
ELSEVIER
Volume 30, Issue 4, December 2011
ISSN 0278-4165
JOURNAL OF
Anthropological
Archaeology
Editor: John M. O'Shea
Available online at www.sciencedirect.com
SciVerse ScienceDirect

Journal of Anthropological Archaeology 30 (2011) 484–501

Contents lists available at SciVerse ScienceDirect

Journal of Anthropological Archaeology

journal homepage: www.elsevier.com/locate/jaa

Art in time. Diachronic rates of change in the decoration of bone artefacts from the Beagle Channel region (Tierra del Fuego, Southern South America)

Dánae Fiore *

CONICET (National Council of Scientific Research, Argentina), UBA (Universidad de Buenos Aires), AIA (Asociación de Investigaciones Antropológicas), Bartolomé Mitre 1131 7 "G", CP (1036), Buenos Aires, Argentina

ARTICLE INFO

Article history:
Received 19 July 2010
Revision received 8 July 2011
Available online 20 August 2011

Keywords:
Portable art
Technology
Design
Rates of change
Time
Tierra del Fuego

ABSTRACT

This paper explores the differential rates of diachronic change developed by diverse features of portable art in southern Tierra del Fuego. It is argued that decorative designs and techniques, which simultaneously constitute each decorated artefact, had asynchronic rates of change throughout the archaeological sequence. Results indicate that: (I) decorated harpoon points (1) had a broader and more complex design repertoire which entailed a higher labour investment and showed a faster rate of change than beads, due to a greater individual input in their decoration, (2) were richly decorated in spite of their high risk of loss/fracture, yet their decoration was concentrated in the early period of the archaeological sequence and then decreased in time due: a) to such loss/fracture risk, which jeopardised the labour invested in their decoration, (b) to a relative decrease in pinniped hunting which might have reduced the socio-economic and symbolic value of harpoons; (II) decorated beads (1) had a simpler and more standardised design repetoire which entailed a lower labour investment and showed a slower rate of change than harpoons, due to a stricter process of teaching/learning or imitation during their production and a collective way of ornamentation during their display, (2) increased with time and have been decorated during the three periods of the archaeological sequence due to: (a) their lower risk of loss/fracture, which did not endanger the labour invested in their decoration, (b) their social function as a shared form of ornamentation; (III) decorative techniques had a slower rate of change than decorative designs throughout the archaeological sequence due to their differential instrinsic variability potentials.

Introduction: the archaeology of time and the Beagle Channel case

"*we do not go through time, time goes through us*"

(C. Gosden, 1994, p. 1).

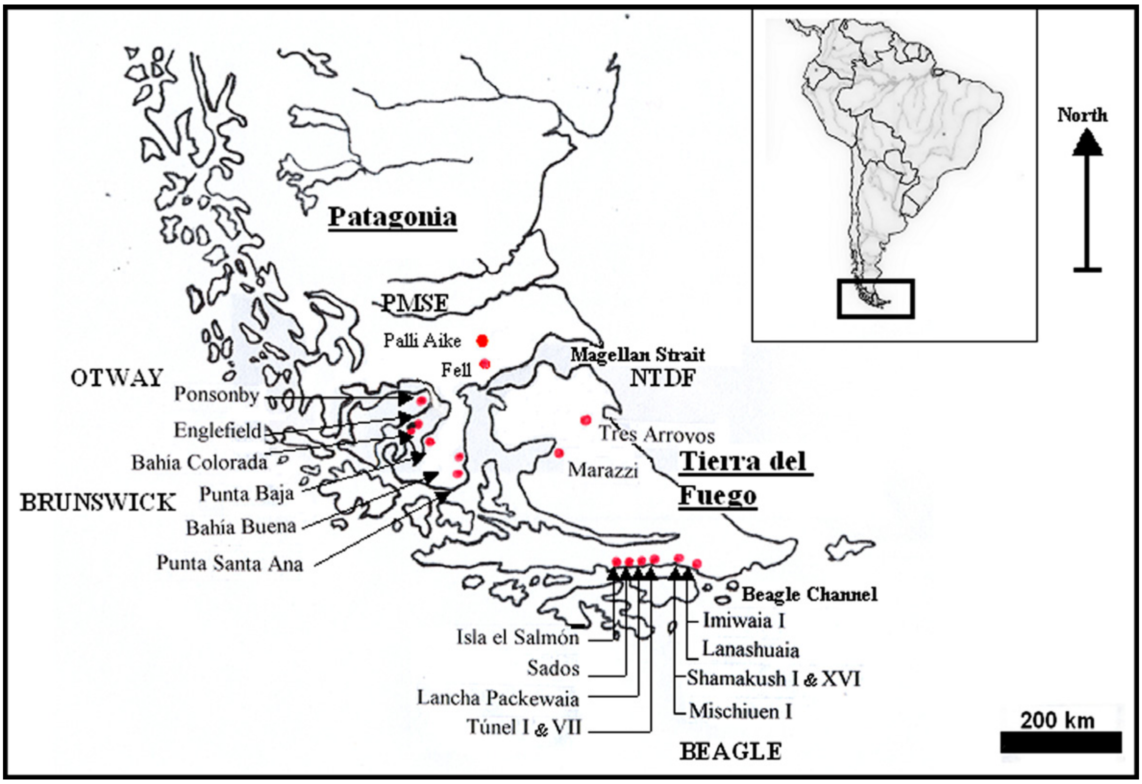
The main aim of this paper is to analyse several conditions under which different constitutive features of portable art developed differential rates of diachronic change in southern Tierra del Fuego.

Time has always been a central element within archaeological research. Yet from the early stages of the discipline, time-related discussions have mainly focused on *chronology*. These have included the use of artefact types as "fossil guides" to establish relative chronologies, the creation of periodifications based on archaeological seriations, cultures, industries and art style sequences, and the establishment of archaeological sequences using "absolute dates" of organic samples through radiocarbon dating (Trigger, 1989; Murray, 1999; Lucas, 2005; Lyman and O'Brien, 2006). More recently, other approaches to time have focused on the co-variation of certain items through time, thus searching for explanations of the positive or negative correlation of different types of artefacts, of a type of hunting tool with a prey species, etc. (Trigger, 1989; Lyman and O'Brien, 2006). Thus, the *duration, succession* and *simultaneity* of different types of evidence (e.g. artefacts, archaeofaunal remains, etc.) can be measured and investigated because "time – which is intrinsically unitary and unifying – allows for the co-ordination of diverse processes..." (Gell, 1992, p. 315).

Still, artefacts can be regarded as whole entities or can be analytically subdivided into different constitutive features: for example, raw material, production technique and decorative design are different features which *simultaneously* constitute an artefact at a given point in time, but these features can have different *diachronic trajectories* due to different conditions affecting their reproduction when new artefacts are manufactured (see below). These diacronic trajectories can be identified by assessing for how long each feature *continues* and how often each feature *changes* within a given set of artefacts of different dates. Thus, this approach allows to search for differential *rates of change* that each of these features may have, which entail that in spite of the fact that they *simultaneously* constitute an artefact, they may change *asynchronically* throughout an archaeological sequence (Garcia Canclini,

* Fax: +54 11 4823 8645.
E-mail address: danae_fiore@yahoo.es

0278-4165/$ - see front matter © 2011 Elsevier Inc. All rights reserved.
doi:10.1016/j.jaa.2011.07.002



Map 1. Decorated artefact distribution in Tierra del Fuego and Patagonia sites. *Key*: OTWAY (Otway Sound); BRUNSWICK (Brunswick Peninsula); PMSE (Southeastern continental Patagonia); NTDF (Northern Tierra del Fuego); BEAGLE (Beagle Channel).

1986; Gortari, 1991; Gosden, 1994; Mc. Glade, 1999; Fiore, 2006a,b; Lyman and O'Brien, 2006). In sum, this theoretical perspective regards time not just as an external frame of things (in this case artefacts) but also as an internal factor present in the production and reproduction of the constitutive elements of artefacts, which have their own specific rates of change.

This perspective will be applied to study the covariations and rates of change of several features of portable art – i.e. decorated artefacts – from the Beagle Channel region (Tierra del Fuego, southern South America; see Map 1). The Beagle Channel region is located at the southern portion of Isla Grande de Tierra del Fuego, which is the biggest island of the Fuegian archipelago (currently divided between Chile and Argentina). The Channel runs west–east and is approximately 180 km long and 4–7 km wide (Orquera and Piana, 1999). The geography of this region is characterised by mountain ranges (the end of the Andes) and an irregular coastline, which varies in altitude respect to the sea level.

The Northern shore of this Channel has been subject to intensive archaeological research for more than 30 consecutive years (Orquera and Piana, 1999). Such research has shown the existence of an archaeological sequence of 6400 years that provides evidence of the development of a littoral adaptation of hunter–gatherer–fishers. Such populations consumed various littoral resources (pinnipeds, fish, birds, shellfish, etc.), and generated numerous sites, most of which are shellmiddens (Orquera and Piana, 1999). In such sites there is abundant evidence of the development of a bone tool technology (Orquera and Piana, 1999, Scheinsohn, 1997), which includes various types of harpoon points, wedges, awls, rods, beads, etc. Several of these show geometric engraved designs: these decorated artefacts are the focus of this paper.

Portable art materials add up to 316 decorated bone artefacts, which have been found in the following sites (see Table 1 and Map 1):

(a) 12 stratified sites: TI, TII, TVII, LP, MisI, ShI, ShE, ImiI, LanI (Orquera and Piana, 1999; Piana and Orquera, 2009) and IES5, IES6, IES9 (Figuerero Torres and Mengoni Goñalons, 1986);
(b) a surface site – SHXVI – consisting of a locus of a single finding (Orquera, pers. commun., 2010);
(c) a site disturbed during road works in Ushuaia city – Sados, from which only a few artefacts could be recovered, though without proper contextual archaeological information (Orquera, pers. commun., 2010);
(d) a locus of surface findings found in the Central portion of the Beagle Channel – CBCh, which also lack further contextual archaeological data (Museo del Fin del Mundo collection).

The archaeological sequence covered by these sites ranges from 6400 BP to the 19th century. Yet it should be noted that not all sites cover the same time span: only three have early assemblages (TI, MisI, ImiI), three have middle period assemblages (TI, LP, ImiI), while twelve sites include recent assemblages.[1] This sample unbalance will be taken into account when analysing the diacronic trajectories of artefact decoration in order to avoid potential sample size biases.

Theoretical framework: rates of change in art production

The production of portable art entails a work process by which a design is created on a certain artefact by the use of one or several techniques. Such work process implies a series of *economic factors*, including raw materials availability, technical knowledge, skills and practice to manipulate the materials, labour invested to

[1] The only exceptions being Sados, ShXVI and CBCh, which have no radiocarbon dates and therefore are not included in any of the three periods.

Table 1
Beagle Channel decorated and non-decorated artefacts per period.

Site	Bone artefacts	6400–4300	4300–2200	2200–100	Indet	Sup	Total	% dec
Tunel I	Non-dec	537	40	9	64	19	669	
	Dec	108	16	1	16	4	145	17.8
Tunel II	Non-dec	0	0	9	0	0	9	
	Dec	0	0	1	0	0	1	10.0
Tunel VII	Non-dec	0	0	142	0	0	142	
	Dec	0	0	1	0	0	1	0.7
Lancha P	Non-dec	0	43	55	0	0	98	
	Dec	0	1	0	2	0	3	3.0
Misc I	Non-dec	58	0	105	0	0	163	
	Dec	9	0	7	1	0	17	9.4
Sh I	Non-dec	0	0	29	1	0	30	
	Dec	0	0	1	0	0	1	3.2
Sh Ent	Non-dec	0	0	1	0	0	1	
	Dec	0	0	6	0	0	6	85.7
Sh XVI	Non-dec	0	0	0	0	0	0	
(surface site)	Dec	0	0	0	0	1	1	100.0
Imi I	Non-dec	269	7	9	43	3	331	
	Dec	22	26	61	5	0	114	23.8
Lan I	Non-dec	0	0	19	0	0	19	
	Dec	0	0	1	0	0	1	5.0
Sados	Non-dec	0	0	0	7	0	1	
(no dates)	Dec	0	0	0	3	0	3	30.0
CBCh	Non-dec	0	0	0	0	0	0	
(surface locus)	Dec	0	0	0	0	6	6	100.0
IES 5	Non-dec	0	0	3	0	0	3	
	Dec	0	0	6	0	0	6	66.6
IES 6	Non-dec	0	0	0	3	0	3	
(no dates)	Dec	0	0	0	1	0	1	25.0
IES 9	Non-dec	0	0	0	0	0	0	
(no dates)	Dec	0	0	0	10	0	10	100.0
Total	–	*1003*	*133*	*466*	*156*	*33*	*1791*	–
Total non-dec	–	864	90	381	118	22	1475	–
Total dec	–	139	43	85	38	11	316	17.6
% dec	–	13.9	32.3	18.2	24.3	33.3	17.6	–
Dated sites	–	3	3	10	–	–	10	–

produce the items, and social relations of production which determine who makes, distributes and consumes the decorated artefacts (Boas, 1955; Leroi-Gourhan, 1965, 1976; Conkey, 1987; Aschero, 1988; White, 1992; Fiore, 2007).

