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Prehistoric Hunting Techniques in Patagonic Environments (Tierra del Fuego, Argentina)

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In this paper, it is our purpose to present different hunting techniques developed in adaptative systems in the Atlantic Coast and the Southeast of Isla Grande, in Tierra del Fuego.

To that effect, we shall use the information in the archaeological record of sites known under the name of "shell midden", in Punta María 2 (Borrero, 1985) and Rancho Donata (Lanata, 1988), placed in coast-wood and plain environments respectively. Both correspond to pedestrian hunters-gatherers frameworks and yield information about a period of late occupation, within the last 1,000 radiocarbon years.

We reach our goal starting from a functional analysis of the archaeological lithic heads, which are called generically, though not precisely (see under), spearheads.

Heads are visualised as part of a technical system (Bleed, 1986) characterised by its own working mechanism and subject to the laws of fluids mechanics and projectiles path to fulfil efficiently the function of its design. Therefore, we consider that efficiency, from an archaeological point of view, could be estimated according to:

a. head aerodynamics, to determine if the head or its shafter direct the projectile path during its flight;
b. the options available to the artisan to minimise the risks of head fracture before and after target penetration. This aspect is closely related to the working mechanism of the technical system due to the fact that target penetration angles depend on the type of the flight path.

Focusing the issue of the workability of the lithic heads from a global perspective, enabled us to direct the research towards the presence of indicators, in the way of "symptoms", that appear in spearheads, which would allow to assume their means of propelling (Ratto, 1988a, 1988b, 1989, 1990a, 1990b).

Therefore, our general hypothesis is that the design of lithic heads is related to: (a) the physical-mechanical qualities of the rocks employed in their manufacture, (b) the physical-mechanical qualities of the wood employed as shafters, (c) the working mechanism of the technical system and (d) the resistance offered by the target. Thus, the study of lithic heads involves both morpho-functional variables (dimensional and aerodynamic) and physical-mechanical variables (rocks, woods, hides).

The importance of knowing the workability of lithic heads does not only imply a greater knowledge about the hunting equipment's employed, *but we also assume that the different propelling modes of the technical systems generate the implementation of certain hunting* techniques, related to the hunting of a particular prey and the topography of the area. Thus, it is possible to differentiate between technical systems by hurling and by hand; as well as to evaluate the distance hunter-prey during the hunting action. To this respect, relating the lithic heads function to the archaeological and animal environment together with the ethnographic information of the hunting which developed in the region, allows for the generating of models on the hunting techniques used and their interrelation with other spheres of the adaptative system (use of space, function of the sites, main economies—marine vs. land resources—, etc.).

Lastly, the goal of this paper is to give an explanation about the problem of techno-factures variability—lithic headers—in exactly the opposite order Aschero (1988) presents: "[...] Mainly, what I intend to know are not the regularities of the means of optimisation of demand-supply of resources, but those constant features or regularities that make the variability of the archaeological frameworks coherent [...] and that turn those techno-factures, the ergological complexes and the activities in which they take part, into a representation of the

individual, of the group where he belongs, or the socio-cultural system that produces it [...]". We think that to approach the stylistic study of these techno-factures, we must first exhaust the variability explanation through the means of functional analysis.

1. Methodology

The analysis of the archaeological lithic heads workability involves the following steps, which have been explained and established in previous papers (Ratto, 1988a, 1988b, among others):

1. performance of petrographic cuts of lithic raw materials present inside each of the archaeological sites and their corresponding exploitation territories. The aim is to determine the different qualities of the rocks, focusing on their internal structure represented through their physical-mechanical characteristics (grain size, cohesion, compactness, hardness, tenacity, etc.);
2. examination of the vegetal species within the aforementioned territory, of potential use as shafters and bows, pointing at their technological qualities;
3. analysis of the lithic heads morpho-functional variables: (a) determination of "reinforcement surfaces", (b) aerodynamics, (c) response to mechanical efforts through shock or impact (fracture pattern), (d) target penetration aptness;
4. from issues 1 and 3, we analyse the heads shape-function relationship, differentiating the various propelling modes: (a) technical systems with power storage and (b) without power storage: by hurling or hand;
5. evaluation of the animal context associated with the heads analysed (ethnology, age types, considerations on hide resistance and muscle mass of the preys);
6. elaboration of models of the possible hunting techniques employed and their interrelation with other spheres of the adaptative system.

