Quaternary International 373 (2015) 45–54

Contents lists available at ScienceDirect

Quaternary International

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

Stratigraphic lithic assemblages from shell middens on the northern coast of Santa Cruz (Patagonia, Argentina)

Heidi Hammond [a, *], Leandro Zilio [b], Alicia S. Castro [b]

[a] CONICET & Departamento Científico de Arqueología, Museo de La Plata, UNLP, Paseo del Bosque s/n, La Plata 1900, Prov. Buenos Aires, Argentina
[b] Departamento Científico de Arqueología, Museo de La Plata, UNLP, Paseo del Bosque s/n, La Plata 1900, Prov. Buenos Aires, Argentina

ARTICLE INFO

Article history:
Available online 26 February 2015

Keywords:
Lithic artifacts
Shell middens
Technological organization
Northern coast of Santa Cruz

ABSTRACT

Results of the study of artifact lithic assemblages recovered from systematic excavations of shell middens on the northern coast of Santa Cruz (Patagonia Argentina), are presented. The characteristics and composition of lithic assemblages are analyzed to discuss functionality and integrity of the archaeological sites, and also to evaluate general trends of the technological organization of human groups that inhabited the area. This work represents an initial approach to the interpretation of the archaeological record of coastal shell middens from the study of lithic artifact assemblages recovered in stratigraphic contexts.

The evidence from the artifact assemblages allows discussion of the activities that hunter gatherers carried out on shell middens, as well as issues of technological organization of manufacture of stone artifacts and the strategies related to exploitation of lithic raw materials in the study area. Coastal shell middens are places were multiple activities were performed. Regarding lithic technology, the manufacture and maintenance of stone tools, the use thereof, and the discarding of tools and debitage are the activities most represented.

1. Introduction

From the archaeological information generated from many years of study on the northern coast of Santa Cruz (NCSC; Patagonia, Argentina) we have evidence of the occupation of this coastal area by hunter gatherer populations from the middle Holocene, until the arrival of the first Europeans (Zubimendi, 2010). The occupation of this coastal strip and the exploitation of coastal resources would have had a greater intensity during the late Holocene (Castro et al., 2003). Shell middens represent the most common type of site in the archaeological record of the NCSC. These are composed of different archaeological materials in a sedimentary matrix: animal bones (seals, seabirds, fish, and terrestrial mammals, among others), lithic artifacts, charcoal and mainly, mollusc shells (Zubimendi, 2012; Hammond and Zubimendi, 2013; Hammond, 2013, 2014; among others).

Shell middens are heterogeneously distributed along the coastal strip and are located in sectors where marine resources, such as pinnipeds, seabirds, and molluscs, were available in the past (Castro et al., 2003; Zubimendi, 2010). Some archaeological localities on the study area would have been more intensely or recurrently used that other over time, especially due to the availability of food resources (Zubimendi, 2010).

In the case of the NCSC, we already know the main materials that compose the shell middens. However, we still need to define specific functionality, as well as the site formation processes of this type of coastal archaeological record. This work represents an initial approach to the interpretation of the archaeological record of coastal shell middens, from the study of lithic artifact assemblages recovered in stratigraphic contexts. We consider that the characteristics of the artifact assemblages recovered from shell middens are related to the activities that human groups performed at these coastal locations, the rate of discard of lithic artifacts, the conservation of raw materials, and the functionality of sites. The main aim of this article is to analyze the characteristics of artifact lithic assemblages recovered from systematic excavations of shell middens located on the NCSC, to discuss the

* Corresponding author.
E-mail addresses: heidihammondunlp@gmail.com (H. Hammond), leandrozilio@yahoo.com.ar (L. Zilio), aliciacastro52@gmail.com (A.S. Castro).

http://dx.doi.org/10.1016/j.quaint.2015.02.003
1040-6182/

functionality and integrity of archaeological sites, and to analyze general trends on the technological organization of human groups that inhabited the area.

On the NCSC, different sectors or localities characterized by natural, environmental, and geomorphological variability are recognized. In this article, we present the analysis of lithic assemblages from eight shell middens located in different archaeological localities along the NCSC (Fig. 1), all dated in the late Holocene.

Artifact structure of lithic assemblages and diversity (in terms of richness and homogeneity) is analyzed. Preservation indicators and lithic raw materials on which the artifacts were made are recorded. These results are evaluated and discussed considering the knowledge of the structure and fabric of shell middens, and the variables related to the formation processes, both anthropogenic and natural (Wood and Johnson, 1978; Schiffer, 1983; Kidwell and Holland, 1991; Favier Dubois and Borella, 2007; Zubimendi, 2012; Hammond, 2013, 2014; among others).

Technology is considered as an ordered set of knowledge and processes, aimed at production of material culture, to deal with social and natural world (Skarbun, 2009). In this sense, technology is a dynamic process that is socially constituted and, while technological options and the organization of productive activities have a material basis, are inherently social phenomena (Dobres and Hoffman, 1994). Its development involves the manipulation of resources and the implementation of different strategies, choices, and decisions that are shaped by external factors (environment and availability of raw materials, among others) and internal (level of knowledge and cultural norms (Alvarez, 2000). The technology in this context is closely related to the economical and livelihood strategies of human groups. It is argued that there is a relationship between material culture produced in a specific place and the functionality of the sites.

2. Regional setting

The study area of the NCSC extends from the limit between Chubut and Santa Cruz provinces at the north, and the archaeological locality of Bahía Laura to the south, through approximately 420 km of coastline (Castro et al., 2003, Fig. 1). The area is characterized by arid to semiarid climate with average temperatures ranging between 4 °C and 17 °C, and rainfall of 200 mm concentrated during winter season. The predominant winds come from the west and prevail during the summer months. The vegetation belongs to the Patagonian Province of the Andean-Patagonian domain, characterized by a shrub steppes composed of grasses and *coirones* (*Stipa humilius* and S. *speciosa*), interrupted by sectors of shrubs of *mata negra* (*Verbena tridens*).