While social relations of production usually have a low archaeological visibility in prehistoric hunter–gatherer contexts, because their social division of labour often has a low or ambiguous material structuration, *labour investment* can be inferred by analysing certain features of the products themselves. In bone artefact decoration, labour investment will vary, among other elements, according to the decoration techniques and to design complexity. If an assemblage of decorated artefacts shows: (a) the use of techniques which require high amounts of time investment and/or require precise technical gestures which entail a high skill investment and/or (b) the use of a range of different decoration techniques (each demanding the development and use of specific skills), then if would be inferable that the labour invested in its production was higher than if the decoration techniques were simple, required little time and little skill investment and/or were less varied. In addition, if an assemblage of decorated artefacts shows a repertoire of complex designs (created by intricate motifs due to their shape, size, position, orientation, etc.) then its labour investment can be considered higher than if its designs were simpler and/or were less varied (Leroi-Gourhan, 1965; Aschero, 1988; White, 1992; Bednarik, 2001; Fiore, 2007).

Such labour investment in artefact decoration may be constant or might change in time – increase or decrease – due to changes in the material conditions of artistic production: e.g. changes in raw materials availability, in social relations of production, in social mechanisms of transmission (which can affect the continuity of technical tradition or of design tradition – see below), etc. Diachronic changes can also happen due to the material uses of the decorated artefacts: if their decoration was related to their practical-mechanical function for technical or subsistence purposes, a change in the socio-economic perception of such function might entail a change in the intensity (or entire demise) of their decoration; in the case under study, the hypothesis that harpoon decoration decreased with the decrease of pinniped (*Arctocephalus australis* and *Otaria flavescens*) hunting will be explored. Also, if the artefact's practical-mechanical function entails a high loss/fracture risk, such risk may be affordable under certain conditions (e.g. when the artefact is considered to be worth of decoration due to its socio-economic function) but not under other conditions (which might prioritise the low loss/fracture risk of the artefact in order to decorate it; Fiore, 1999); in the case under study, the hypothesis that harpoon decoration decreased in comparison to bead decoration due to their differential loss/fracture risks will be explored.

Besides these economic factors, there are crucial *social factors* involved in artefact decoration, which are distinguished from the former only for analytical purposes, but operate simultaneously during the production and use of portable art. These social factors involve:

(a) The choice of which artefacts to decorate, according to their social functions. Any object (be it a tool, or a body ornament) may have had ulterior social functions beyond its practical–mechanical functions (e.g. a tool may also work as a prestige item). Yet some artefacts have been designed specifically to comply with social aims as their "canonical affordance" (sensu Costall, 1997, p. 79): beads and pendants were designed to be worn hanging on the body or sawn to clothing, directly affecting the person's appearance and social representation (White, 1992; D'Errico, 1993; Wright and Garrard, 2003). This paper will explore the hypothesis that such social function may have affected the diachronic continuity of their decoration.

(b) The symbolic function of the decorative designs. Decorative designs may have functioned as a symbolic visual enhancement of the artefact's practical-mechanical functions: harpoon points may have been decorated to symbolically enhance their performance as hunting tools and/or that of their owners/users in hunting tasks. The previously mentioned hypothesis that links harpoon decoration with pinniped hunting also takes into account these symbolic aspects.

(c) The motif repertoire used to decorate a certain group of artefacts. When a design repertoire is wide, it entails a greater degree of social and individual freedom in the act of decorating; conversely, when a design repertoire is narrower, it entails a lower degree of social and individual freedom in decoration production. This in turn can be related to two aspects of art production: the social mechanisms of transmission and the standardization of designs and/or techniques.

The use of a narrow and repeated group of motifs chosen from a broader available repertoire and combining certain motif types laid out in specific positions and orientations to decorate certain artefacts entails design standardization, which often results from social-aesthetic conventions that constrain which visual attributes are expectable, acceptable and/or desirable in artefact decoration and/or from conveying a precise message by encoding and decoding its contents through visual means (Solso, 1994). Such standardization entails an effective mechanism of cultural transmission to ensure its continuity through time and space, both by teaching and learning and/or by imitation (Shennan, 2002). Teaching–learning entails a certain degree of social control in the production/reproduction process, while both teaching–learning and imitation entail the routine repetition of actions and the continuity of knowledge by the force of habit (which does not always involve intentional social control although the force of habit can also have rather structuring outcomes; Leroi-Gourhan, 1953–1955; Bourdieu, 1977; Shennan, 2002). Thus, standardization leaves little room for individual innovation and ensures design reproduction through time.

Clearly, technique can also be standardised due to many reasons, including: (a) to favour cost-minimising procedures (these involve reducing material costs such as raw materials availability, time, energy, knowledge, labour and/or skill involved in the use of a decorative technique); (b) to favour high-cost procedures (in spite of their potentially high material costs, a certain decorative technique may be repeatedly chosen due to the socio-economic value and/or social prestige given to applying such high-cost techniques to artefact production and/or to using artefacts produced by such high-cost techniques); (c) to fit social conventions through a technique's visible attributes (quality, texture, colour, etc. achieved through the use of a specific decorative technique). In all cases, the diachronic continuity entailed in technological standardization is a result of repeatedly following a routinised production sequence (Leroi-Gourhan, 1953–1955; Pfaffenberger, 1988). Thus, a high technological standardization entails a certain control of and/or habit repetition in the decorative production process and thus allows for its reproduction in time.

When comparing designs and techniques at any given moment, techniques have a narrower intrinsic variability range than designs. This happens due to the fact that techniques and designs share several constraints (social appropriateness, aesthetic values, etc.) but techniques have higher material constraints than designs (raw material availability, tool development and manufacture, knowledge and skills development and transmission, etc.).

Table 2
Archaeological expectations.

Archaeological expectations	Design	Technique
Expectation A	Higher rate of change	Lower rate of change
Expectation B	Lower rate of change	Higher rate of change
Expectation C	Same rate of change	Same rate of change

Thus, art's techniques and designs usually do not have the same rate of change in time: it is expectable that technique will often have a slower rate of diachronic change than design (this is visible in many rock art cases from Patagonia, Argentina, in which few techniques are used to create many motifs; Fiore, 2006a,b).

Nevertheless, as noted above, designs can also narrow their wider intrinsic variability when they fit a specific social function and/or are standardised to encode a particular message. Under such conditions, the rates of change can reverse: in spite of its narrower intrinsic variability, technology can achieve a faster diachronic rate of change than design, since different techniques can be used at different moments to produce the same design[2] (though much less frequent, this is also visible in some specific rock art cases from Patagonia, Argentina, in which a single motif type has been produced using different techniques; Fiore, 2006a,b).

When applied to the case under study, the conditions mentioned above can generate three alternative archaeological expectations (Table 2):

(A) it is more expectable to find a higher rate of change in the Beagle bone artefact designs and a lower rate of change in their decorative techniques, which would entail that designs changed faster than techniques;
(B) it is less expectable (but clearly possible) to find a higher rate of change in the Beagle bone artefact decorative techniques and a lower rate of change in their designs, which would entail that techniques changed faster than designs;
(C) it is even less expectable to find the same rate of change in the Beagle bone artefact decorative techniques and designs, which would entail that the former changed at exactly the same pace than the latter.

Expectations A and B imply that decorative design and technique have different rates of change due to differential conditions: the confirmation of expectation A would entail a more effective socio-economic reproduction of decorative techniques, hinting towards a greater individual freedom of design choices; conversely, the confirmation of expectation B would entail a more effective social standardization of design choices (and possibly of the message they conveyed), hinting towards a greater individual freedom of technical choices.

Methods

This paper includes data about all the currently available samples of portable art from the Beagle Channel region, which add up to 316 artefacts: 299 have been directly analysed while 17 (corresponding to sites IES5, IES6, IES9) have been quoted from published literature (Figuerero Torres and Mengoni Goñalons, 1986). Given that the main focus of this research is diachronic continuity and change, the data are analysed here from a regional approach; therefore, spatial factors – such as inter-site variability – are not taken into consideration. Two different but complementary temporal scales (Bailey, 1983; Bradley, 1991) are used in data analysis:

[2] This does not imply that the initial social and/or symbolic meanings of a design have always remained the same, since they may have been reinterpreted and transformed through time.

Table 3
Beagle Channel decorated and non-decorated harpoon points, beads and other bone artefacts, per period.

Sites	Artefacts	Periods			Indet + sup	Total
		6400–4300 BP	4300–2200 BP	2200–100 BP		
6 sites = TI, TVII, LP, MisI, ImiI, LanI	Non-dec hpp	84	11	53	27	175
6 sites = TI, LP, MisI, ImiI, Sados, CBCh	Dec hpp	43	1	1	15	60
10 sites = TI, TII, TVII, ShI, ShXVI, ShE, MisI, ImiI, LanaI, CBCh	Non-dec beads	261	7	93	18	379
10 sites = TI, TII, TVII, ShI, ShXVI, ShE, MisI, ImiI, LanaI, CBCh	Dec beads	43	34	74	13	164
10 sites = TI, TII, TVII, LP, MisI, ShI, ShE, ImiI, LanI, Sados	Other non-dec artefacts	519	72	232	86	909
12 sites = TI, TII, TVII, LP, ShI, ShXVI, ShE, MisI, ImiI, LanaI, Sados, CBch	Other dec artefacts	53	8	4	10	75
–	Total non-decorated materials	864	90	378	131	1463
–	Total decorated materials	139	43	79	38	299

Key: Non-dec = not decorated; dec = decorated; hpp = harpoon points; indet = indeterminate date; sup = surface find.

(a) periods: these are broad-scale time slots which have been defined by sub-dividing the archaeological sequence in three intervals of equal duration (2100 radiocarbon years); in spite of their low-resolution, they allow for the recognition of clear long-term patterns in the temporal distribution of decorated and non-decorated artefacts, since they include materials of several dated layers of different sites.[3] (see Tables 1 and 3);

(b) dated layers: these are smaller-scale time slots of different duration, which have been defined by the radiocarbon date/s of each layer of each site, or by the relative *ante-quem/post-quem* position of an undated layer respect of an earlier and/or later dated layer; they provide high-resolution temporal information but sometimes generate an excessive sample sub-division which forbids the identification of statistically significant patterns (see Table 4). Therefore, these scales are relevant *per se* to convey trends with different degrees of resolution, but they are more productive when used in a combined manner.

Information of every artefact from all the 13 sites under study has been recorded in a database in order to make comparisons between decorated and non-decorated artefacts. Such database includes the following variables: type of artefact, site, layer, date, period, raw material, presence/absence of decoration, etc.

Information about the 299 decorated materials has been recorded in a second database including the following variables: artefact number, type of artefact, site, layer, date, period, type of decoration technique/s, decorative designs, etc. Decorative designs have been recorded using two scales: motif classes (lines, figures, dashes and dots) and, within these, motif types (types of lines, types of figures, etc.). Given that artefacts show cases of single-motif designs and cases of multiple-motif designs (which combine two or more motifs in a single artefact), the whole designs have been studied in order to search for the various motif combinations found in the materials, while motif types have been studied regardless of their combination in order to search for the basic repertoire from which designs were built. While design count amounts to the exact number of artefacts (one artefact = one design); motif count exceeds the total number of artefacts (one artefact = one, two or more motifs).

Decorative techniques have been identified by the macroscopic and microscopic observation of all the 299 decorated artefacts through stereomicroscope (Nikon SMZ800) and of 18 artefacts from 5 of the sites under study through ESEM (Philips Electroscan 2010), using experimental parameters as diagnostic criteria observed by SEM (Jeol U3 and Phillips 500) and ESEM (Philips Electroscan 2010).