Due strictly to space limitations, we refer to previous works (Ratto, 1989, 1990a, 1990b) in order to know the data base of the archaeological sample analysed, the analysis of the petrographic cuts and the technological qualities of the types of wood present in the area under study. However, in table 1, we present the most relevant information on which the conclusions and the models generated in this paper are based.

2. Environmental characteristics and resources of the sample's original sites

Studies on the paleo-climate of Isla Grande, in Tierra del Fuego indicate that the species (*Nothofagus pumulio, N. betuloide* and *N. antarctica*) that form the various forests, have hardly changed their distribution in the last 1,000 years (Markgraf, 1980).

The areas of Punta María and Rancho Donata have undergone studies of potential exploitation of resources. In the case of Punta María, 50 % of the area is maritime and 50 % corresponds to forestry—*Nothofagus antarctica*—(Borrero, 1985). Rancho Donata is 45 % maritime area and 55 % plain—low gramineous meadow—(Lanata, com. pers.). Both areas are represented by sites known as "shell midden" (artificial accumulations of mollusk shells).

The lithic raw materials are found as beach pebbles. We must point out that current studies (Ratto, in press) would indicate, as expected, that the supply of lithic material exceeded the limits of the exploitation territory of the sites.

Within the land animal resources, the *guanaco* (*Lama guanicoe*) has the greatest economic importance. It is an ungulate, of about 100 kg, with gregarious behaviour, without sexual dimorphism and strong territoriality (Raedeke, 1978; Cajal, 1985), its main feeding is grass and branches. The presence of strangers is sensed from a considerable distance by the male leader, who warns the rest of the group. Generally, it prefers open spaces—plains and meadows—though in Tierra del Fuego it also occupies the forest. Besides, the annual shifting for a family group (10 to 12 individuals) is estimated at about 30 km (Borrero, 1985). Another way of social organisation of the species is the male herds which are migratory and non-territorial (over 100 individuals), which alternate between high forest areas in summer and low plain areas in winter. Therefore, as Borrero states (1985), the forest-meadow ecotone is an area inhabited differentially by *guanacos* during the winter. This seems to confirm Borrero's observation (1985) as to the fact that, from the point of view of human exploitation, it is possible to find *guanacos* at any time of the year and place in the island. However, the same author believes that, given the environment structure and the