The area presents geomorphological variability. In the San Jorge gulf, the coast is characterized by the presence of large boulder beaches with wide intertidal platforms and areas of rocky tidal flats with shoals of molluscs (called *restingas*). The Cabo Blanco sector has rocky shores and boulder beaches. South of Deseado ria estuary, sand and boulder beaches interspersed with outcrops of porphyries of the Bahía Laura formation are observed. In the latter sector, there are large shoals of molluscs, as well as sand dunes and aeolian mantles on terraces where numerous shell middens have been identified. There is also evidence of high consumption of coastal resources, especially molluscs and pinnipeds, by hunter gatherer societies that inhabited this coastal sector (Castro et al., 2003; Zubimendi et al., 2004; Zubimendi, 2012; Hammond, 2013; Hammond and Zubimendi, 2013).

From the study of different archaeological sites and lithic artifact assemblages recovered in each of these coastal sectors, on San Jorge gulf, a generic use of space and the absence of a defined pattern in the performance of activities of different kinds (consumption of

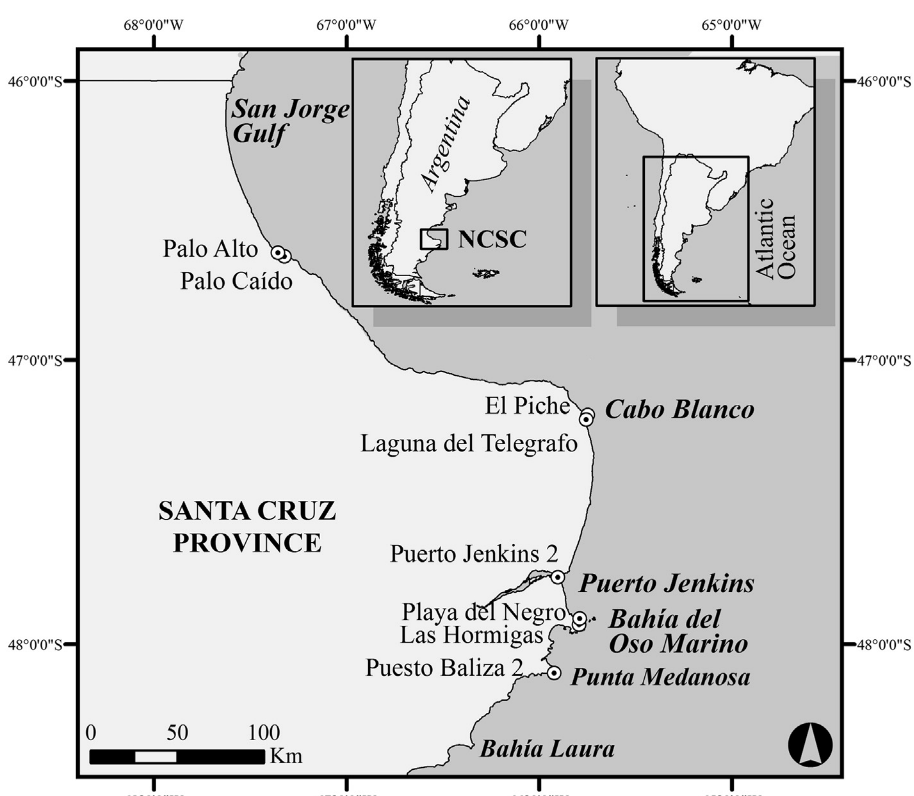

Fig. 1. NCSC and archaeological locations mentioned in this article.

shellfish and pinnipeds or manufacture of lithic artifacts) was inferred. The archaeological record was associated with a wide mobility system, where the coastline was used in a less structured way (Zubimendi et al., 2004, 2005). In Cabo Blanco, it was inferred that human settlements were most frequent in areas where there is a greater availability of food resources, such as pinnipeds, seabirds, and molluscs. In the coastal area located north and south of the outcrop the evidence of human occupation decreases (Zubimendi, 2010); although archaeological evidence has been identified around lagoons very close to the shoreline. In the southern sector of Deseado ria estuary, there is evidence of intensive use in specific sectors of the coastline, which would have been related to the availability of economic resources and lithic raw materials in primary and secondary sources (Zubimendi, 2010; Ambrústolo, 2011).

The lithic assemblages from the study area show great diversity and richness. Those properties are higher in the coastal strip than in the inland territory, where the density of the archaeological record seems to be lower than in the coastal strip (Castro et al., 2003; Zubimendi, 2010).

2.1. Regional structure of lithic raw material sources

The San Jorge gulf contains mantles of gravels of fluvioglacial origin (Neogene-Quaternary) and large boulder beaches with availability of several raw materials as potential sources. Potential secondary sources are composed of rounded nodules and boulders of chalcedony of different sizes. It has also been identified raw materials such as translucent white chalcedony, basalt and xilopal available as coastal boulders. In Cabo Blanco, one of the potential sources of lithic raw material consists of rocks from the outcrop which forms the cape. These quartzite and rhyolites have regular to poor quality for knapping. Boulders of basalt and other raw materials of good quality for knapping are available in the beach ridges of coastal boulders (Zubimendi, 2010).

Ambrústolo (2011) mentions that at the southern sector of the Deseado ria estuary there are raw materials belonging to the Bahía Laura Group lithologies, including pink rhyolitic lavas of porphyritic texture and rhyolitic ignimbrites. These rocks are of regular quality for knapping, but have been used for making some stone artifacts such as scrapers and side scrapers. In the same sector, potential secondary sources of supply are represented by deposits of gravel that form coastal beach ridges with large amounts of boulders and fragments of volcanic rocks.