In order to generate a first general diachronic panorama of the production of portable art in the Beagle Channel archaeological sequence, the frequencies and proportions of decorated artefacts have been related to the total number of non-decorated artefacts per period and per dated layer. Given that the number of artefacts per period and per dated layer does vary, X^2 tests have been used to assess whether the number of decorated artefacts has increased, decreased or maintained a stable proportion respect of non-decorated artefacts, regardless of sample size.

Specific correlations between bone artefacts and other materials (such as lithic artefacts and archaeofaunal remains) have been statistically analysed through X^2 tests and regression tests.

Rates of change are quantitatively inferred using two procedures. The first procedure consists of analysing the differential degrees of variability of *two variables* (e.g. design versus technique) measured *on the same set of artefacts* (e.g. all the decorated materials under study) in the whole archaeological sequence or within a certain period, and assessing which variable has shown more frequent changes (number of decorative motifs versus number of decorative techniques). As a result, the variable that has more states is considered to have a higher rate of change than the one against which it has been compared. Thus, in this case rates of change indicate the comparative speed at which a certain feature of a set of artefacts has changed when compared to another feature of the same set: this provides a notion of the diachronic *rhythm* or *tempo* developed by each feature (e.g. design versus technique) in the same set of artefacts within a certain period.

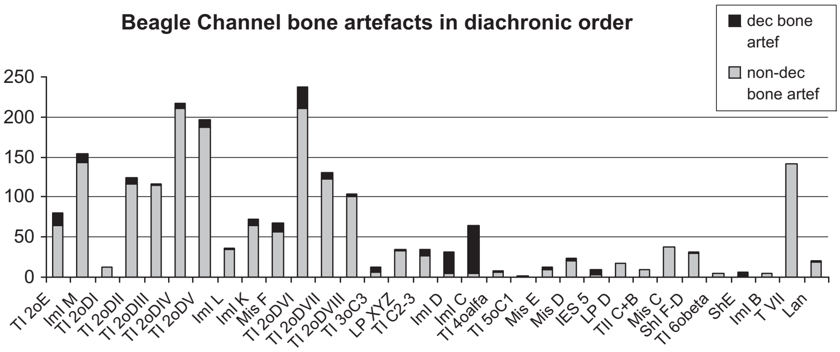
The second procedure consists of analysing the differential degrees of variability of *one variable* (e.g. design) measured on *two sets of artefacts* (e.g. harpoons versus beads) in the whole archaeological sequence or within a certain period, and assessing in which artefact set the variable has shown more frequent changes (i.e. number of decorative motifs in harpoons versus number of decorative motifs in beads). Given that each of the two sets of artefacts are likely to include a different number of items, the number of states of the measured variable need to be assessed in relation to the number of analysed artefacts, in order to avoid biases due to sample size. X^2 tests have been used to calculate this. As a result, after assessing and rejecting sample size biases, the artefact set that has more states of the variable under study (e.g. harpoons)

[3] The period length – 2100 radiocarbon years – does not have any cultural significance and is only an analytical tool: it has been chosen because it is operative to lump numerous contiguous dated layers and thus helps in distinguishing three moments in the peopling process of the region (early, middle and recent). Large-scale periods such as these have proven useful in the identification of long-term trends in several types of materials in the region (Scheinsohn, 1997; Fiore, 2006a,b; Alvarez and Briz I. Godino, 2006; Zangrando, 2009). Moreover, using the same periods than other authors allows for the comparison with trends already found in several archaeological materials of the region.

Table 4
Beagle Channel decorated and non-decorated materials: distribution per sites and dated layers.

Site and layer	Sit & lay	Years ^{14}C – BP	Non-dec hpp	Dec hpp	Non-dec beads	Dec beads	Other non-dec bone artefacts	Other dec bone artefacts	Total lithic tools	Total non-dec	Total dec	Total bone artefacts
Tunel I (2oC; layer E)	TI 2oE	6200 ± 100 6070 ± 70	6	9	4	2	55	4	272	65	15	80
Imiwaia I (LowC, layer M)	ImI M	6490 ± 120 5000 ± 140	13	5	75	0	55	6	87	143	11	154
Tunel I (2oC; layer D I)	TI 2oDI	6470 ± 100 6020 ± 120	0	0	0	0	12	1	20	12	1	13
Tunel I (2oC; layer D II)	TI 2oDII	6410 ± 150	6	7	6	0	104	1	42	116	8	124
Tunel I (2oC; layer D III)	TI 2oDIII	5950 ± 170	2	2	3	0	109	1	10	114	3	117
Tunel I (2oC; layer D IV)	TI 2oDIV	Post 5950 Pre 5840	7	3	7	1	197	2	32	211	6	217
Tunel I (2oC; layer D V)	TI 2oDV	5840 ± 185 5630 ± 120	7	3	30	3	150	3	37	187	9	196
Imiwaia I (LowC; layer L)	ImI L	4900 ± 120	2	0	15	0	17	2	23	34	2	36
Imiwaia I (LowC; layer K)	ImI K	Post 4900 Pre 3620	5	0	22	0	37	9	53	64	9	73
Mischiuen I (LowC; layer FS) Mischiuen I (LowC; layer FN)	Mis F	4890 ± 210 4430 ± 180	1	1	2	5	54	4	14	57	10	67
Tunel I (2oC; layer D VI)	TI 2oDVI	4590 ± 130	3	2	5	13	203	11	67	211	26	237
Tunel I (2oC; layer D VII)	TI 2oDVII	Post 4590 Pre 4300	4	1	13	6	105	1	50	122	8	130
Tunel I (2oC; layer D VIII)	TI 2oDVIII	Post 4590 Pre 4300	6	0	20	1	75	2	45	101	3	104
Túnel I (3oC; layer C3)	TI 3oC3	4300 ± 80	0	0	0	1	7	4	17	7	5	12
Lancha Packewaia (layer X, Y, Z)	LP XYZ	4020 ± 70	4	1	0	0	29	0	105	33	1	34
Tunel I (noC; layer C2-3)	TI C2-3	3430 ± 90 2930 ± 100	5	0	3	6	19	2	55	27	8	35
Imiwaia I (UppC; layer D)	ImI D	3620 ± 160 3340 ± 150	1	0	0	26	4	0	8	5	26	31
Imiwaia I (UppC; layer C)	ImI C	Post 3340 Pre 150	2	0	1	60	2	0	8	5	60	65
Túnel I (4oC; layer alfa-X)	TI 4oalfa	3030 ± 90 2660 ± 100	1	0	2	2	3	0	73	6	2	8
Túnel I (5oC; layer C1 floor2)	TI 5oC1	1990 ± 110 1920 ± 80	0	0	1	0	0	1	8	1	1	2
Mischiuen I (MidC; layer E)	Mis E	1970 ± 190	0	0	0	1	10	1	21	10	2	12
Mischiuen I (MidC; layer D)	Mis D	Post 1970 Pre 1060	3	0	0	2	17	2	20	20	4	4
Isla El Salmon 5	IES 5	1820 ± 120 1765 ± 25 1560 ± 90	0	0	0	6	3	0		3	6	9
Lancha Packewaia (layer D)	LP D	1590 ± 50 470 ± 50	2	0	0	0	15	0	60	17	0	17
Tunel II (layer C) Tunel II (layer B)	TII C + B	1140 ± 90 1120 ± 90	0	0	4	1	5	0	9	9	1	10
Mischiuen I (UppC; layer Cbase) Mischiuen I (UppC; layer Cupp)	Mis C	1060 ± 85 860 ± 90	1	0	0	0	37	0	148	38	0	38
Shamakush I (layer F) Shamakush I (layer D)	ShI F-D	1020 ± 100 940 ± 110	0	0	11	1	19	0	204	30	1	31
Túnel I (6oC; layer beta)	TI 6obeta	670 ± 80 450 ± 60	1	0	0	0	3	0	40	4	0	4
Shamakush Enterratorio	ShE	620 ± 60	0	0	0	6	1	0	27	1	6	7
Imiwaia I (UppC; layer B)	ImI B	150 ± 70	1	0	1	1	2	0	14	4	1	5
Tunel VII	T VII	100 ± 90	30	0	31	1	80	0	683	141	1	142
Lanashuaia I	Lan	Recent	3	0	0	1	16	0	120	19	1	20

Key: Sit & lay = site and layer abbreviation (used in graphics 1–5); hpp = harpoon point. Dates quoted from Orquera and Piana (1999), Piana and Orquera (2009) and Figuerero Torres and Mengoni Goñalons (1986). Site Lanashuaia I has been dated as "recent" using the presence of archaeofaunal materials of european origin which were introduced in the region by the 1860s; the radiocarbon dating of a charcoal sample obtained from the site was impossible due to the fact that the atomic activity of the sample was higher than the scanning potential of the equipment used (Piana et al., 2000, p. 456).



Graphic 1.

is considered as the one in which such feature (e.g. design) has had a greater rate of change. Thus, in this case rates of change indicate the comparative speed at which a certain feature has changed in one artefact set compared to another artefact set: this provides a notion of the diachronic *rhythm* or *tempo* developed by such feature (e.g. design) in the two sets of artefacts along the whole sequence or within a certain period.

In sum, rates of change stem from assessing feature variability per time unit: the higher the diachronic variability of a given feature, the faster its rate of change.

The decorated artefacts

The decorated artefacts include four broad categories: tools (harpoon points, awls, wedges, rods, etc.), ornaments (beads and pendants), objects of unknown function (e.g. sub-rectangular tablets), and unformatted bones (decorated bones or broken bone pieces). From a broad temporal scale, these decorated bone artefacts are more *frequent* in the early period than in the middle and recent periods, yet the *proportion* of decorated artefacts is higher in these latter periods than in the first one (see Table 1). Moreover, when comparing the decorated versus non-decorated artefacts per period, it is noticeable that they are not randomly distributed in each period ($X^2 = 31.88$; df = 2; Pval = 00000, 99% confidence). This suggests that in general terms the intensity of decoration – based only on the proportion of decorated materials – increased over time from the early to the middle period and then decreased moderately in the recent period (but without ever reaching the early period level).

From a temporal scale with greater resolution, taking into account the distribution of decorated and non-decorated bone artefacts per dated layer in each site (Table 4), it becomes clear that their frequencies are not proportional in each layer ($X^2 = 775.56$; df = 26; Pval = 0000; 99% confidence[4]; Graphic 1). This indicates that the practice of decorating was not dependent on the frequency of artefacts: it was an intentional task, which seems to have depended on other variables. This indicates that the practice of decorating artefacts at a certain moment was not dependent on the higher or lower frequency of artefacts used in such moment (and thus is not dependent on sample size): it is the result of anthropic action and was thus an intentional task, which seems to have depended on other variables.

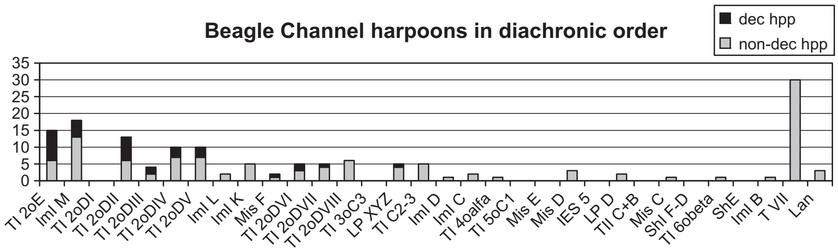
One of these variables is the type of artefact that was chosen for decoration: consistently with the greater early frequency of decorated artefacts, their variety of types was also greater in the early period and decreased with time: decorated wedges, rods, tablets, pendants and unformatted bones disappear by the middle period, while decorated awls, for example, strongly decrease. The two most frequent types of decorated artefacts are precisely those that persisted throughout the entire archaeological sequence: harpoon points and beads (see Tables 3 and 4). These will be the central focus of analysis in this paper for two reasons: (a) their higher frequencies allow for the search of statistically significant temporal tendencies, (b) their different practical-mechanical and social functions allow for the search of different diachronic trends in their decoration.