Level of Analysis	Variables considered		Heads Peydunculate Rancho Donata				Heads Peydonculate Punta María 2			
	Name	Desc. stat.	arrow (N = 10)	penetrating hand (N = 10)	non-penetrating hand (N = 2)	hurled by hand (N = 3)	arrow (N = 4)	penetrating hand (N = 2)	non-penetrating hand (N = 0)	hurled by hand (N = 8)
MORPHOFUNCTIONAL	limb length (mm)	X	26.09	43.69	50.40	42.43	37.40	36.10	–	30.83
		σ	12.76	14.89	–	20.75	9.11	–	–	4.08
		C.V.	48.93	34.09	–	48.91	24.36	–	–	13.25
	limb width (mm)	X	21.29	41.00	43.65	32.86	31.10	34.25	–	29.27
		σ	10.93	6.81	–	12.73	1.74	–	–	3.22
		C.V.	51.36	16.62	–	38.74	5.60	–	–	11.00
	reinforcement (module)	X	5.74	4.85	5.84	3.51	4.42	5.78	–	3.89
		σ	1.64	0.59	–	0.73	0.55	–	–	0.24
		C.V.	28.68	12.26	–	20.83	12.50	–	–	12.80
	fin angle	X	15.10	17.00	28.00	18.33	8.75	21.00	–	27.25
		σ	3.41	5.57	–	7.50	1.70	–	–	6.47
		C.V.	22.60	32.81	–	40.93	19.51	–	–	23.76
	peduncle length (mm)	X	3.89	7.94	22.20	10.86	2.86	6.40	–	10.57
		σ	0.93	2.31	–	4.60	0.85	–	–	3.85
		C.V.	24.03	29.16	–	42.37	29.66	–	–	36.43
	peduncule width (mm)	X	6.10	16.55	32.90	14.06	6.05	17.10	–	18.62
		σ	1.64	2.96	–	2.82	0.45	–	–	1.63
		C.V.	27.02	17.90	–	20.11	7.45	–	–	8.78
	peduncle thickness (mm)	X	2.03	3.47	6.10	3.90	2.17	2.20	–	4.18
		σ	0.45	1.04	–	0.43	0.26	–	–	0.78
		C.V.	22.27	30.04	–	11.17	12.09	–	–	18.73
	apex angle (flat perspective)	X	45.60	53.90	58.00	47.66	32.25	55.00	–	52.25
		σ	7.89	17.23	–	6.42	6.55	–	–	12.53
		C.V.	17.30	31.98	–	13.48	20.31	–	–	23.98
	apex section (contact area -mm-)	X	0.93	1.88	2.90	1.40	0.93	0.80	–	1.45
		σ	0.23	0.42	–	0.42	0.11	–	–	0.53
		C.V.	25.05	22.55	–	30.30	12.37	–	–	25.30
	head length (mm)	X	33.93	53.93	72.55	51.80	45.65	40.50	–	42.50
		σ	20.24	12.81	–	14.91	9.45	–	–	6.73
		C.V.	59.65	23.75	–	28.79	20.72	–	–	15.84
	Transversal section Side symmetry Aerodynamics		symmetric perfect perfect	asymmetric imperfect non aerodyn.	asymmetric imperfect non aerodyn.	asymmetric perfect imperfect	symmetric perfect perfect	asymmetric imperfect non aerodyn.	– – –	sym./asym. perf./imperf. aero/non
Physical mechanical prop. (Rocks)	grain size (mm) hardness cohesion-compactness tenacity		85% < 0.05 85% D 100% C 60% C 40% B	70% < 0.05 80% D 20% C 100% C 70% B 30% C	100% < 0.05 50% C 50% D 100% C 100% B	67% < 0.05 100% D 100% C 67% B 23% C	75% < 0.05 75% C 100% C 100% B	amorph/> 0.1 100% C 100% C 50% B 50% C	– – – –	variety 62% C 28% D 100% C 62% B 28% C

X = Arithmetic average; σ = Standard deviation; C.V. = Variation coefficient; N = Sample.
Physical mechanical properties (rocks): A = low B = average C = high D = very high
(Important: it can be noted that to a lesser nominal value of the reinforcement module—greater reinforcement surface—corresponds rocks of lesser tenacity.

Table 1 — Technical systems of the Pedeunculate lithic haeds: sites of Rancho Donata and Punta María. Descriptive statistic and physical-mechanical characteristics of rocks used for their manufacture.

characteristic adaptative systems, it is possible to expect a lower density of *guanacos* in the exploitation area of Rancho Donata than in the northern meadows of the island (Borrero, 1985). Due to its latitude, Punta María is situated inside the forest-meadow ecotone.

As regards the maritime resources of the areas analysed, the pinnipedia have greater relevance. In spite of ethnological differences between the two existing species (*Otaria flavescens* and *Arctocephalus australis*), both inhabit the coastline building annual colonies, fixed and predictable, although the area occupied varies according to the annual biological cycle (Lanata & Winograd, 1985). The *Otaria* (adult male, 300 kg) are bigger than the *Arctocephalus* (adult male, 150 kg). However, there is an important sexual dimorphism between and within species. Moreover, greater weight is not equivalent to a greater use of meat, due to the high percentage of fat. Pinnipedia are awkward animals, of slow movements and clumsy on land, conditions which benefit the hunter. But at the slightest warning signal, the escape is towards the sea.