2.2. Shell midden structure

During systematic excavations in shell middens to study their composition, as well as structure and the formation processes of this type of coastal archaeological record of this Patagonian area (Zubimendi and Hammond, 2009; Zubimendi, 2012; Hammond, 2013; Hammond and Zubimendi, 2013), it has been recorded that they correspond mainly to single depositional events, although overlapping events have been identified in some cases (Hammond and Zubimendi, 2013). The stratigraphy of shell middens analyzed in the NCSC show tabular to lenticular geometries and variations in the density of shells. The sites emplaced in dunes and aeolian mantles are affected by wind erosion, causing the collapse of the shells on the fronts that are exposed, creating slopes covered by large amounts of shells and other archaeological remains. These shell middens take the form of mounds, some of them of large size.

Sites composed by a high density of mollusc shells have bioclast-supported fabrics, in which the shells are in contact with each other. In contrast, shell middens with lower density of shells scattered in sediment have matrix-supported fabrics (Favier Dubois and Borella, 2007). The shell middens with bioclast-supported fabrics show better integrity because the shells in contact with each other, forming a compact structure that is more resistant to erosion and removal of the materials (Zubimendi, 2012; Hammond, 2013).

Different features at the shell middens indicating good conditions of integrity, such as presence of articulated mussel shells, limpet imbricated shells, mollusc shells fragmented *in situ* (Hammond, 2013, 2014), and refitting of lithic debris have been identified. Another characteristic is the recovery of lithic artifacts of very small and small size, pointing to a rapid burial process without mobilization of the archaeological remains.

Different agents and processes involved in the formation of shell middens have been identified (Wood and Johnson, 1978; Schiffer, 1983). Biological, anthropogenic, geological and physical-chemicals ones (Hammond, 2013) can cause physical changes in the archaeological remains according to their intrinsic characteristics (Lyman, 1994). The agent's action can be inferred from the study of the remains recovered in archaeological contexts (Nash and Petraglia, 1987). Study of the distribution and the intrinsic properties of the lithic artifacts makes it possible to discuss issues about integrity of the sites, considering cultural and natural processes involved in formation (Binford, 1980; Stein and Teltser, 1989; Pal, 2008).

3. Theoretical aspects

Technology involves manufacturing processes of lithic artifacts (Odell, 2004). In this sense, the concept of technological organization (Torrence, 1989; Nelson, 1991) highlights the dynamic component of the technology, which can be considered as a strategy for solving social and economic problems of human groups in the past (Bousman, 2005). Studies on technological organization focuses on selection and integration of strategies to obtain, make, use, transport and discard tools and materials needed for their manufacturing and maintenance (Nelson, 1991: 57). The technological strategies depend on the human perception of the environment, and this perception is influenced by the social reality of each group. These strategies are the result of a set of decisions made by individuals within each social group that will allow solving a problem or a need. These decisions involve the implementation of the strategies that are most appropriate to a particular situation (Torrence, 1989). The strategies are responses to social, economic, environmental and/or resource structure conditions, and they will affect the way in which time and energy is reversed in the different stages of production (Flegenheimer et al., 1995).

The concept of operational chain (*Chaine operatoire, sensu* Leroi-Góurhan, 1964) in the study of lithic technology involves all technical stages from procurement of raw materials until the discarding of artifacts. It includes different process of transformation and use of the lithic artifacts. Each technical state reflects the specific technical knowledge employed to perform the transformation of lithic raw materials (Boeda, 1994).

In the study of lithic assemblages, the relationship between knapping debris and tools established in terms of operational chains, will be a way to evaluate the structural stability and integrity of the sites, and also to discuss further on about the behaviors of discard of the artifacts. The concept of integrity refers to a property of the archaeological deposits that can be measured in degrees (high or low) and depends on both the quantity and intensity of the cultural and/or natural agents that contribute to the formation of the archaeological deposit. Resolution is defined as the property of the archaeological record that shows the number of occupational events in one place of the landscape for a certain time, depending partly on the integrity (Binford, 1981).

Artifact diversity is a concept that will be used for a quantitative analysis of the assemblages. The study of artifact diversity, from a quantitative perspective, involves the estimation of two elements: richness and homogeneity (Guraieb, 1999). The richness reflects the number of different kinds of items that compose a sample. Homogeneity is represented by how individuals are distributed into different classes, indicating if all these are equally abundant or instead, if there is inequality between the frequencies of each. Heterogeneity will arise from the relationship between richness and homogeneity, defining the relationship that exists between the number of classes in the sample and their frequencies (Lanata, 1996; Guraieb, 1999). Different authors note that the sample size have an impact on the estimate of richness (Jones et al., 1983; Borrero and Lanata, 1988; Lanata, 1996). It is theoretically expected that the larger the sample size, the higher the value of richness of the sample (Lanata, 1996), and the value of richness would increase with increasing sample size.

4. Materials and methods

Eight lithic assemblages recovered from systematic excavations in shell middens were analyzed (Table 1). The excavations were carried out from artificial stratigraphic levels of 5 cm and in one case of 10 cm (Palo Alto). The artifact samples sizes are variable because excavated surfaces differ between the shell middens (Table 1).

During field work, the sieve pan containing all the smallest archaeological materials remaining after sieving, was collected for classification and further analysis at the laboratory. The recovery of the finest materials and thorough laboratory analysis has allowed the recovery of a large amount of lithic material of very small and small size, usually is very difficult to find during excavation. The recovery of this class of remains is important because it allow us to obtain important technological and functional information (Kornbacher, 1992).

The study of artifact assemblages and their classification in typological groups was carried out from the consideration of techno-morphological macroscopic variables, following the guidelines of Aschero (1983), and functional variables (microwear, stretch marks, damage of the edges and the patterns that define the object as useful beyond their morphology) considering the guidelines of Castro (1994). Size, degree of preservation of the object, presence of cortex and raw materials on which the artifacts were made (Aragón and Franco, 1997), were recorded. We also considered variables related to natural or anthropogenic processes that influenced the formation of the archaeological deposits.