Harpoon points were manufactured with maritime mammal bones, often identified as belonging to cetacean species (Scheinsohn, 1997). Morphologically, harpoon points can be subdivided into two classes according to whether they are detachable or non-detachable from their hafts. Detachable harpoon points include five types according to their base morphology in their distal portion (cross-shaped base, simple base [unilaterally-shouldered], shield-shaped base [bilaterally-shouldered], protuberance base, fusiform base), while non-detachable harpoon points include only one type (fixed-base) (Orquera and Piana, 1999; Fiore, 1999). These types can be subdivided into nine sub-types according to the number of teeth in their proximal portion (one, two, many) and their position on the harpoon (Orquera and Piana, 1999; Fiore, 1999). The sub-division of harpoons in types and subtypes, while interesting in itself, entails dealing with a great typological variability which expands considerably the dataset under study and would require a detailed and lengthy discussion of its implications for each type and subtype. Given that the main aim of this paper is to shed light on potential diachronic trends comparable between beads and harpoons, which need to be based on statistically significant data, all the harpoon point types/sub-types will be analysed jointly. Yet specific trends per harpoon class will be discussed when relevant, in order to provide a synthetic panorama of the internal diachronic variability in the decoration of this tool group.

Beads were manufactured with bird bones. Although the bead bone analyses are currently in preparation, preliminary results show that beads were mainly produced with Procellariiformes (e.g. albatross and shearwaters) and Phalacrocoracidae (e.g. cormorants) radius and ulnas, while humerus were used in lesser frequencies (Orquera, pers. commun., 2009; Tivoli and Fiore, in preparation[5]). Bird bone beads were made by cutting off the distal portions of the bones and rubbing both ends to give them a smooth finish (Piana and Estevez, 1995; Figuerero Torres and Mengoni

[4] Test carried out excluding cases which have less than $N = 5$ in both columns (decorated and non-decorated artefacts). This is further reinforced by the lack of correlation between decorated and non-decorated bone artefacts (correlation coefficient = +0.09; $r^2 = 0.8\%$).

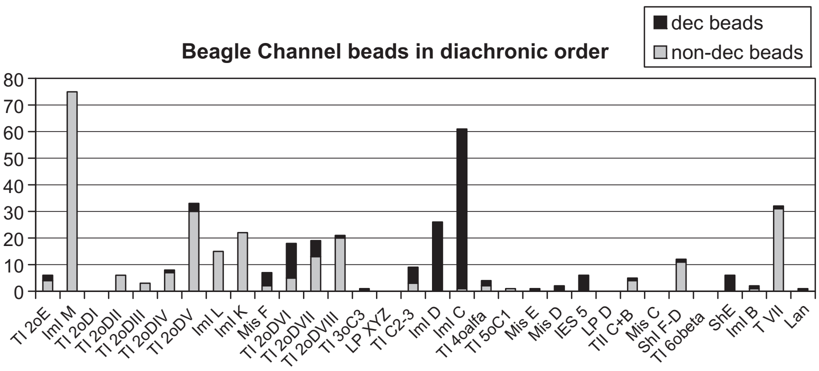
[5] The bird bone beads have been recorded in seven sites: Imiwaia I, Lancha Packewaia, Mischiuen I, Shamakush I, Túnel I, Túnel II, Túnel VII (Tivoli and Fiore in preparation).



Graphic 2.

Table 5
Beagle Channel decorated and non-decorated harpoon points classes per period.

Harpoons	Sites	6400–4300 BP	4300–2200 BP	2200–100 BP	Indet	Sup	Total
Section A – Decorated and non-decorated harpoons							
hpp non-dec	6 sites: TI, TVII, LP, MiscI, ImiI, LanI	84	11	53	20	7	175
hpp dec	6 sites: TI, LP, MisI, ImiI, Sados, CBCh	43	1	1	13	2	60
Total hpp	8 sites: TI, TVII, LP, MiscI, ImiI, LanI, Sados, CBCh	127	12	54	33	9	235
Section B – Detachable and non-detachable harpoons							
hpp non-detach	5 sites: TI, TVII, LP, MisI, ImiI	44	4	5	8	4	65
hpp detach	8 sites: TI, TVII, LP, MisI, ImiI, LanI, Sados, CBCh	83	8	49	25	5	170
TOTAL hpp	8 sites: TI, TVII, LP, MisI, ImiI, LanI, Sados, CBCh	127	12	54	33	9	235
Section C – Detachable and non-detachable harpoons, with indication of decoration or non-decoration							
hpp non-detach non-dec	5 sites: TI, TVII, LP, MisI, ImiI	41	4	4	7	4	60
hpp non-detach dec	3 sites: TI, MisI, ImiI	3	0	1	1	0	5
hpp detach non-dec	6 sites: TI, TVII, LP, MisI, ImiI, LanI	43	7	49	13	3	115
hpp detach dec	5 sites: TI, LP, ImiI, Sados, CBCh	40	1	0	12	2	55
TOTAL hpp	8 sites: TI, TVII, LP, MisI, ImiI, LanI, Sados, CBCh	127	12	54	33	9	235



Graphic 3.

Goñalons, 1986). Sometimes the decoration seems to have been made before severing the distal portions (Piana and Estevez, 1995; Figuerero Torres and Mengoni Goñalons, 1986), while in other occasions decoration seems to have followed after the manufacture of the piece (this is only determinable when unfinished pieces and/or manufacture debris is available for study).

The comparison between decorated and non-decorated *harpoon points* per dated layer of each site shows that harpoon decoration was highly concentrated in the early layers and was extremely infrequent in the middle and recent layers (Graphic 2). This is even clearer when facing the sample though a broad temporal scale: 43 decorated harpoon points are found in the early period, while only 1 is found in the middle and 1 in the recent periods[6] (Tables 4 and 5 – section A). Again, these are not randomly distributed, since they bear no proportion to the non-decorated harpoon points of each period: in other words, harpoon decoration did not decrease in time because the Beagle Channel populations were producing fewer harpoon points (X^2 = 23.12; df = 2; Pval = 0000; 99%). Some possible reasons for this strong tendency towards the decline of harpoon decoration with time are discussed below.

The comparison between the decorated and non-decorated beads per dated layer per site shows that bead decoration spans throughout the entire sequence, but increases with time (Graphic 3). The data in Table 4 show that bead decoration occurred – with low frequencies – in the early layers of the two oldest sites (TI and ImiI) and then, unlike the harpoon points, it broadened to ten sites (TI, TII, TVII, Imi I, LanaI, MisI, ShI, ShE, IES5, IES6, IES9). The frequency of decorated beads per layer is variable. Under the assumption that some necklaces would be composed of similar beads, such beads may be assigned hypothetically to a single necklace due to their striking similarity in bone element, size and decoration; thus, it is likely that in some cases (e.g. ImiI layers D and C) an entire

[6] The remaining 15 harpoon points are either found in layers of indeterminate date or as surface finds, and thus cannot be placed with certainty in any of these periods.

section of a necklace or even a whole necklace was deposited in a single event. This would bias to an extent the representation of the intensity of this activity in such layers in comparison to other layers in which the beads bear more differences, which suggests that they may have corresponded to different necklaces and may have been deposited in different events. Yet in spite of the potential number of deposition events, it is interesting to note that bead decoration was not directly dependant on the frequency of beads per layer: it increased with time. This is even clearer when assessing the number of decorated and non-decorated beads per period: bead decoration increased with time despite of the fact that bead production was not increasing proportionally ($X^2 = 149.36$; df = 2; Pval = 0.000; 99% confidence; this has been calculated per period, lumping the data of each dated layer recorded in Table 4 into the early, middle and recent periods).

Moreover, in spite of the greater number of sites with recent chronology (12), as noted above, the variability of types of decorated artefacts is greater in the early sites, which are fewer (3): not only harpoon points and beads, but also awls, wedges, rods, pendants, and bone fragments were decorated in the early period (although with much smaller frequencies than harpoons and beads). Such variability of types of decorated artefacts was drastically reduced in the middle and recent periods: this is partly expectable due to the smaller frequency of decorated artefacts in such periods (i.e. sample reduction often entails variability reduction), but it is not expectable due to the greater number of middle/later sites (i.e. having more middle/recent assemblages increases the chances of finding decorated artefacts in such periods), and thus suggests a potential trend of anthropic origin (see Table 4).

In sum, harpoon decoration decreased in time regardless of sample size and of number of sites, while bead decoration showed the opposite trend. The next section shows how these different tendencies are also visible in the differential variability of harpoon and bead decorative designs.

Designs: diachronic variability and standardization

Portable art in the Beagle Channel was made by engraving designs on bone artefact surfaces.[7] Three engraving techniques have been identified in the Beagle Channel portable art assemblages: incision, pressure and gouging. The definitions of each technique and the main criteria used to identify them are the following:

(a) *incision*: it implies passing the point or short edge of a tool with a longitudinal movement over the bone artefact surface in order to remove bone material along a line; it generates a linear mark with the shape of a groove that has internal striae which result from the contact between the tool and the bone tissue while the former moves unidirectionally or bidirectionally[8] (see Photos 1A and 1B and Drawing 1);

(b) *Pressure-and-displacement*: it implies applying the point of a tool with strong pressure against the bone artefact surface and then displacing shortly and it in one direction, in order to crush and remove bone material in a circumscribed area of the artefact (i.e. beneath the tool's point of contact with the bone artefact); it generates a comparatively deep mark which can be described as a small hole of irregular shape, with internal striae that sometimes exit the hole, pointing towards the tool's direction (see Photos 2A and 2B and Drawing 2);

(c) *Gouging*: it implies the transversal movement of a narrow portion of a tool edge over the engraved surface in order to penetrate its surface, scrape and remove a section of the material; it generates a mark with an oval-like shape with internal striae and/or an irregular surface due to the uneven removal of bone tissue (see Photos 3A and 3B and Drawing 3).

Photo 1A. Decorated harpoon point fragment, with incised design; site Tunel I, artefact #1249.

Out of 299 artefacts, incision was used as a single decorative technique in 286 cases and combined with other techniques (pressure-and-displacement and gouging) in eight cases; four artefacts were decorated with pressure-and-displacement and only 1 with gouging.

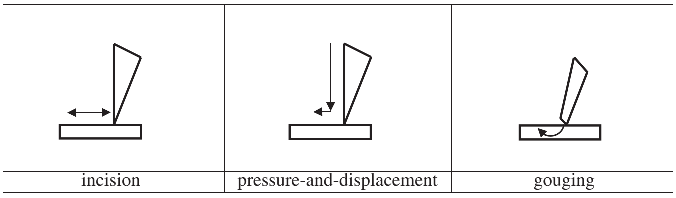
The decorative designs are highly geometric, composed basically by four broad motif classes (in decreasing order of frequency): dashes, lines, figures and dots. These classes include several types of motifs: lines include 23 different motif types, figures include five types, while dashes and dots include one motif type each (see Table 6).

When taking into account the two most frequent types of decorated artefacts (beads and harpoon points), the first noticeable pattern is that harpoon points show designs constituted by the four motif classes, while beads are only decorated by two classes

[7] The identification of the engraving techniques was carried out in a three-step process. Firstly, the materials were observed in order to identify macroscopical similarities and differences in the morphology of their engraved marks, which might have responded to technical differences. This first macroscopical approach indicated that most of the engraved marks were lineal (which later turned out to be identified as made by incision), while few of them showed the shapes of irregular dots or of small concave areas where bone material had been removed (which later turned out to be identified as made by pressure-and-displacement or gouging). Secondly, experimental marks were made on several bone pieces under controlled conditions in order to generate a set of comparative parameters to guide the macroscopic and microscopic observations of the archaeological materials (due to space limitations and to the nature of the main topic discussed here, the details about the experiments and the microscopic observations are not developed in this paper). Following the published literature on the topic (Marschack 1972; White 1982; D'Errico, 1991; D'Errico, 1995; Bromage and Boyde, 1984, etc.) and based on our own microscopic observations of the experimental marks (with stereomicroscope and SEM), several macroscopic features and microscopic traces of these marks were validated through blind tests as diagnostic criteria to identify each engraving technique. Thirdly, these criteria were used in the observation and characterization of each decorated piece (all of them were observed with stereomicroscope and a sample was also observed with ESEM).

[8] Incision can be the result of unidirectional or bidirectional movements: their identification has been possible due to the microscopic observation of microtraces kwnown as smears (Bromage and Boyde, 1984) which are located inside the groove and function as diagnostic criteria to distinguish between both types of movement (out of the total sample, these microtraces have been recorded in artefacts observed through ESEM). Also, incision marks show variations in their widths and depths according to the number of strokes/movements of the tool and to the tool's edge/point angle, among other factors (these features have been identified by observations through stereomicroscope and ESEM). Yet all these data are not relevant to the main topic of this paper and thus will not be discussed here.

Photo 1B. Detail of decorated harpoon point fragment, with incised design; site Tunel I, artefact #1249.