Lanata and Winograd (1985) state that "the slaughter of sea lions, particularly on land or related to it, have more elements of harvesting than of hunting...". Therefore, hunting is easy mainly during the summer—birth and mating—when dependence on land environment is absolute; afterwards, they begin going out to the sea. As regards their offspring, it should be pointed out that its peripheral place within the community makes hunting from land easier, as well as cubs abandoned by their mothers (Vaz Ferreira, 1982a, 1982b). Lastly, in both archaeological areas has been recorded the close presence of sea lions communities (Borrero, 1985; Lanata, 1990).

3. Archaeological records of Punta María and Rancho Donata

We refer to Borrero (1985) and Lanata (1985, 1990) to find specifications about the formation process of the sites, sampling techniques, excavated surface and other data of interest. Therefore, we intend to make a brief comment about the archaeological and animal record associated to the lithic heads analysed.

In Punta María 2 we find pinnipedia (*Otaria f.* and *Arctocephalus a.*) and *guanacos* as the most represented species. There are cetacea in a lesser proportion. From the chosen bone sample (N = 488: includes only fragments anatomically determined, which do not include diaphysis fragments of *guanaco*), pinnipedia correspond to the 52.66%, *guanacos*, the 42.41% and cetacea, the 4.93%. Age studies of *guanaco* remains indicate an occupation of winter and summer. One characteristic is that the material appears most fragmented. In the case of pinnipedia, the Minimum Number of Individuals (MNI) adds to composed by 62.7% offspring—"very young" (Borrero, 1985)—and 37.3% adult; this would indicate a selectivity towards certain age groups, coherent with Borrero's (1985) observation, that states "Punta María 2 seems to be a site formed by land hunters who, more or less irregularly, make use of maritime products". As regards the annual period of use of the coast sites, there are summer (newly-born pinnipedia) and winter indicators (theoretical foundations for the issue of fat supply, see details in Borrero, 1985). We should also point out that besides lithic headers, the record displays archaeological evidence of monodentated harpoons manufactured with bones of *guanaco*.

The archaeological and animal complex of the various sites in the area of Rancho Donata is currently being analysed. However, we submit the evidence of the site of Rancho Donata 7 (Lanata, 1988), which presents the following proportions regarding the total bone sample (N = 899): 9.23% of *guanacos*, (MNI = 4), 50.72% of pinnipedia (MNI = 13), 7.34% of penguins (MNI = 12), 14.85% of cormorants—*Phalacrocora sp.*—(MNI = 12), 0.34% of great bustards—*Choephaga sp.*—(MNI = 2), 0.55% of other specified fowl (MNI = 2) and 17.24% of non-specified fowl (MNI = 9). The archaeological and animal sample is dominated in MNI by pinnipedia and fowl, the *guanaco* being represented in a lesser scale. Moreover, this observation agrees with the preliminary data obtained from the archaeological and animal analysis of other sites in the area (Lanata, com. pers.). As regards to the age types of the pinnipedia and *guanacos*, they correspond to newly borns and/or juveniles. Therefore, these indicators would show the exploitation of the resource during the summer, without excluding the possibility of site occupation in other seasons. Besides, the analysis of Rancho Donata 7 conveys to it the function of consumption site, where the pinnipedia entered the site complete, and the *guanacos* were processed in other sites and consumed in this one (Lanata, 1988). Lastly, we should point out that only four harpoons manufactured with bone material were recovered in the different sites of the area (Lanata, com. pers.).