The artifact diversity was analyzed. Diversity was estimated from a quantitative perspective, despite the small sample size. For measurement of the richness, The Shannon index H was used. This expresses the probability that any element picked at random from a set corresponds to a particular category. When all the elements of a set belong to the same category, the minimum value of H is 0. The maximum value of H is a function of the number of present categories (Guraieb, 1999). To measure homogeneity (J), the index of Zar (1974) and Pielou (1977, in Lanata, 1996) were used. The lower limit indicates that the analyzed sample contain only one category. The maximum (1) indicates that the sample has items evenly distributed in all classes or categories.

4.1. Archaeological sites

A contextual description of shell middens analyzed in this article is presented in Table 1. The sites are located in open spaces and situated in different geomorphological surfaces, as aeolian mantles on beach ridges of coastal boulders and aeolian mantles on Holocene terraces, beach ridges of coastal boulders, plateau edge and inactive tidal plains. The available radiocarbon data establish their chronology in the Late Holocene, at later times to 2300 BP (Table 1). The shell middens Palo Alto (PA) and Palo Caído (PC) are located in the San Jorge gulf (Fig. 1). These are emplaced on the plateau edge close to the coastline, approximately 200 m apart. On both, the shells are scattered in the sedimentary matrix (Zubimendi et al., 2010).

The Laguna del Telégrafo (LT) and El Piche (EP) shell middens are located in Cabo Blanco archaeological locality (Fig. 1), emplaced on an inactive tidal plain. On LT we could differentiate a lens of mollusc shells situated directly under a thin superficial layer of sediments, primarily composed of shells of *Aulacomya atra* and bird bones. In EP, a lens of archaeological remains composed primarily of *Nacella*

Table 1
Contextual description of shell middens presented in this article.

Achaeological locality	Achaeological site	Location	Excavated area in m^2	Stratigraphic thickness (cm)	Age C14 (years BP)	Reference
San Jorge gulf	Palo Alto (PA)	Plateau edge	2	39	690 ± 90 (LP-2280) *Nacella magellanica*	Zubimendi et al., 2010. Zubimendi, 2012.
	Palo Caído (PC)	Plateau edge	0.25	15	560 ± 60 (LP-2275) *Nacella magellanica*	Zubimendi, 2012.
Cabo Blanco	Laguna del Telégrafo (LT)	Inactive tidal plain	2	10	2380 ± 60 (LP-1677) Charcoal	Trola et al., 2007; Zubimendi, 2012.
	El Piche (EP)	Inactive tidal plain	6	10	1850 ± 90 (LP-2027) Charcoal	Trola et al., 2007; Zubimendi, 2012.
Puerto Jenkins	Puerto Jenkins 2 (PJ2)	Beach ridges of coastal boulders	0.5	30	690 ± 60 AP (LP-2630) Charcoal	Hammond and Zubimendi, 2013.
Bahía del Oso Marino	Playa del Negro (PN)	Inactive tidal plain	0.5	42	1450 ± 60 (LP-2682) Charcoal	Unpublished
	Las Hormigas (LH)	Aeolian mantle on Holocene terrace	1	55	370 ± 40 (LP-2504) Charcoal	Hammond and Zubimendi, 2013.
Punta Medanosa	Puesto Baliza 2 (PB2)	Aeolian mantle on beach ridges of coastal boulders	0.5	40	1290 ± 60 (LP-2732) Charcoal	Unpublished

magellanica, *A. atra* and bird bones, was recorded (Trola et al., 2007; Zubimendi, 2012).

Puerto Jenkins 2 (PJ2) is located in the locality of Puerto Jenkins on a line of coastal boulders, on the southern margin of the Deseado ria estuary (Fig. 1). The site consists of a dense lens of *Nacella magellanica* shells and other archaeological remains (Hammond and Zubimendi, 2013).

In Bahía del Oso Marino archaeological locality (Fig. 1), Playa del Negro (PN) and Las Hormigas (LH) sites were excavated. In the first a concentration of *Nacella magellanica* shells scattered in the sedimentary matrix was recorded. The shell midden is altered by the action of fossorial rodents. In LH, a lens of archaeological remains emplaced upon aeolian sediments, with good integrity and a rich lithic assemblage, was recorded (Hammond and Zubimendi, 2013).

Puesto Baliza 2 (PB2) is located in the archaeological locality Punta Medanosa (Fig. 1). It is emplaced on an aeolian mantle deposited on a line of coastal boulders. In this site, scattered archaeological remains were identified in the sedimentary matrix, making up a matrix-supported fabric type (Table 1).

All contexts mentioned above represent single depositional events. However, variability of the fabric, density of mollusc shells, and lithic artifacts was registered (Table 2). The geometry in all cases is slightly planar, the shells do not have a preferential orientation in space, and their inclinations are variable. In most of the sites, shells are recovered predominantly complete, sometimes in contact with each other (bioclast-supported structure), and in other cases, dispersed in the sedimentary matrix (matrix-supported structure). Toward the base of all of these accumulations, the shells lose contact with each other, becoming a disperse accumulation within the sediment. Information on the structure of the sites, volume excavated, and malacological and artifact density is presented in Table 2.

5. Results

5.1. Typological structure of the artifact assemblages

The total sample of artifacts analyzed is represented by 2609 lithic pieces (Table 3), of which 3 (0.11%) are cores; 34 (1.30%) are retouched tools; 617 (23.64%) are potential blanks, defined as flakes and blades of form and size that have the possibility to be knapped as formal tools (Castro, 1994; Paunero and Castro, 2001); and 1955 (74.93%) are knapping debris. In Fig. 2, a general trend is observed in the formation of the artifact assemblages. All have similar proportions of each of the typological groups. The most represented group corresponds to knapping debris, followed by potential blanks. Tools and cores are identified in lower proportions.