Drawings 1–2–3. Schematic rendition of inferred decorative engraving techniques.

Photo 2A. Decorated pendant, with design made by pressure-and-displacement technique; site Tunel I, artefact #2447.

(dashes and lines – see Tables 7 and 8). It is also noticeable that these artefacts have different motif-type repertoires (regardless of their combinations to make whole designs): the 60 decorated harpoon points show a repertoire of 26 motifs, most of which are different types of lines and figures (with few dash series and dot rows), while the 164 decorated beads show a 5 motif repertoire, mostly constituted by dash series, with fewer lines (usually rings or spirals) and no figures or dots (see Tables 7 and 8 and Fig. 1). This indicates that harpoon decoration had greater repertoire variability than bead decoration.

Moreover, such variability is even greater when considering the designs created by combining such motifs. Out of 60 decorated harpoon points, 34 are decorated by a single-motif design and 26 by combining two or more types of motifs, thus generating a total of 40 different designs: this indicates a very high design variability and greater room for individual input in harpoon decoration.

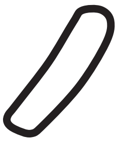
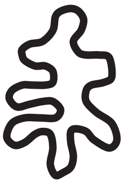
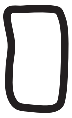
Photo 2B. Detail of decorated pendant, with design made by pressure-and-displacement technique (note also some incised dashes on the lower portion of the artefact); site Tunel I, artefact #2447.

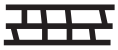
Photo 3A. Decorated harpoon point fragment, with gouged design (note some very thin and superficial incised lines in the middle portion of the artefact, near the harpoon tooth); site Tunel I, artefact #1807.

Photo 3B. Detail of decorated harpoon point fragment, with gouged design; site Tunel I, artefact #1807.

Conversely, out of 164 beads, 140 are decorated by a single-motif design and 24 by combining two types of motifs, thus generating a total of 11 different designs: this indicates a lower design variability and a stricter social control and/or a greater force of habit in their decoration. It could be argued that given that most beads

Table 6
Beagle Channel portable art motif repertoire: classes and types of decorative motifs, per main artefact types.

Motif class and type	Example	Dec hpp	Dec bead	Other dec artef
FIalov		X		
FIelongoval		X		
FIsinu		X		
FIsub-rectang		X		
FIrectserie				X
GUIset		X	X	X
PTset		X		X

Motif class and type	Example	Dec hpp	Dec bead	Other dec artef
LIanul		X	X	
LIcurvaA		X		
LIcurvaC		X		
LIcurvaU		X		
LIespiral			X	
LIanul/LIespiral		X	X	
LIperimirr		X		
LIrectaR		X		
LIrectaG				X
LIrectaBrellGUI		X		
LIrectaL		X		
LIrectaLrellZZ		X		
LIrectangoa		X		
LIrectangrect		X		
LIrectaU		X		
LIrectaV		X		
LIrectaV(simil alov)		X		
LIrectaVap		X		
LIrectaVrellLIr		X		
LIrectaZZ		X	X	
LIrectaZZap		X		
LIrectaZZrellGUI				
LIsinuV		X		

Key: The first letters of the motif type indicate the class to which they belong: FI = figures; GUI = dashes; PT = dots; LI = lines.

are smaller than harpoon points they provide a constrained space to create variable designs on them, thus reducing the options; yet other motifs of the Beagle repertoire could have been produced on such artefacts (e.g. chevrons, crosses, L-shaped lines, straight longitudinal lines, series of dots, rectangles, almond-shaped ovals, sinuous lines, etc.). Since some of these potential motifs entail a greater labour investment than the ones that were actually used, it is also inferable that bead decoration entailed a certain degree of labour economy. In sum, data suggest that beads had a comparatively narrower design affordance than harpoon points.

Regarding the decoration techniques, most harpoon designs were created by incision (the only exception being those which include point motifs, which were created by gouging and/or pressure-displacement); all beads were decorated by incision. This engraving technique is also very frequent in the decoration of bone harpoons, beads and other artefacts of other American, European and African contexts (e.g. Camps-Fabrer, 1966; Stewart, 1973; Julien, 1982; Corchón Rodríguez, 1986; Sieveking, 1991).

In sum, harpoon decoration was more variable (less standardised) than bead decoration regardless of the fact that decorated harpoon points are much fewer, were found in a comparatively shorter period and in fewer sites than beads. Hence these patterns result from human actions and do not depend on sample size or sample spatial–temporal distribution. The next section explores some of the potential reasons for this significant feature of the region's archaeological record.

Portable art in context

Harpoon point decoration involved a considerable labour investment due to the variety and detailed carving of their decorative designs. Such economic investment was sustained during a long period of 2100 years (6400–4300 BP), which indicates that the social and/or symbolic function of these decorated tools was effective within its socio-economic context, and was effectively transmitted through generations. One can only speculate about such functions: they may have been symbolically related to the artefact's efficiency in hunting prey, to the indication of individual and social identity of the producer/user of the harpoon points, etc. Yet what seems to be clear is that these decorated harpoon points were indeed used for hunting: the fracture index[9] of the decorated harpoon points (0.80) is very similar to that of the non-decorated harpoon points (0.79; see Table 9), and there is no statistically

[9] The fracture index has been calculated as follows: number of fractured harpoon points divided per total number of harpoon points. The data used to calculate the fracture index of decorated and non-decorated harpoon points are recorded in Table 9.

Table 7

Decorated harpoon points: motif repertoire and its distribution per period.

Period	Motif types used in harpoon points																										motif repertoire	technique repertoire	N hpp	N sites
	FIalov	FIelongoval	Fisinu	FIsub	GUIset	Lianul	LIcurvaA	LIcurvaC	LIcurvaU	LIanul/ LIespiral	Liperimirr	LIrectaR	LIrectaBrellGUI	LIrectaL	LIrectaLrellZZ	LIrectangoa	LIrectangrect	LIrectaU	LIrectaV	LIrectaV (simil alov)	LIrectaVap	LIrectaVrellGUI	LIrectaZZ	LIrectaZZap	LIsinuV	PTset				
100–2200					1																						1	1	1	1
2200–4300					1																						1	1	1	1
4300–6400	4	1	1	1	2	3	5	6	2	1	1	13	1	2	1	2	2	1	1	4	1	1	2	2	2	6	26	3	43	3
Indet + sup	3	1					2	2	1		1	9					1								1	1	10	1	15	4
Total cases	7	2	1	1	4	3	7	8	3	1	2	22	1	2	1	2	3	1	1	4	1	1	2	2	3	7	26	3	60	6

Key: Each term refers to a different type of motif. Motif types are named as follows: FI indicates types of figures; GUI indicates dashes; LI indicates types of lines; PT indicates dots. Since a design may be constituted by a single type of motif or by a combination of two or more types of motifs, the number of motif types recorded in this table is larger than the number of decorated harpoons. Motif repertoire = number of motif types used in harpoon points (regardless of combination); technique repertoire = number of decorative techniques used in harpoon points (regardless of combination); *N* hpp = number of decorated harpoon points; *N* sites = number of sites.

significant relationship between harpoon decoration/non-decoration and harpoon fracture (X^2 test = 0.00; df = 1; Pval = 1); these seem reliable indicators of their actual involvement in a practical-mechanical function which involved the risk of breakage. Such risk may also have been one of the reasons why harpoon decoration decreased with time: labour was invested in the manufacture of a design which may have been lost at sea or broken during hunting. Comparatively, bead decoration bears a lower risk of losing the labour invested in such decoration, since comparatively their loss chances are lower and their breakage chances are even lower.

Another reason why harpoon point decreased with time may have been the decrease of pinniped hunting. Although some harpoon types may have been used also for capturing other species, evidence shows that harpoon points were indeed used to hunt sea lions and fur seals: (a) there is a smaller number of harpoon points in sites where the proportion of pinnipeds is lower (e.g. this is noticeable when comparing between sites Tunel I, Imiwaia I and Shamakush I; see data in Orquera and Piana, 1999); (b) there is a piece of bone artefact – likely to be a harpoon tip – stuck in the vertebrae of a pinniped in site Tunel I (Orquera, pers. commun., 2009); (c) numerous ethnographic data clearly point to the use of harpoon points for pinniped hunting (Orquera and Piana, 1999). Recent studies have shown that pinniped hunting decreased through time when compared to the exploitation of other resources, such as fish, guanacos and birds, although they still provided the greatest proportion of kcal. (Zangrando, 2009). Hence, it is worth exploring the hypothesis that harpoon use and harpoon decoration decreased with the decrease of pinniped hunting. The available archaeofaunal data relevant for assessing this issue do not come from all the sites under study in this paper: data of site Tunel I will be used here, which contains one of the longest archaeological sequences and one of the greatest collections of harpoon points of the region (see Table 4), which makes it a relevant example to test this hypothesis.

If the hypothesis were correct, it would be expectable to find a correlation between pinniped hunting, harpoon frequency in general and harpoon decoration in particular. A regression analysis shows that in Tunel I there is a clear correlation between pinniped NISP and harpoon frequencies in general (correlation coefficient = 0.88; r^2 = 78.9%; 99% confidence; Table 10); and between pinniped NISP and decorated harpoon points in particular (correlation coefficient = 0.82; r^2 = 68.7%; 99% confidence). Such correlations suggest that the interest in decorating harpoon points may have shifted away from these artefacts due to a potential general reduction of the socio-economic value of these tools, which may have stemmed from the relative decrease in the consumption one of the main preys that were captured with them: the pinnipeds. Yet, as shown in the previous section, such decrease in the attention paid to the harpoon points was not due to a problem of sample size reduction. Therefore, an intentional pattern is inferrable from these data. Such pattern is of course only applicable to Tunel I site, and it is not assumed to be necessarily representative of the whole region. Nevertheless, given that, as noted above, this site covers a long diachronic sequence and includes one of the biggest collections of harpoons, the results obtained do shed new light on the harpoon-sea lion relationship and are an interesting starting point to develop further comparative studies with other sites of the region.

An independent line of evidence that links harpoon decoration with pinniped hunting is the comparison between the densities of pinniped remains per excavated volume (m^3) in Tunel I and Imiwaia I, with the frequencies of decorated and non-decorated harpoon points in each site. This shows a statistically significant relationship between the decorated harpoon points and the pinniped remains (X^2 = 8.98; df = 2; Pval = 0.0112; 95% confidence; Table 11), which in turn points again to the relationship between both activities.

Table 8
Decorated beads: motif repertoire and its distribution per period.

Period	Motif types used in beads					Motif repertoire	Technique repertoire	*N* beads	*N* sites
	GUIset	Lianul	LIanul/LIesp	LIespiral	LIrectaZZ				
100–2200	28	50	1	1	6	5	1	74	7
2200–4300	33		2			2	1	34	2
4300–6400	40	8	3	2		4	1	43	3
Indet + sup	11		1	1	1	4	1	13	4
Total cases	112	57	7	3	7	5	1	164	10

Key: Each term refers to a different type of motif. Motif types are named as follows: GUI indicates dashes; LI indicates types of lines. Since a design may be constituted by a single type of motif or by a combination of two or more types of motifs, the number of motif types recorded in this table is larger than the number of decorated beads. Motif repertoire = number of motif types used in beads (regardless of combination); technique repertoire = number of decorative techniques used in beads (regardless of combination); *N* beads = number of decorated beads; *N* sites = number of sites.

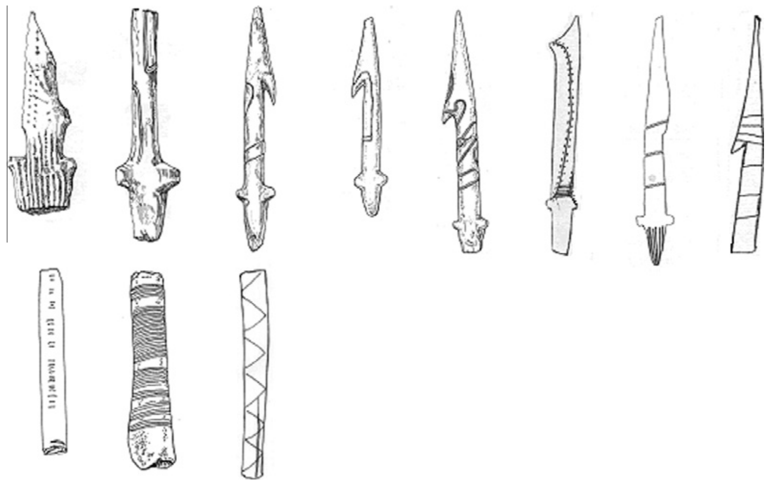


Fig. 1. Decorated artefacts from the Beagle Channel region. *Key*: Above, from left to right: decorated harpoon points from Lancha Packewaia (artefact #30B); Sados (artefact #4); Túnel I (artefacts #1253, #15, #1868, #2447, #13, #2483). Drawings 1 to 5 by Diana Alonso. Below, from left to right: decorated beads from Túnel I (artefacts #506 and #1326) and Shamakush XVI (artefact #15). Drawings 1 and 2 by Diana Alonso. Drawings have been made at different scales: decorated bead sizes normally range from 15 mm to 60 mm (with an outlier case of 133 mm); decorated harpoon points range from 120 mm to 180 mm (measured in complete – not fragmented – cases).