4. Discussion

Our purpose is to focus the discussion starting from the concepts of "reliability" and "maintenance" as described by Bleed (1986) regarding their design of hunting weapons. The minimal condition a design must fulfil is to be effective in carrying out the function for which it was designed. From an archaeological perspective, the efficiency of a technical system can be estimated through its availability, i.e., the time of its use to carry out a certain task. Therefore, the options are as follows: (a) to design a reliable system, so that the fulfilment of its function has low or zero possibilities of failure or (b) to design a maintenance system where the possibilities of failure could be overcome, taking the system to another functional phase. What is important is that

these differences can be visualised through the external appearance of the final design.

Bleed (1986) states that the reliable systems are important when the cost due to failure of the hunting activity is very high. In general, they are associated to the programming of hunting activities in a logistic way (according to Binford, 1980). Instead, maintenance systems are more suitable for chance hunting or when the costs for failure in the activity are low. It is important to emphasise that these concepts are not opposite aspects in a continuum, but they only express various ways, alternative or not, in which a group employs its hunting technology within the annual cycle. Therefore, any of the two equipment designs would imply a different use of space, production of sites with different functions, a new use of the same space, etc.

Thus, from the concepts briefly explained, we intend to characterise the technical systems analysed, through their lithic headers, and to rebuild the characteristics of the preys and the hunting strategies employed.

5. Classification of technical systems

As stated previously in this paper, the lithic heads of the sites in the areas studied were described to the following technical systems (table 1):

a. *with power storage*: the heads are shafted in shafts forming an arrow propelled by a bow;
b. *without power storage*:
   b1. spear hurled by hand: the head is joined to a haft and propelled through muscular drive;
   b2. penetrating hand weapons: the head is joined to a haft and penetrates the target without being propelled;
   b3. non-penetrating hand weapons: the head may or may not be joined to a haft; its main function is not to penetrate but to cut, to remove the flesh, etc.

5.1. The case of Punta María

We see differences in the heads "manufacturing quality" from both technical systems diagnosed. The spearheads final design presents, in general, a "technical value" superior to that of the heads of a hurling spear (fig. 1 and 2). This may mean that the bow and arrow "specific weight", within the group adaptative system, is larger than that of hurling spears.

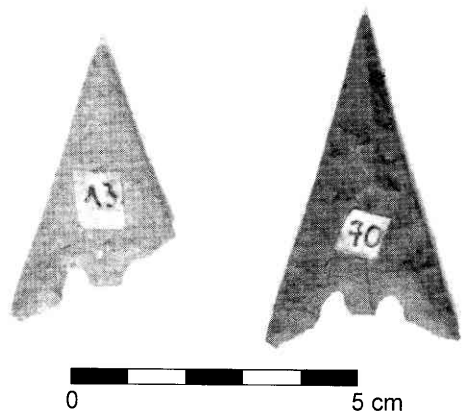

Fig. 1 — The lithic heads of Punta María 2. System technical with power storage: arrow propelled by bow (13 and 70).

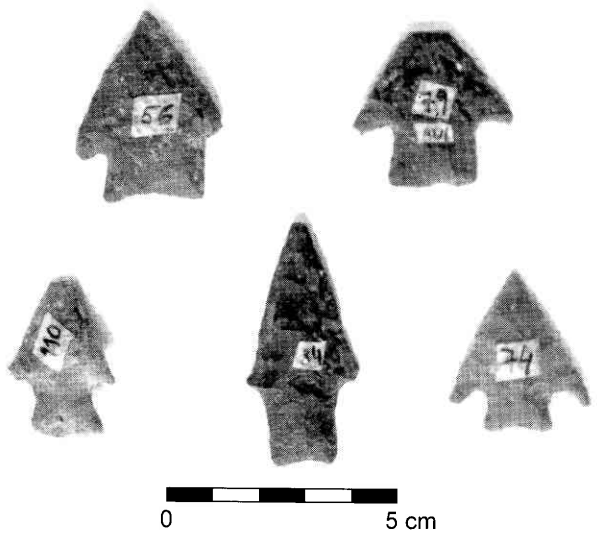

Fig. 2 — The lithic heads of Punta María 2. System technical without power storage, penetrating hand weapons (56 and 74), spear hurled by hand (79, 110 and 84).

