle Channel region. The use of mid-sized lithic weapon points and simple-tenon harpoon points started later.

The last two millennia include the Recent Component of Lancha Packewaia ( $1590 \pm 50$  BP onwards: Orquera et al., 1977), Shama-kush I and layer C of Mischiúen I (both circa 1000 BP), Shamakush VIII and other assemblages. Layers B of Lancha Packewaia, B of Túnel VII, and B–C of Lanashuaia (for the latter two, see Estévez and Vila, 1995; Piana et al., 2000) correspond to the contact period with the Europeans (Fig. 5: Late Period). The frequency of lithic points of middle size increased (some might have been daggers), as well as the small and micro-lithic ones. In Aje I ( $1400 \pm 90$ ) their use as arrows, and consequently the existence of bows has been inferred. Regarding the simple-tenon harpoon points, their adoption did not imply a functional change respect to the cross-shaped base ones, but the simple-tenon was probably easier to manufacture. The rest of the material record shows little changes.

No strong correlation has been found between the use and increase of lithic weapon points (presumably arrows) and dietary procurement. Guanaco consumption increased noticeably in the middle times of the sequence, but it decreased again thereafter to very low figures. Pinnipeds provided most of the kilocalories: in the Lancha Packewaia Recent Component, more than 60%. The predominance of males over females continued, but the proportion of juveniles (between 5 months and 3–4 years old, but not newly-born) increased from 22% in early times to 48% in layer C of Túnel I. Fish consumption increased during the last 1500 years (in Túnel VII it exceeded that of the pinnipeds) and a new species was incorporated: *Thyrstites atun* or barracuda (Zangrando, 2009). According to this researcher, this later inclusion would indicate greater fishing farther from the coast.

## 6. Final comments

A cold, windy and rainy environment imposes high metabolic demands on humans. However, the natives did not live permanently on the verge of hunger, as some observers have asserted. Archaeology indicates that their diet was rich in calories, since pinnipeds provide great quantities of grease: 100 g of meat and grease, in the proportions found in a medium-sized *Arctocephalus*, provide around 240 kcal (Schiavini, 1990), much more than the terrestrial herbivores found in the area. Mussels have a low nourishment value (1.45 kcal per individual of average size archaeologically found: Orquera, 1999), but their availability made them a reliable resource, valuable as a dietary complement and as a “safety-valve” for emergency cases. Isotopic analyses (Panarello et al., 2006) confirm the great incidence of maritime resources in the human diet.

The social and technological simplicity was connected to the environmental characteristics of the area. The even distribution of resources and the small magnitude of micro-regional and seasonal variations on available resources made finding dietary staples a rather predictable task. These circumstances did not foster the elaboration of refined tools, and, according to the optimal foraging models, they favor social dispersion in small groups evenly

distributed throughout the landscape. No incentive for reaching greater levels of technological or social complexity can be seen, and a greater complexity would have been counterproductive (Orquera and Piana, 2009).

There were inter-regional differences and changes through time, but of limited magnitude. The abundant use of obsidian along Otway Sound (in contrast to the Beagle region) and the inverse relation with the consumption of guanacos and some birds probably reflect local conditions. More difficult to explain through this line of reasoning is the absence of lithic weapon points in the Beagle Channel early components, opposed to their abundance in the Otway and Magellan Strait sites (such difference did not continue in middle and later times). Nevertheless, the assemblage as a whole generates a general impression of homogeneity, continuity and stability. In spite of the differences, both regions show many similarities in subsistence, lithic and bone typology, and general lifestyle. There are strong proofs of contact between both regions in times of the initial components. Later, the similarities of transformations suggest that such contacts continued or that both groups reacted the same way to internal or external stimuli (natural, cultural or both). However, it is necessary to increase research in the Chiloé zone to determine in detail how it was integrated to the rest of these features.

Except for the inclusion of *Thyrstites* in the diet, the consumed species were always the same. There were innovations in the hunting weapons, but little in the processing tools (Piana and Orquera, 2007). Some authors think that the expansion of sub-foliated lithic spear points in the middle times of the sequence would indicate a migration or a population change (Schidlowsky, 2001; Morello et al., 2002; Ocampo and Rivas, 2004), but Piana and Orquera (2007) think that it is more likely only the diffusion of a technological innovation which did not entail ethnic replacements or basic cultural changes. Legoupil and Pigeot (2009) quote Leroi-Gourhan (1973): a group can borrow a feature only when it is in condition to invent it.

The advent of a greater evenness in the diet, the increase of fishing activities (Zangrando, 2009), the adoption of lithic weapons and the greater consumption of sub-adult pinnipeds do not preclude the panorama from being basically typically that of foragers (*sensu* Binford, 1980) or time-minimizer travelers (Bettinger, 2001) up to the end of the 19th century. This is partly due to the small magnitude of environmental changes and also to the fact that human action did not hinder the normal reproduction of resources. Pinniped reproduction colonies were far from the Beagle Channel region, although near Cape Horn and in Otway Sound access to them could have been easier (Legoupil, 1989). Nevertheless, the hunters did not reach the open and productive sea regions where these animals fed, and only caught individuals which approached the shores. According to Schiavini (1990), this explains the greater consumption of male individuals in the Beagle sites, which in turn would have led to not threatening the survival of the *Arctocephalus* population.

In spite of its simplicity, the system was successful. Its collapse happened by the end of the 19th century, and was caused by the catastrophic pinniped depredation carried out by Euro-american, Chilean and Argentine groups, as well as by the introduction of sickness against which the indigenous populations had no immunity (see summary in Orquera, 2002).

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