Table 9
Beagle Channel decorated and non-decorated harpoon points: complete and fragmented cases per site.

Site	Comp/fragm	Non-dec hpp	Dec hpp
Imi I	Complete	8	0
Imi I	Fragment	32	6
Lana	Complete	3	0
Lana	Fragment	0	0
Mis	Complete	4	0
Mis	Fragment	4	2
TI	Complete	9	9
TI	Fragment	71	35
TVII	Complete	8	0
TVII	Fragment	22	0
LP	Complete	5	2
LP	Fragment	9	1
Total	Complete	37	11
Total	Fragment	139	44
Total hpp		175	55

Key: hpp = harpoon point. This table excludes data about decorated harpoons in site Sados (*N* = 3) and in locus Central Beagle Channel (*N* = 2) since the contexts have not been documented extensively enough to provide a proper frame of comparison with potential non-decorated harpoons that might have been deposited in these sites.

Table 10
Site Tunel I: pinniped NISP and harpoon points per dated layer.

Tunel I	NISP pinnipeds	hpp	hpp non-dec	hpp dec
Layer E	12,922	15	6	9
Layer D I	2223	0	0	0
Layer D II	6645	13	6	7
Layer D III	3288	4	2	2
Layer D IV	11,346	10	7	3
Layer D V	5067	10	7	3
Layer D VI	4764	5	3	2
Layer D VII	4434	5	4	1
Layer D VIII	3398	6	6	0
Layer C3	983	0	0	0
Layer alfa	780	1	1	0
Layer C1 floor 2	707	0	0	0
Layer beta	113	1	1	0

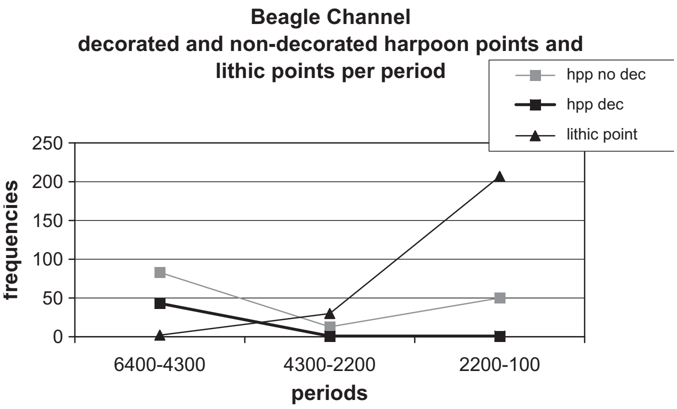
Key: hpp = harpoon point; non-dec = not decorated; dec = decorated.
Note: The frequencies of the harpoon points recorded in this table correspond only to the dated layers of site Tunel I (*N* = 70); the remaining harpoon points (*N* = 54) have been found in layers which can only be attributed to a period but not to a specific date (e.g. layer D general = 6400–4300 BP), in layers of indeterminate date, or in the site's surface.

The decreasing attention paid to harpoon decoration in the Beagle Channel region can also be related to a relative decrease in the use of bone artefacts in general, which was concomitant with an increase in the importance of lithic tools, measured by their frequency in each assemblage (see Table 4). This is particularly noticeable when comparing the frequencies of harpoon points versus lithic points per period: while the former decreased, the frequency of the latter increased in time ($X^2 = 242.31$; df = 4; Pval = 0; 99% confidence; see Graphic 4). It is clear that bone tools

Table 11
Sites Tunel I and Imiwaia I: decorated and non-decorated harpoon points compared to pinniped remains volume.

	Tunel I	Imiwaia I
hpp non-dec	80	40
hpp dec	44	6
pinnip volume	1658	300

Key: hpp = harpoon point; pinnip volume = pinniped remains per excavated volume (remains per 1 m^3).



Graphic 4.

did not perform the same functions than lithic tools, and that lithic points did not replace harpoon points.[10] Yet it is also clear that the former became predominant in the most recent assemblages of the sequence: such change in the tool-kit may have been accompanied by a change in the social perception and value of bone artefacts (including not only harpoon points but also awls, wedges, rods, etc.), which may have influenced the reduction in their decoration through time. It is clear that bone tools were still crucial to carry out a number of tasks, but apparently their producers considered that they no longer required the extra labour investment involved in their decoration.

Another factor which may have influenced this diacronic trend is the class of harpoons that were decorated. As noted above, harpoon points can be broadly divided into two classes: detachable and non-detachable. Along the whole archaeological sequence, detachable harpoon points were always more frequent than non detachable ones, yet while in the early and middle periods the detachable/non-detachable harpoon points ratio was about 2/1, the proportion of detachable harpoon points increased noticeably in the recent period, generating a 9.8/1 ratio respect of non-detachable ones (Table 5 – section B; $X^2 = 12.48$; df = 2; Pval = 0.0019; 99%). The reasons for this technological change in the frequencies and proportions of each harpoon class are far from the scope of this paper, but it is interesting to characterise how they were treated in terms of their decoration: it is clear that detachable harpoon points were selected for decoration (out of 170, 55 [32%] were decorated), while few non-detachable harpoon points received decoration (out of 65, 5 [8%] were decorated), so the association between detachable harpoon points and decoration is statistically significant and does not seem to be random or due to sample size ($X^2 = 13.77$; df = 1; Pval = 0.0002; 99%; Table 5 – section C).

This is particularly interesting, since according to historic and ethnographic sources from Tierra del Fuego and to archaeological inferences from the materials under study, detachable harpoons mainly served to hunt pinnipeds and other maritime mammals while both hunter and prey were at sea (e.g. from a canoe), since upon the impact on the prey, the point was automatically detached from the haft but remained firmly linked to it with a string – the haft then acted as a buoy which helped indicate the location of the wounded prey and diminished its possibilities of escaping (Orquera and Piana, 1999). Therefore, this class of harpoons has a higher loss risk than non-detachable harpoons, which, according to the same sources, were used to hunt on dry land and thus had higher chances of being retrieved and re-used. This implies that detachable harpoons were intensely decorated even though their potential loss risk was higher. In turn, this adds more evidence to the point made above, that making and using decorated harpoons had a social and/or symbolic value which was more important for their producers/users than the economic value of losing the labour invested in engraving them if they got lost at sea.

As noted above, most of the decorated harpoon points were recorded in the early period – 6400–4300 BP. Thus, when assessing the diachronic changes in the decoration of detachable and non-detachable harpoon classes, it is noticeable, as expected, that the greatest proportion of decorated pieces in both harpoon classes is concentrated in such period (Table 5 – section C). Yet it is interesting to note that in spite of the diachronic increase recorded in the frequency of the detachable harpoon points, none are decorated in the recent period, while in spite of the noticeable diachronic decrease in the frequency of non-detachable harpoon points, there is still one decorated case in such period ($X^2 = 52.59$; df = 6; Pval = 0.0000; 99%).

In sum, the data show a drastic diachronic reduction in harpoon decoration, which is not dependant on sample size, and can be related to: (a) a covariation with pinniped hunting (both measured diachronically in a NISP/harpoon point regression in site Tunel I, and by comparing decorated/non-decorated harpoon point frequencies with pinniped remains per excavated volume in sites Tunel I and Imiwaia I); (b) a diachronic reduction in the frequency of bone artefacts in general and an increase in the frequency of lithic tools (particularly visible in the comparison between harpoon points and lithic points per period); (c) their breakage risk (a risk which did occur, according to their breakage index); (d) their loss risk, which was higher in detachable harpoon points, which were indeed the most frequently decorated ones in the early period, and which ceased to be decorated in spite of their high frequencies in the recent period. Thus, while the labour invested in harpoon decoration in the early period seems to have been related to the social, symbolic and/or economic value of making, having and/or using such an engraved tool, in the longer term a cost-minimising rationale seems to have at least been partly involved in the noticeable diachronic decrease of their decoration throughout the Beagle Channel archaeological sequence.

Conversely, beads show a different diachronic trajectory. As noted above, their decoration increased with time beyond the number of beads per assemblage, thus not depending on sample size but reflecting human actions. Given that beads' risk of loss/fracture is very low, such factor may have played a significant role in the diachronic increase of their decoration, in so far as the labour invested in such task would not be endangered.

A contextual factor that might have influenced this process is the consumption of birds as a dietary staple in the subsistence sphere and as a source of raw materials for tool-making in the technological sphere (see Table 12). Regarding the subsistence sphere, it is interesting to note that zooarchaeological studies of the bird remains from 5 sites of the Beagle Channel indicate that "there is a clear increase in the relative abundance of bird remains

[10] There is one case of a lithic point inserted into a pinniped vertebra in site Ajej I (Orquera pers. commun., 2009), which indicates that both types of weapons might have turned complementary to carry out this task.

Table 12
Comparative data about bird consumption and use in subsistence (archaeofauna) technology (hollow awls) and ornamentation (beads).

	Archaeofaunal assemblages	Hollow awls	Decorated and non-decorated beads
Number of sites	5	6	7
Sites	Tunel II Imiwaia I Mischiuen I Shamakush I Shamakush X	TunelI Tunel II Imiwaia I Mischiuen I Shamakush I Shamakush X	TunelI TunelII TunelVII Imiwaia I Mischiuen I Shamakush I Lancha Packewaia
Predominant family/ genus/species	Phalacrocoracidae (cormorants) Spheniscus (penguins)	Procellariidae (e.g. petrels) Phalacrocoracidae (e.g. cormorants)	Procellariiformes (e.g. albatross and shearwaters) Phalacrocoracidae (e.g. cormorants)
Predominant bones	–	Humeri and tibias	Radius and ulnas
Bibliographical references	Tivoli (2010b)	Scheinsohn (1997) and Tivoli (2010a)	Tivoli and Fiore (in preparation)

Table 13
Site Tunel I: birds NISP and beads per layer.

Tunel I	NISP birds	Total beads	Non-dec beads	Dec beads
Layer E	indet	6	4	2
Layer D I	70	0	0	0
Layer D II	252	6	6	0
Layer D III	185	3	3	0
Layer D IV	901	8	7	1
Layer D V	450	33	30	3
Layer D VI	515	18	5	13
Layer D VII	305	19	13	6
Layer D VIII	527	21	20	1
Layer C3	800	1	0	1
Layer alfa	960	4	2	2
Layer C1 floor 2	64	1	1	0
Layer beta	32	0	0	0

in assemblages after 1500 years BP" (Tivoli, 2010b, p. 10[11]), hence bird bone bead decoration and bird dietary consumption both increased diachronically.

Thus, it is worth exploring whether both activities show a statistically significant relationship: a correlation between bird bone beads and archaeofaunal bird remains would indicate that there was an overall increased attention towards birds in general, which involved their capture and consumption in two different but related spheres – i.e. subsistence and ornamentation. In order to test this hypothesis, the available data about bird consumption in the archaeofaunal assemblages per dated layer of site Tunel I (Orquera and Piana, 1999; Zangrando, 2009) are correlated with the frequencies of bird bone beads in general and of decorated beads in particular per dated layer of the same site, regardless of taxonomical identification. A regression analysis of these data shows that there is no statistically significant relationship between birds NISP and bird beads in general (correlation coefficient = 0.17; r^2 = 3.17%; Table 13), and between birds NISP and decorated beads in particular (correlation coefficient = 0.19; r^2 = 3.65%; Table 13). This suggests that bird bone bead production did not covary with bird dietary consumption along the sequence of site Tunel I, which entails that the relationship between bird use as raw material for ornamentation and as a subsistence staple did not increase in a coordinated manner.