To that respect, the theoretical calculus of the ethnographic bows potential energy of the Selk'nam ethnic group (Ratto, 1988b, 1989), northern inhabitants of the Isla Grande, in Tierra del Fuega, made it possible to estimate the fundamental role of this weapon performed within the Selk'nam adaptative system (historical pedestrian hunters). The bow design corresponds to the category of "reliable weapon" (see above), created with overdimensional criteria and greater "force" (110 pounds average) than needed and employed in normal and predictable situations in the hunting of *guanaco*.

Based on the ethology of the *guanaco* and the topography of Punta María 2 surroundings, I do

not believe that the hurling spears were used in "normal" conditions in *guanacos* hunts.

Therefore, the greater "technical value" of arrowheads allows us to classify them as members of a reliable technical system, i.e., available and in use during much of the annual cycle. From this, we infer that the guanaco has a "specific weight" greater than other species exploited and present at the site. Moreover, it is possible that it was the basis of the group's subsistence during the greatest part of the annual cycle. According to this, we can establish the exploitation of different social groups within the same species, inaccessible or with low probabilities of success, as a "critical resource" if the appropriate technical hunting equipment is not available:

1. constant supply of *guanacos*, predictable in space and time (family group hunting);
2. supply of *guanacos* which is unpredictable as regards space and time (male herds hunting). To that respect, the option Borrero (1985) proposes is very interesting as a means of transmission of information. In this way, the technical system design responds efficiently to the most disadvantaged hunting situation.[1]

The lesser "specific weight" of hurling spears within the group's adaptative system, can be interpreted as fulfilling a specific function within a relatively short period of the annual cycle. This could be related to the problem of fat supply during the winter (Borrero, 1985). However, this conveys an apparent contradiction: if the solution of the fat problem is "critical", why not develop a reliable hunting equipment? I believe the answer can be found in the ethology and availability of the pinnipedia resource. We have referred to both aspects previously. In this case, the hunter has a "more privileged" situation regarding his prey: he can choose and, of course, he will choose the one that implies lesser risk and greater success, with smallest investment of energy.

Pinnipedia are not only clumsy and slow on earth, but also, according to their age, they occupy a specific place within the colony (cubs in the periphery). Cases of solitary adults have been recorded; adult males are weakened after the mating season; the young ones have a high mortality rate during their first month and it is very common for their mothers to abandon them. They also present a considerable weight difference between newly-borns and adults within the same species (male *Otaria* adult 300 kg, cub 14 kg, male *Arctocephalus* adult 150 kg, cub 3–5 kg). As has already been said, both species use to share spaces (for further reference, see Vaz Ferreira, 1982a, 1982b; Lanata & Winograd, 1988; Borrero, 1985).

I believe that hurling spears could have been employed as harpoons, to perform a hunt from landposts of young and adult animals. This technique would not be justified in the case of cub hunting, as there are others of a lesser cost (see under). Moreover, the fins in the heads of this technical system, act as "hook", in the same way as the teeth of a harpoon. Therefore, it is highly probable that a rope was tied to the hafts in such a way that, when the weapon was hurled and it penetrated the animal, the latter could not escape towards the sea, once wounded, as it was caught by the hunter through the rope. Thus, the wounded animal could be bludgeoned to death. These techniques are documented ethnographically (Gusinde, 1982; Gallardo, 1910; Lista, 1887; among others).

As to penetrating hand weapons, they could be used in those cases in which the animal ethology allows a total approach to it, like in the case of pinnipedia cubs (see above). The design of this heads does not allow a "serial hunting" of cubs. The fins, the same as in the previous case, act as "hooks". Therefore, if they were employed in this way, the hunting expedition must have been made up of several men. On the other hand, we do not exclude the employment of this technical system as a hurling spear—in spite of the high risks of head fracture—if the occasion required it.