The quantities and proportions of typological and subtypological groups of each artifact lithic assemblage are presented in Table 3. The analysis shows that all the assemblages reflect a similar typological structure, consisting mainly of flakes with natural edges, abundant knapping debris, and a few tools. Some classes

Table 2
Structural features of shell middens analyzed in this article.

Achaeological site	Fabric	Geometry	Shell density (NISP/dm^3)	Lithic artifacts density (NR/dm^3)
PA	Matrix-supported	Tabular	11.17	1.69
PC	Matrix-supported	Tabular	9.32	1.02
LT	Bioclast-supported	Lenticular	3.67	1.32
EP	Bioclast-supported	Lenticular	2.66	1.06
PJ2	Bioclast-supported	Tabular	28.98	0.32
PN	Matrix-supported	Tabular	14.13	1.15
LH	Bioclast-supported	Lenticular	8.23	0.69
PB2	Matrix-supported	Tabular	18.80	0.36

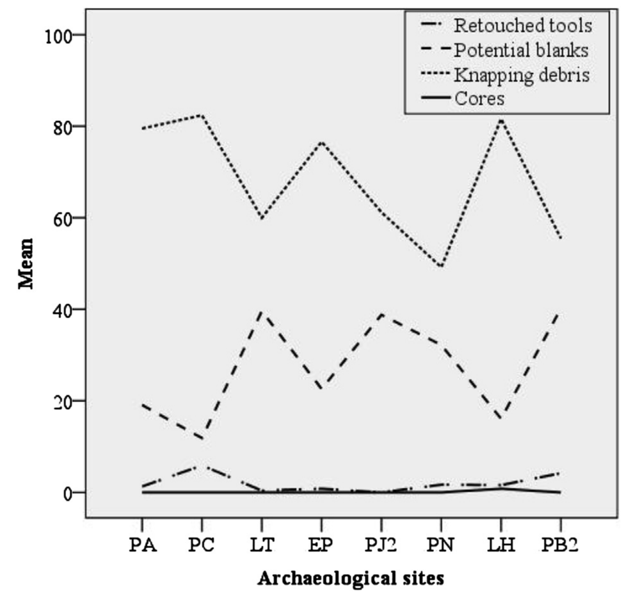

Fig. 2. Conformation of artifact lithic assemblages from the proportion of typological groups.

such as projectile points, brushes, drills, denticulate, scrapers, and cores are represented only in some of the assemblages.

Small flakes (secondary flakes represented by angular flakes, single edge and retouch flakes) and lithic debris predominates among the knapping debris typological group. We could also identify microflakes and, in a lesser proportion, slivers. Within potential blanks, flakes largely predominate over blades in all the assemblages.

The LH artifact assemblage is the one with the grater artifact richness, with a total of 13 classes represented. From LH, three cores of opal of small size, with an irregular morphology and exhausted, were recovered. Lithic debris was refitted into two different artifacts. In one case, four pieces were refitted and six in another.

Among tools classes, the most common types are projectile points and indeterminate tools. The indeterminate tools correspond mostly to fragments, so that it is not possible to define its specific tool morphology. The rest have no diagnostic features to define them as a particular type of tool. The potential blanks on which the tools were made corresponds in most of the cases to secondary flakes of single edge and angular flakes. Three kinds of retouch were registered: marginal, deep, and total, the latter only on the bifacial preform recovered at PN.

Tools are represented in similar percentages by complete tools (41, 17%) and fragments (44, 11%; Table 4). Projectile points in all cases correspond to fragmented pieces.

Microscopic functional analysis was performed to verify the tool use (Castro et al., 2011). Functional analysis was done on 28 edges from 16 tools. Four artifacts were used according to functional analysis (Fig. 3), and they correspond to scrapers and side scrapers used on leather and bone.

In a fragment of an indeterminate tool from PN (Fig. 3, A), a bone microwear of low intensity used was identified. In a scraper from EP, the microwear refers to a probable use on two edges (frontal and one lateral side), because of the presence of initial undifferentiated marginal microwear, and changes in brightness and some transverse striations in the ventral edge of the tool. In a side scraper from LH (Fig. 3, B), bone microwear on two edges was identified. In the scraper fragmented from PB2 (Fig. 3, C), and in a scraper fragment from EP (Fig. 3, D) damage and fractures due to the action of

Table 3
Artifactual structure from each archaeological site.

Typological group	Sub-typological group	PA	PC	LT	EP	PJ2	PN	LH	PB2
Tools	Brush	–	–	1 (0.4%)	–	–	–	–	–
	Projectile point	2 (0.2%)	1 (2%)	–	–	–	1 (0.4%)	3 (0.8%)	–
	Drill	–	–	–	–	–	–	1 (0.3%)	–
	Scraper	1 (0.1%)	–	–	3 (0.5%)	–	–	–	–
	Side scraper	–	–	–	1 (0.2%)	–	–	1 (0.3%)	–
	Bifacial preform	–	–	–	–	–	1 (0.4%)	–	–
	Retouched edge	2 (0.2%)	2 (3.9%)	–	–	–	–	–	–
	Denticulate	–	–	–	1 (0.2%)	–	–	–	–
	Chopper	3 (0.3%)	–	–	–	–	–	–	–
	Indet. tool	4 (0.4%)	–	–	–	–	2 (0.8%)	1 (0.3%)	3 (4.2%)
Potential blanks	Flake	175 (19.1%)	5 (9.8%)	97 (36.6%)	143 (22.5%)	19 (38.8%)	78 (32.2%)	60 (15.8%)	29 (40.3%)
	Blade	–	1 (2%)	8 (3%)	1 (0.2%)	–	–	1 (0.3%)	–
Kanpping debris	Small flake	258 (28.2%)	13 (25.5%)	21 (7.9%)	135 (21.2%)	14 (28.6%)	34 (14%)	103 (27.1%)	14 (19.4%)
	Microflake	79 (8.6%)	4 (7.8%)	19 (7.2%)	41 (6.4%)	6 (12.2%)	20 (8.3%)	68 (17.9%)	2 (2.8%)
	Sliver	251 (27.5%)	22 (43.1%)	–	–	5 (10.2%)	45 (18.6%)	95 (25%)	9 (12.5%)
	Debris	139 (15.2%)	3 (5.9%)	119 (44.9%)	311 (48.9%)	5 (10.2%)	61 (25.2%)	44 (11.6%)	15 (20.8%)
Cores	Core	–	–	–	–	–	–	3 (0.8%)	–
Total		914	51	265	636	49	242	380	72