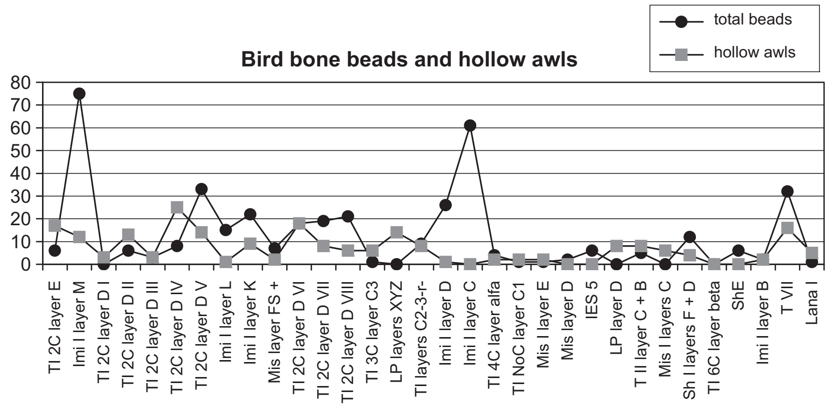
Yet it is clear that taxonomical identifications of archaeofaunal and ornamental materials in Tunel I and other sites might point to specific covariations for the use of certain families/genus/species in ornament production and dietary consumption. As noted above, preliminary results of ornament studies from seven sites indicate that the bird families most frequently used to produce beads were Procellariiformes (e.g. albatross and shearwaters) and Phalacrocoracidae (e.g. cormorants; Tivoli and Fiore, in preparation), while the zooarchaeological studies from five sites indicate that Phalacrocoracidae (cormorants) and Spheniscus (penguins) were the most frequently consumed species in the Beagle Channel region (Tivoli, 2010b, p. 4). Hence some species seem to have been consumed both in the subsistence sphere and in the artistic-ornamental sphere (e.g. cormorants), while others seem to have been mainly restricted to one sphere and not related to the other (e.g. penguins seem to be closely related to subsistence and not to ornamentation). Further analyses involving taxonomical identifications will provide higher-resolution information about this issue, yet what is clear at this point of the research is that bird bone decoration increased in time within a context of increase in bird consumption for subsistence purposes, and that there is some overlap in the use of some species in both spheres.

Regarding the technological sphere, it might be the case that bead making was related to the production of other artefacts made with bird bones, such as the hollow awls (see description of these tools in Scheinsohn (1997)). Thus, it is worth exploring the hypothesis of a co-variation between bird bone beads and bird bone awls frequencies at a broad scale – that is, regardless of taxonomical identification – in the dated layers of the 13 sites studied in this paper. A correlation between both types of artefacts would suggest that bead production and tool-making had similar diachronic trends due to an overall similar attitude towards the exploitation of birds for ornamental and technological purposes, regardless of their species. A lack of correlation would suggest that both types of artefacts followed independent trajectories, and thus would point to specific trends in the production, decoration and use of beads respect of the production and use of awls. The latter situation seems to be what happened in the Beagle Channel region, since not only has bead production been more frequent than hollow awl production, but also a regression test shows that they clearly do not covary in time (correlation coefficient = 0.18; r^2 = 3%; see Graphic 5).

One of the reasons for this lack of diacronic covariation may be related to the fact that the production sequences of beads and hollow awls seem to have been relatively separate because different bones and/or different species were used to make them: beads were mainly produced with radius and ulnas of Procellariiformes (e.g. albatross and shearwaters) and Phalacrocoracidae (e.g. cormorants) (Tivoli and Fiore (in preparation)) while awls were mainly produced with humeri and tibias of Procellariidae (e.g. petrels), Phalacrocoracidae (e.g. cormorants) and Anatidae (e.g. ducks) (Scheinsohn, 1997; Tivoli, 2010a[12]). Thus, although there is some

[11] The archaeofaunal assemblages have been recorded in the following five sites: Tunel II, Imiwaia I, Mischiuen I, Shamakush I and Shamakush X (Tivoli, 2010a,b).

[12] Bird bone awls have been recorded in six sites: Túnel I, Tunel II, Imiwaia I, Mischiuen I, Shamakush I and Shamakush X (Scheinsohn, 1997; Tivoli, 2010a).



Graphic 5.

potential overlap in the use of cormorants for technical and ornamental purposes, other species seem to have been mainly consumed in one sphere and not in the other: further taxonomical analyses of bird bone beads will shed more light on these matters in the future. Yet what is clear is that the bones more frequently used to make each type of artefact are different, which would have made the exploitation of a single species compatible for the twofold purpose of tool-making and bead-making, while in the case of the use of different species for each artefact type, such incompatibility would not have existed. In this context, it rather seems that bead making/decoration was a relatively independent creation that fluctuated diachronically due to internal factors apparently unrelated to hollow awl production rates, such as the effective use and transmission of techniques to make and decorate beads and/or the socio-economic value given to these ornaments.

In sum, these trends suggest that bead production in general and bead decoration in particular increased in time in concordance with an increase in bird remains in the archaeofaunal record, but they were neither directly related to bird consumption for subsistence purposes nor to the production of tools with bird bones: they rather seem to have been an independent event focused on people's interest in self-ornamentation.

Discussion and conclusions: art in time, time in art

The data under study in this paper have shown a number of trends in the diachronic production of portable art in the Beagle Channel region. It is clear that in the early period of the archaeological sequence (6400–4300 BP) a larger number of types of artefacts were chosen for decoration with a much broader range of decorative designs than in the following periods. Such broad range was narrowed considerably towards the middle and recent periods: both design variability and the types of decorated artefacts were reduced drastically. Tools, particularly harpoon points, ceased to be decorated in spite of the fact that harpoon points were still produced in the region. Conversely, beads continued to be decorated and even increased their proportions of decorated cases (versus non-decorated beads). Both of these trends are neither due to sample size, nor related to the number of assemblages under study. In fact, the early period includes within a few sites a greater variability of artefact types and of motifs repertoire, while the recent period shows lesser variability of artefacts and of motifs across more assemblages from different sites. This indicates a clear trend that did not result from chance, but stemmed from human actions.

The reasons for such actions may be many, and the analyses carried out in this paper shed light on some of them. Firstly, the fact that harpoon points ceased to be decorated seems to show a choice towards the reduction in the risk of losing the labour invested in their ornamentation when they broke or got lost at sea. Such labour investment was particularly high, since many of the designs displayed on the harpoon points were the most complex and varied of the whole Beagle Channel repertoire.

Harpoon production and harpoon decoration co-varied with the frequency of pinnipeds in some of the archaeofaunal assemblages, which were one of the key preys for subsistence. It is possible – tough not archaeologically testable – that harpoon points were decorated in order to increase symbolically their performance potential in capturing these preys. This does coincide with the fact that their decoration diminished within a context of relative diachronic increase in the consumption of other resources such as fish, birds and guanacos, as noted by zooarchaeological studies (Zangrando, 2009; Tivoli, 2010a,b).

After harpoon decoration decreased, the production and use of lithic flaked points showed a noticeable increase. In spite of the fact that the former are not replaceable by the latter, such process may have contributed to diminish the socio-economic value of harpoon points and thus the attention paid to their visual appearance.

Finally, in harpoon decoration variety was the norm. The broad design repertoire recorded in harpoon decoration indicates that motif creation was either developed in a rather free cultural context, or that it was fostered through a social requirement of individual expression. In other words, the fact that designs were not socially constrained to a stricter repertoire suggests that their variety was either indifferent or desirable. Given that the great majority of harpoon points were engraved through incision, teaching-and-learning and/or imitation seem to have functioned as the basic mechanisms of transmission of technical knowledge, while design creation seems to have included also individual innovation. Thus, complying with expectation A, in the harpoon points case decorative technique had a lower rate of change than design, an outcome that is expectable given that, as mentioned above, numerous motifs can be created with a single technique.

Conversely, bead decoration continued through time. The choices behind this process seem to include a factor related to the reduction of labour investment, both due to beads' intrinsic lower risk of loss/fracture and to the comparatively simpler designs traditionally engraved on these materials. The selection of these bird bone pieces for decoration shows no correlation with bird bone artefact production nor with bird consumption for subsistence: therefore, bead production and bead decoration do not seem to have been related to raw material availability or to its use for other technical purposes. Rather, results show that in the Beagle Channel region there was a persistence of self-ornamentation as an issue of social importance that continued through time.

Not only was there a continuation in bead wearing: there was also an increase in the decoration of such beads, which suggests an enhancement of their social value. Contrary to the harpoon points case, bead designs are simple, quite standardised, and have low repertoire variability. In terms of their production, this entails that their decoration entailed a lower labour investment and was subject to greater social control and/or to greater force of habit: individual innovation seems to have had little room while teaching-and-learning and/or imitation would have been the key transmission mechanisms that led to the continuation of bead decoration through 6400 years. In terms of their display, the design constraint generated by standardization hints towards the existence of certain explicit rules and/or implicit habits which dictated what was appropriate to wear as a personal ornament. This relatively narrow range of options shows little room for the expression of individual identities, but rather hints to a visual construction of a collective social identity reflected in a well-defined repertoire repeated through time.[13]

Such collective identity may have been transcended the Beagle Channel populations and may also have included the neighbouring populations in Northern Tierra del Fuego (site Tres Arroyos; Massone, 1988, Massone et al., 1993), in Otway Sound (site Ponsomby; Legoupil, 2003), in Brunswick Peninsula (site Punta Santa Ana; Ortiz Troncoso, 1979) and in South-Eastern continental Patagonia (site Palli Aike; Bird 1988), across the Magellan Strait (see Map 1), which share several identical bead designs of similar dates (Fiore, 2006b).[14] This is consistent with the purpose of creating and maintaining social alliances through visual means, which would serve as reciprocity mechanisms to buffer stress and minimise risks (Sahlins, 1977; Gamble, 1982; Jochim, 1983). Such alliances would partly flourish by reinforcing similarities within and between groups: the similarities in bead designs might have fit this purpose.

Within this long-term process, and fitting expectation A, bead decoration technique had a lower rate of change than bead design, which again is expectable due to their respective intrinsic possibilities of variation. Yet bead design standardization does indicate some stricter control or stronger traditional habit over its reproduction, making this case closer to (but not classifiable within) expectation B.

More importantly, due to their standardization, bead designs had a lower rate of change than harpoon designs. This suggests that the former were subject to stronger selection conditions than the latter, partly due to their size and shape, which may have constrained the types of designs to be engraved in them, but mainly due to their social function in the creation of a collective way of self-ornamentation, which did not afford deep individual differences – as harpoon points did. Thus, while in the cases under study decorative techniques seem to have followed a similar reproduction path, motif repertoires seem to have been reproduced by slightly different mechanisms of transmission – less socially controlled in the harpoon points case and more socially controlled in the beads case. These mechanisms may have contributed to their differential continuity through time.

In summary, portable art in the Beagle Channel showed various changes through time, which were related to:

(a) contextual changes in the *subsistence and technology sphere*, visible in: (1) a lack of co-variation between harpoon production and harpoon decoration frequencies, which indicates that the identified trends are not biased by sample size; (2) a co-variation between harpoon point decoration and pinniped consumption (in sites where the data are available); (3) a preliminary lack of co-variation between bird bone beads, bird archaeofaunal remains and bird bone tools;
(b) internal *economic and social factors* within the artistic sphere itself, visible in: (1) an overall diachronic reduction of labour investment in portable art production through the archaeological sequence – the number of decoration techniques is reduced, the number of artefact types selected for decoration is reduced, motif repertoire is reduced, motif complexity is reduced; (2) a differential labour investment in decorating artefacts with different loss/fracture risks: in the early period harpoon decoration involves the highest labour investment in terms of its motif variability and complexity in spite of its high loss/fracture risk, yet harpoon decoration strongly decreases diachronically while bead decoration increases, indicating a shift towards a cost-minimising logic throughout the three-period sequence; (3) greater room for individual innovation in harpoon decoration versus stricter socio-economic conventions in bead decoration;
(c) internal *technique and design features* of artefact decoration, visible in: (1) a longer diachronic continuity of bead decoration repertoire versus a shorter diachronic continuity of harpoon decoration repertoire; (2) a faster rate of change of harpoon points' wider design repertoire versus a slower rate of change of beads' narrower design repertoire; (3) a slower rate of change of decorative technique than of decorative design.

All these processes operated simultaneously while art was being produced and displayed, but had different diachronic trajectories and asynchrony *rhythms* or *tempos* of production/reproduction: unravelling them sheds light on some of the conditions under which art changed in time.