Therefore, we assert that the technical systems of both hurling spears and penetrating hand weapons, have "maintenance systems" characteristics, which availability and use are restricted to a period of the annual cycle. Moreover, with the possibilities of choice given to the hunter, the cost of failure of the technical system function is very low.

1. The space of Punta Marla's area was used repeatedly and according to the use of the different resources offered by the environment.
2. The hunting of guanacos did not coincide with that of pinnipedia.

[1] The hide of the *guanaco* is more resistant than that of goats and sheep (Angelinetti, com. pers.). Moreover, hide resistance increases with the age of the animal (Miller & Karmas, 1985; Angelinetti & Eguen, 1985).

3. The hunting of pinnipedia had to take place when the main resource (*guanaco*) did not fulfil certain requirements (in winter, due to the problem of fat supply? Borrero, 1985, see above). If this were so, it is possible that the site was used in winter as "consumption site".
4. The hunting of pinnipedia cubs marks a summer occupation of the site (Borrero, 1985). However, it is possible that the hunting occupied the space in that moment without having planned the hunting of cubs, but profiting from them as an alternative resource and "taking advantage of the occasion". The planning was directed to the hunting of guanacos in some of their social groups (see above).
5. For the exploitation of land resources, the coast was occupied by "task forces" that carried the anatomic parts of greater economic value to other camp sites of general consumption. Therefore, in that moment, the site fulfilled the function of "processing". This statement is backed by the archaeological and animal record, which presents bones of *guanaco* of low economic output and marrow consumption; as regards pinnipedia bones, although there are no studies on economic anatomy, the complete animal is not represented (Borrero, 1985).

5.2. The case of Rancho Donata

In general, we do not see difference in the "manufacturing quality" of the heads among the technical systems diagnosed (table 1). Therefore, the "specific weight" of these weapons within the system would be similar. This speaks in favour of complementary strategies in the appropriation of animal resources during the annual cycle. In general, we classify the technical systems of Rancho Donata within the "maintenance" type.

However, we must point out the high morphological variability and "manufacturing quality" that exists within the group of the heads diagnosed as arrowheads (fig. 3). Thus, we estimate that the sample analysed (N = 10) is reflecting the use of the same space in different periods, by human group, with different adaptative strategies. To this respect, the total site sample presents arrowheads that could be ascribed to a period after the contact with European society, as it is the case of the glass heads (analysed in another work, Ratto, 1990b, and not included in the N = 10) and the lithic heads documented ethnographically (Gusinde, 1982) as belonging to the Selk'nam ethnic group (included in the N = 10). Among the heads analysed, only one presents a "technical value" higher than the rest of the sample that could be ascribed to a "reliable technical system", while the rest is assigned to a "maintenance technical system". We have already mentioned that this technical system is particularly efficient in the hunting of *guanacos* in some of their social organisations (see above).

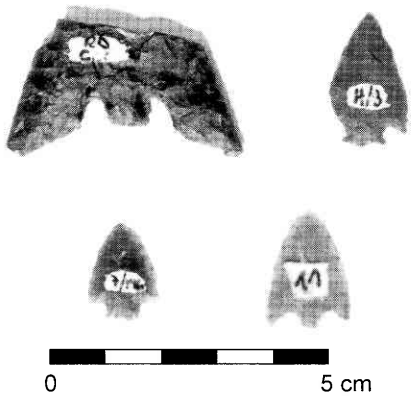

Fig. 3 — The lithic heads of Rancho Donata. System technical with power storage: arrow propelled by bow (2, C/2, H/3, 7/196 and 7/183).