thermal alteration were identified. In a scraper from PB2 (Fig. 3, C), microwear on the frontal edge was identified. The microwear is not widespread and was probably used for leather work. The remaining stone tools did not have diagnostic traces of microwear.

The quantities and proportions of complete and fragmented artifacts according to their size module are presented in Table 5. In all cases the same trends are recognized: the pieces with very small size modules, considering the size relation between the length and height of the object, (less than 20 mm) make up between 70% and 98% of the total in all the assemblages analyzed. This correlates with the high proportion of knapping debris. Those artifacts could be related to intermediate and final stages of knapping process and making stone tools, specially formation and reactivation of edges. Artifacts with small size modules (between 20.1 and 40 mm) are represented in low proportions in the assemblages, except in LT where small artifacts comprise about 25% of the sample. Only some of the assemblages have artifacts of medium size (between 40.1 and 60 mm), large (between 60.1 and 80 mm) and very large (between 80.1 and 100 mm).

Artifact diversity was analyzed, as we consider it is important to understand the technological composition of the assemblages. This information is presented in Table 6 from the indices of richness and homogeneity.

The values of richness (H) range between 0.54 and 0.73, with an average of 0.64 ± 0.07. The highest index corresponds to LH and the lowest to LT site. The homogeneity index (J) has an average of 0.75 ± 0.09, which shows that the distribution of the artifacts in the samples tends to be even. The diversity of an assemblage can be directly related to the size of the sample, and not with the developed behaviors (Jones et al., 1983). It has also been suggested that as the sample size increases the number of classes represented also increases (Guraieb, 1999).

The coefficient of correlation between richness and homogeneity is positive, though slight. The value of the linear correlation coefficient is 0.14. The two variables covary in the same direction. The result is an ascending line, as shown in Fig. 4. These results indicate that the samples have similar artifact structures, and related values of diversity.

Chalcedony and siliceous rocks predominate in all the assemblages (Table 7). These were used to manufacture the different groups of stone artifacts. Other raw materials registered in low percentages are rhyolite, opal, tuff, obsidian, basalt, and porphyry. The tools are made of chalcedony and silex, rocks of good quality for knapping. Black obsidian has been identified in most of the assemblages in very low percentages. Studies by Ambrústolo (2011) and Ambrústolo et al. (2012) indicate that it would not be available locally, but comes from sources distant hundreds of kilometers from the study area.

The porphyritic raw materials (poor and regular quality for knapping) and basalts (of variable quality) are available at the coastline, outcrops, and canyons especially south of the ría Deseado. The siliceous rocks are available in secondary sources (Ambrústolo, 2011).

A low percentage of the artifacts showed cortex in the assemblages of PA (1.09%), PC (9.80%), LT (0.75%), EP (3.77%), PJ2 (10.20%), PN (2.47%), LH (3.15%), and PB2 (4.16%). The lithological types that have high frequencies for the presence of cortex are mainly chalcedony, rhyolite, and silicified tuff.

Table 4
Tool preservation.

Archaeological sites	Tool preservation			Total
	Complete	Fragmented (missing between 5 y 30%)	Fragment (missing more than 30%)	
PA	6	1	5	12
PC	2	1	–	3
LT	1	–	–	1
EP	3	1	1	5
PJ2	–	–	–	0
PN	1	–	3	4
LH	1	1	4	6
PB2	–	1	2	3
Total	14 (41.17%)	5 (14.70%)	15 (44.11%)	34 (100%)

6. Discussion

The results of the analysis of the eight artifact lithic assemblages recovered from shell middens shows that they have similar typological structures. In this sense, the sets are composed by similar quantities and proportions of typological and sub-typological groups. Study of these artifact assemblages allows us to interpret, within the frame of the concept of operational chain, the stages of the manufacture of lithic artifacts represented at the shell middens. Given this fact, we could discuss some of the social activities performed in these coastal sites.

Some of the archaeological sites present clear stratigraphic units of archaeological remains with bioclast-supported fabrics. In these contexts, lithic artifacts are generally associated with other remains that make up the archaeological lens. Sometimes, in sites with