Acknowledgments

I am very grateful to Luis Orquera and Ernesto Piana for giving be access to all the decorated materials found by the Beagle Channel Archaeological Project (many of which were excavated before I joined the team), and for their constant interest in this line of research. I am especially grateful to Stephen Shennan for his suggestions on how to face the Beagle archaeological assemblages during the initial stages of this project, and for his comments on the final version of the manuscript. To Luis Orquera for providing unpublished data about pinniped remains from site Tunel I; to Myrian Alvarez, Marita Varela and Francisco Zangrando for their input on different sections of this paper. To the Museo del Fin del Mundo (Ushuaia, Tierra del Fuego, Argentina) for their permission to record its archaeological collections from the central portion of the Beagle Channel. To the Instituto de la Patagonia (Punta Arenas, Chile) for their permission to observe the archaeological collections from sites Bahía Buena, Punta Santa Ana, and Punta Baja. To Eduardo Favret and Ramon Castillo Guerra (CNEA, Buenos Aires) for their help in operating the SEM, and to the staff from CITEFA (Buenos Aires) for their help in operating the ESEM. I am also very grateful to reviewer #1 for her/his useful and constructive comments, which have helped to improve several sections of this paper. Part of the research presented in this paper has been generously funded by Grant PICT 2071 (MINCY-ANPCYT, Argentina). This paper is dedicated to my *maestros* Stephen and Luis.

[13] Yet, maybe only a single age group or gender group within those populations wore the decorated beads. Thus, beads could have been used to create a smaller-scale group identity, generating intra-society differences; but so far there is no evidence to support this possibility.

[14] Other decorated materials – like harpoon points, other bone tools and bone fragments – with similar designs to those from the Beagle Channel have been found in Northern Tierra del Fuego (site Marazzi; Laming-Emperaire et al., 1972), Otway Sound (sites Bahía Colorada and Englefield; Legoupil, 1997; Emperaire and Laming, 1961), Bunswick Peninsula (sites Bahía Buena, Punta Santa Ana and Punta Baja; Ortiz Troncoso, 1979; Legoupil, 1989) and South-Eastern continental Patagonia (site Fell, Legoupil, 2003); see Map 1.

References

Alvarez, M., Briz I. Godino, I., 2006. La organización tecnológica en el proceso de poblamiento del extremo sur de Sudamérica. Habitus. Goiania 4 (2), 771–795.

Aschero, C., 1988. Pinturas rupestres, actividades y recursos naturales, un encuadre arqueológico. In: Yacobaccio, H. (Ed.), Arqueología Contemporánea Argentina. Búsqueda, Buenos Aires, pp. 51–69.

Bailey, G., 1983. Concepts of time in quaternary prehistory. Annual Review of Anthropology 12, 165–192.

Bednarik, R., 2001. Rock Art Science. The Scientific Study of Palaeoart. Brepols, Turnhout.

Bird, J., 1988. Travels and Archaeology in South Chile. University of Iowa Press. Iowa City.

Boas, F., 1955. Primitive Art. Dover Publications, New York.

Bourdieu, P., 1977. Outline of a Theory of Practice. Cambridge University Press, Cambridge.

Bradley, R., 1991. Ritual, time and history. World Archaeology 23, 209–219.

Bromage, T., Boyde, A., 1984. Microscopic criteria for the determination of directionality of cutmarks on bone. American Journal of Physical Anthropology 65, 359–366.

Camps-Fabrer, H., 1966. Matiére et art mobilier dans la Préhistoire Nord-Africaine et Saharienne. Mémoires du CRAPE. Arts et Métiers Graphiques, Paris.

Conkey, M., 1987. New approaches in the search for meaning? A review of research in "Palaeolithic art". Journal of Field Archaeology 14, 413–430.

Corchón Rodríguez, S., 1986. El arte mueble Paleolítico cantábrico: contexto y análisis interno. Ministerio de Cultura, Madrid.

Costall, A., 1997. The meaning of things. Technology as skilled practice. Social Analysis 41 (1), 76–85.

D'Errico, F., 1991. Microscopic and statistical criteria for the identification of prehistoric systems of notation. Rock Art Research 8 (2), 83–93.

D'Errico, F., 1993. La vie sociale de l'art mobilier Paléolithique. Manipulation, transport, suspensión des objets on os, bois de cervidés, ivoire. Oxford Journal of Archaeology 12 (2), 145–174.

D'Errico, F., 1995. A new model and its implications for the origin of writing: the La Marche Antler revisited. Cambridge Archaeological Journal 5 (2), 63–206.

Emperaire, J., Laming, A., 1961. Les gisements des îles Englefield et Vivian dans la mer d'Otway (Patagonie australe). Journal de la Société des Américanistes 50, 7–77.

Figuerero Torres, M.J., Mengoni Goñalons, G. (Eds.), 1986. Excavaciones arqueológicas en la Isla El Salmón, Parque Nacional Tierra del Fuego. PREP Informes de Investigación, vol. 4. PREP, Buenos Aires.

Fiore, D., 1999. Diseños y técnicas en la decoración de artefactos: el caso de los sitios del Canal Beagle, Tierra del Fuego. Actas del XIII Congreso Nacional de Arqueología Argentina 2, 75–89.

Fiore, D., 2006a. Poblamiento de imágenes: arte rupestre y colonización de la Patagonia. Variabilidad y ritmos de cambio en tiempo y espacio. In: Fiore, D., Podestá, M.M. (Eds.), Tramas en la piedra. Producción y usos del arte rupestre. WAC, AINA and SAA, Buenos Aires, pp. 43–62.

Fiore, D., 2006b. Puentes de agua para el arte mobiliar: la distribución espacio-temporal de artefactos óseos decorados en Patagonia meridional y Tierra del Fuego. Cazadores-Recolectores del Cono Sur. Revista de arqueología I, 137–147.

Fiore, D., 2007. The economic side of rock art. Concepts on the production of visual images. Rock Art Research 24 (2), 149–160.

Gamble, C., 1982. Interaction and alliance in Palaeolithic society. Man 17, 92–107.

Garcia Canclini, N., 1986. La Producción Simbólica. Teoría y Método en Sociología del Arte. Siglo XXI, Mexico.

Gell, A., 1992. The Anthropology of Time: Cultural Reconstructions of Temporal Maps and Images. Berg, Oxford.

Gortari, E., 1991. Lógica General. Grijalbo, Mexico.

Gosden, C., 1994. Social Being and Time. Blackwell, Oxford.

Jochim, M., 1983. Palaeolithic cave art in ecological perspective. In: Bailey, G. (Ed.), Hunter–Gatherer Economy in Prehistory. New Directions in Archaeology. Cambridge University Press, Cambridge, pp. 212–219.

Julien, M., 1982. Les harpons Magdaléniens. XVII Supplément á Gallia Prehistoire. CNRS, Paris.

Laming-Emperaire, A., Lavallée, D., Humbert, R., 1972. Le site Marazzi en Terre de Feu. Objets et Mondes 12, 225–244.

Legoupil, D., 1989. Ethno-archéologie dans les archipels de Patagonie: les nomades marins de Punta Baja. Editions Recherche sur les Civilisations, Paris.

Legoupil, D., 1997. Bahia Colorada (île dÉnglefield). Les premiers chasseurs de mammifères marins de Patagonie australe. Editions Recherche sur les Civilisations, Paris.

Legoupil, D., 2003. Cazadores-recolectores de Ponsonby (Patagonia austral) y su paleoambiente desde VI al III milenio AC. Magallania. Tirada Especial Documentos 31, Punta Arenas.

Leroi-Gourhan, A., 1965. Prehistoire de Ĺart occidental. Mazénou, Paris.

Leroi-Gourhan, A., 1976. Sur les aspects socio-économiques de Ĺart paléolithique. Ĺautre et Ĺailleurs; Hommages a Roger Bastide 1, 164–168.

Leroi-Gourhan, A., 1953–1955. Evolution et techniques. I. L'Homme et la matiére. Albin Michel, Paris.

Lucas, G., 2005. The Archaeology of Time. Routledge, London.

Lyman, L., O'Brien, M., 2006. Measuring Time with Artifacts: A History of Methods in American Archaeology. University of Nebraska Press, Lincoln and London.

Marschack, A., 1972. Upper Paleolithic notation and symbol. Science 178 (4063), 817–828.

Massone, M., 1988. Artefactos óseos del yacimiento arqueológico Tres Arroyos (Tierra del Fuego). Anales del Instituto de la Patagonia 8, 107–112.

Massone, M., Jackson, D., Prieto, A., 1993. Perspectiva arqueológica de los Selḱnam. Centro de Investigaciones Diego Barros Arana. Santiago de Chile.

Mc. Glade, J., 1999. The times of history: archaeology, narrative and non-linear causality. In: Murray, T. (Ed.), Time and Archaeology. Routledge, London, pp. 139–160.

Murray, T. (Ed.), 1999. Time and Archaeology. Routledge, London.

Orquera, L., Piana, E., 1999. Arqueología de la región del canal Beagle (Tierra del Fuego, República Argentina). Sociedad Argentina de Antropología, Buenos Aires.

Ortiz Troncoso, O., 1979. Punta Santa Ana et Bahía Buena: deux gisements sur une ancienne ligne de rivage dans le Detroit de Magellan. Journal de la Société des Américanistes LXVI, 133–204.

Pfaffenberger, B., 1988. Fetichised objects and humanized nature: towards and anthropology of technology. Man 23 (2), 236–252.

Piana, E., Estevez, J., 1995. Confección y significación de las industrias ósea y malacológica en Túnel VII. In: Estévez, J., Vila, A. (Eds.), Encuentros en los conchales fueguinos. Treballs d'Etnoarqueologia, vol. 1. CSIC-UAB, Barcelona, pp. 239–260.

Piana, E., Orquera, L., 2009. The Southern top of the world: the first peopling of Patagonia and the cultural endurance of the Fueguian sea-nomads. Arctic Anthropology 46 (1–2), 103–117.

Piana, E., Estevez, J., Vila, A., 2000. Lanashuaia: un sitio de canoeros del siglo pasado en la costa norte del canal Beagle. Desde el país de los gigantes. Perspectivas arqueológicas en Patagonia. In: Proceedings from the Cuartas Jornadas de Arqueología de la Patagonia, vol II, pp. 455–469.

Sahlins, M., 1977. Economía de la Edad de Piedra. Akal, Madrid.

Scheinsohn, V., 1997. Explotación de materias primas óseas en la Isla grande de Tierra del Fuego. PhD Thesis. FFYL, Universidad de Buenos Aires, Buenos Aires.

Shennan, S., 2002. Genes, Memes and Human History: Darwinian Archaeology and Cultural Evolution. Thames and Hudson, London.

Sieveking, A., 1991. Palaeolithic art and archaeology: the mobiliary evidence. Proceedings of the Prehistoric Society 57, 33–50.

Solso, R., 1994. Cognition and The Visual Arts. Bradford Books MIT Press, Cambridge, Massachusetts.

Stewart, H., 1973. Artifacts of the Northwest Coast Indians. Hancock House Publishers, Alberta.

Tivoli, A., 2010a. Estudios avifaunísticos en la región del canal Beagle: la incidencia de las aves en la organización económica de los grupos canoeros de tierra del fuego. PhD Thesis. FFYL, Universidad de Buenos Aires, Buenos Aires.

Tivoli, A., 2010b. Exploitation of bird resources among prehistoric sea-nomad societies of the Beagle Channel region, southern South America. Before Farming 2, 1–12.

Tivoli, A., Fiore, D., in preparation. Prehistoric ornamentation in the end of the World. Bird bone beads in the Beagle Channel region, Tierra del Fuego, Southern South America, MS.

Trigger, B., 1989. A History of Archaeological Thought. Cambridge University Press, Cambridge.

White, R., 1982. The manipulation of burins in incision and notation. Canadian Journal of Anthropology 2 (2), 129–135.

White, R., 1992. Beyond art: toward an understanding of the origins of material representation in Europe. Annual Review of Anthropology 21, 537–564.

Wright, K., Garrard, A., 2003. Social identities and expansion of stone bead-making in Neolithic Western Asia: new evidence of Jordan. Antiquity 77 (296), 267–284.

Zangrando, F., 2009. Historia evolutiva y subsistencia de cazadores-recolectores marítimos de Tierra del Fuego. Sociedad Argentina de Antropología, Buenos Aires.