Regarding the heads diagnosed as belonging to penetrating hand weapons (fig. 4), it is interesting to observe that the design corresponds most probably to two different hunting actions:

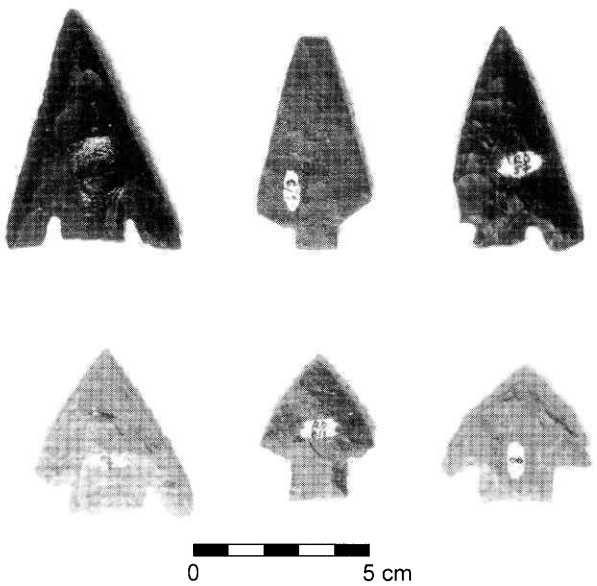

Fig. 4 — The lithic heads of Rancho Donata. System technical without power storage: penetrating hand weapons (C/1, 57, 7, B/1 and 8/1).

1. the case of heads with straight fin basis ("hookless") allows "serial hunting", i.e., the weapon penetrates in a prey, is immediately recovered and can penetrate another prey, and so on. It is highly probable that several men took part in the expedition. Besides, the hunting would be directed to one type of resource which ethology allowed such an approach. This is the case of the pinnipedia cubs situated in the periphery of the colonies and/or penguin colonies;
2. in the case of heads with open and curved fins ("hooking action") after penetrating the prey, they do not allow the immediate recovery of the weapon. Therefore, it is possible it was used in those animals that, due to their biological cycle, allowed a considerable closeness to the hunter. Such could be the case of adult male pinnipedia, weakened after the mating period. It is my assumption that such technical systems would have worked more efficiently with a rope tied to the haft. Thus, the rope would prevent the escape of the animal towards the sea (see above). The technique described is also true for the case of heads for technical systems of hurling weapons. In this case, the biological cycle of the animal can vary in such a way that it does not allow the approach of the hunter. It is my belief that for any of the two cases, the hunting expeditions were made up of several men, the supply of animals being high and low the costs for the failure of the activity.

Heads of non-penetrating hand weapons technical systems (fig. 5), as its name indicates, would carry out actions such as cutting, removing the flesh, etc. Accordingly, they were manufactured in lithic raw materials with "potential workability" for cutting (Ratto, 1990b).

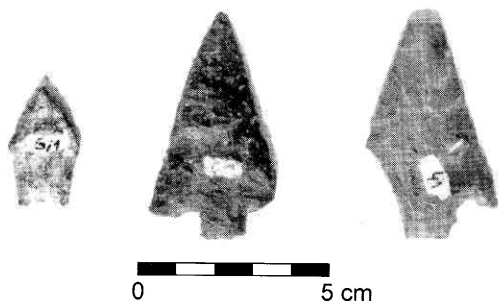

Fig. 5 — The lithic heads of Rancho Donata. System technical with power storage: spear hurled by hand (G/1, 6/1 and 41).

It is interesting to evaluate the relation of what has been said in other spheres of the adaptative system. To this respect we can state:

1. the space of Rancho Donata area was repeatedly used simultaneously and/or exclusively for the profiting of several resources;
2. the surrounding environment presents a very high power concentration (stranding of whales, *guanacos*, penguins, sea lions, great variety of birds, etc.). Therefore, it is possible that the area functioned as a space used by different groups for the profiting of resources (see above) or with different functions according to the resource exploited and the season of occupation. However, and as regards this last observation, the analysis of several indicators assigns a summer exploitation to the site (Lanata, 1988);
3. the generalised exploitation of resources during the summer season with "maintenance" technical systems would favour the formation of multiple-activity sites.

Finally, later studies will enable to interrelate the different adaptative strategies developed in the areas of Punta María and Rancho Donata, as regards to the structure of their corresponding adaptative systems.

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