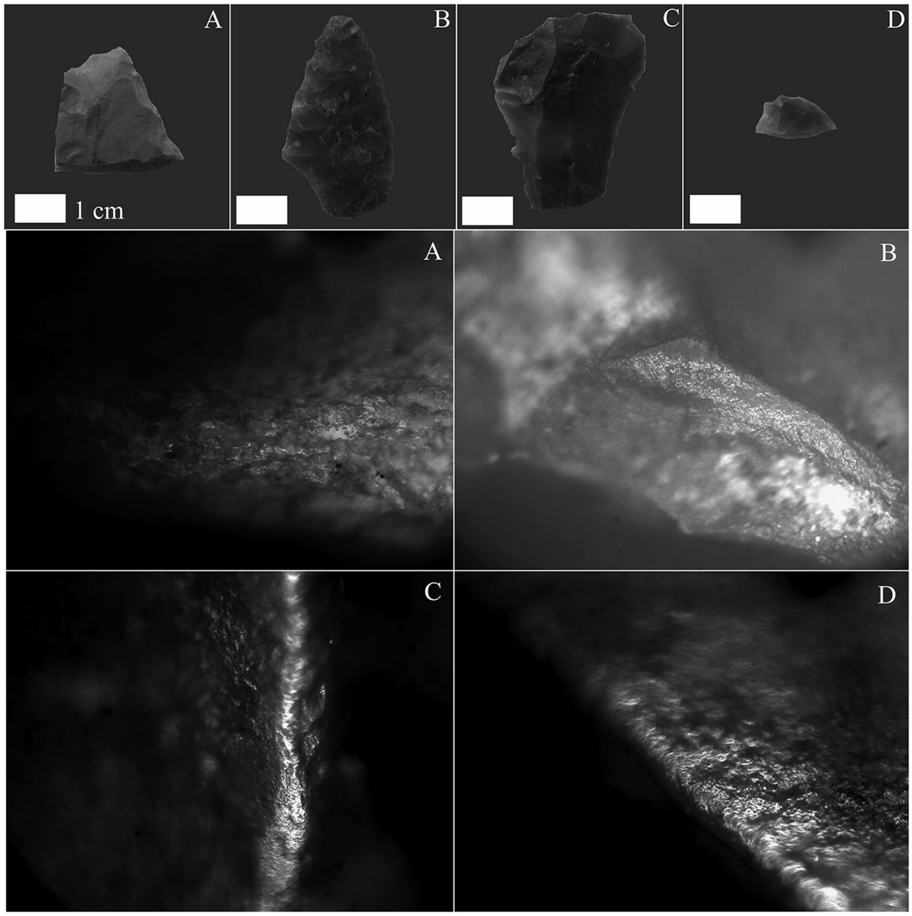

Fig. 3. A. Fragmented tool (PN) with bone microwear; B. Side scraper (LH); C. Fractured scraper (PB2) and D. Front scraper fragment (EP) with leather microwear.

Table 5
Category by size of the artifactual lithic assemblages analyzed.

Size category	*Archaeological sites*							
	PA	PC	LT	EP	PJ2	PN	LH	PB2
Very small (less than 20 mm)	824 (90.1%)	46 (90.2%)	190 (71.7%)	489 (76.9%)	48 (97.9%)	219 (90.5%)	359 (94.5%)	64 (88.9%)
Small (20.1–40 mm)	73 (7.9%)	5 (9.8%)	66 (24.9%)	136 (21.4%)	1 (2.1%)	22 (9.1%)	18 (4.7%)	8 (11.1%)
Medium (40.1–60 mm)	8 (0.9%)	–	7 (2.6%)	10 (1.6%)	–	–	3 (0.8%)	–
Large (60.1–80 mm)	5 (0.5%)	–	2 (0.8%)	1 (0.1%)	–	1 (0.4%)	–	–
Very large (80.1–100 mm)	4 (0.4%)	–	–	–	–	–	–	–
Total	914	51	265	636	49	242	380	72

bioclast-supported fabrics, lithic artifacts of medium or large size were found at the base of the deposit. This could be related to the structure of the shell middens which are composed mainly by shells. The general structure could be defined as friable, in which certain materials may suffer vertical displacements. Diverse authors propose that the archeosediments (Butzer, 1982; Stein, 1987) which form shell middens are porous, so gaps between them are created, through which the particles can easily move down inside the structure (Dunnell and Stein, 1989; Madsen, 1992; Hammond and Zilio, 2014). From this porous structure of shell middens, vertical displacements and mobilization of lithic artifacts can occur, facilitated by the action of water and gravity. In LH, medium sized lithic artifacts deposited at the base of the lens of archaeological remains were recorded, which could be due to vertical migration processes. In shell middens with matrix-supported fabric, the lithic artifacts are scattered in the sedimentary matrix of the site, as are the other archaeological remains.

Table 6
Richness and artifactual homogeneity of the assemblages. n: sample size; k: number of categories; H: richness index; J: homogeneity index.

Archaeological sites	n	k	H	J
PA	914	8	0.69	0.76
PC	51	8	0.68	0.76
LT	265	6	0.54	0.69
EP	636	8	0.54	0.59
PJ2	49	5	0.62	0.89
PN	242	8	0.69	0.76
LH	380	11	0.73	0.70
PB2	72	6	0.65	0.83

The characteristics of the artifact assemblages analyzed, the size distribution of lithic artifacts, the proportions of artifact groups, and the selection of raw materials, could indicate specific knapping activities linked to manufacture and maintenance of stone tools.

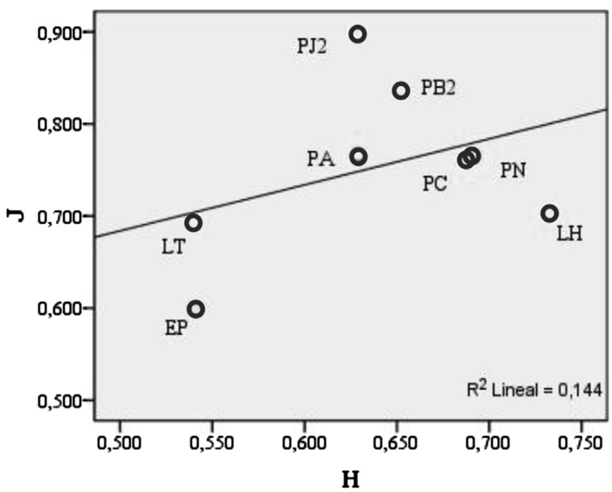

Fig. 4. Correlation between richness and homogeneity.

The presence of very small and small sizes debitage lacking cortex indicates an emphasis on intermediate and final stages in the manufacturing sequence. All the assemblages are comprised between 70% and 95% of debitage with sizes less than 20 mm, which may reflect the performance of knapping related to the final stages of making stone tools, specially formation and reactivation of edges. On the other hand, the high proportion of knapping debris is interpreted as the product of direct discard at the site and not as a result of deposition processes by deliberate actions during the occupation of the site, such as sweeping or cleaning, or by post-depositional processes.

The tools represent very low percentages in all samples, and 59% are not complete. From the functional analysis, it is interpreted that some of the tools were used to work on bone and leather. That evidence is consistent with the results of studies of faunal remains from shell middens distributed along the NCSC which indicate an intensive use of marine resources (Zubimendi et al., 2011; Hammond and Zubimendi, 2013). The high level of fragmentation observed in bones of larger fauna (specially pinnipeds) is characteristic of assemblages generated as a result of the activities of consumption and discard, which could be indicative of the final stages of processing in the context of family or the consumer unit (De Nigris, 2004). The low representation of formal tools could also indicate that part of the knapped tools ensemble on the site was discarded elsewhere.

The analysis of lithic raw materials suggests that rocks of good quality available in secondary sources, many of them in the study area and others hundreds of kilometers distant, such as black obsidian, have been the most used. This mirros the trend indicated by Ambrústolo (2011) for the use of lithic raw materials in the study area. The initial stages of cores reduction to obtain potential blanks for making tools or flakes with natural edges are not represented at the studied sites. These means already prepared potential blanks for making stone tools could have been transported into these residential areas. The small sizes of potential blanks may be related to the maximization of the use of raw materials of good quality for knapping. The lithic artifact density is generally low in relation to other kinds of remains that make up the shell middens, as has also been identified for other similar contexts in Patagonia (Borrero and Caviglia, 1978; Orquera and Piana, 2000).

A feature observed in the samples is the high representation of very small and small artifacts. This suggests that these contexts have been quickly covered by sediments after the deposition of cultural material. The wind dynamics of the area would not have permitted preservation of the microartifacts. The natural site formation processes have not significantly affected the integrity of the sites, although in shell middens emplaced on dunes or aeolian mantles the lithic material on the surface could correspond to a palimpsest or an "averaged surface assemblages" (Orquera and Piana, 1992; Borrero, 1993). This is consequence of the process of deflation which causes the exposure of the remains, generating a mixture of the exposed surface materials. The most important natural agent of formation of coastal archaeological sites in open spaces in Patagonia is wind.

Regardless of the localities or the geomorphological sectors where sites are located in the NCSC, artifact lithic assemblages are represented by the same stages of the operational chain of knapping of stone tools. These assemblages are structurally similar and have common characteristics. All are temporally placed during the late Holocene.

7. Conclusion

The results presented in this paper regarding the structure of artifact lithic assemblages, as well as other structural characteristics of the sites as the presence of articulated mussel shells, limpet imbricated shells, mollusc shells fragmented *in situ* and refitting of lithic debris, indicate that these deposits have fairly good integrity. These features and the recovery of lithic artifacts of very small and small sizes indicate a rapid burial process without mobilization of the archaeological remains.

Based on the analysis, the hunter gatherers who occupied the shell middens performed specific stages of the manufacture of stone artifacts in these sites. The low artifact diversity recorded

Table 7.
Quantity of artifacts and lithic raw materials per site.

Raw materials	Archaeological sites							
	PA	PC	LT	EP	PJ2	PN	LH	PB2
Chalcedony	803 (87.9%)	43 (84.3%)	103 (38.9%)	290 (45.6%)	29 (59.3%)	175 (72.3%)	301 (79.2%)	49 (68%)
Rhyolite	68 (7.4%)	6 (11.7%)	7 (2.6%)	–	–	9 (3.7%)	1 (0.3%)	3 (4.2%)
Basalt	25 (2.7%)	1 (1.9%)	7 (2.6%)	47 (7.4%)	1 (2%)	4 (1.7%)	1 (0.3%)	–
Quartzite	–	–	52 (19.6%)	119 (18.7%)	–	27 (11.2%)	9 (2.4%)	5 (6.9%)
Porphyry	2 (0.2%)	–	17 (6.4%)	19 (2.9%)	1 (2%)	–	–	–
Opal	2 (0.2%)	–	4 (1.5%)	14 (2.2%)	–	1 (0.4%)	34 (8.9%)	–
Tuff	–	–	–	–	–	4 (1.6%)	–	1 (1.4%)
Silicified tuff	–	–	17 (6.4%)	–	–	13 (5.4%)	7 (1.8%)	3 (4.2%)
Silex	–	–	14 (5.3%)	139 (21.9%)	17 (34.7%)	3 (1.2%)	26 (6.8%)	7 (9.7%)
Black obsidian	4 (0.4%)	–	10 (3.8%)	2 (0.3%)	–	4 (1.6%)	–	3 (4.2%)
Sandstone	11 (1.2%)	–	27 (10.2%)	5 (0.8%)	–	–	–	–
Indet.	–	1 (1.9%)	7 (2.6%)	1 (0.2%)	1 (2.0%)	2 (0.8%)	1 (0.3%)	1 (1.4%)
Total	914	51	265	636	49	242	380	72

indicates that specific activities, such as knapping of stone artifacts, manufacture and maintenance of stone tools, and formation and reactivation of edges, were carried out. In addition, tools that possibly were not functional or have had fractures or breakage during manufacture were discarded. Probably the stone tools were made, reactivated, and brought into optimal conditions in these places, to be used later on the site or elsewhere to carry out activities, such as obtaining and processing of resources. The low proportion of tools corresponds to social behaviors of discard processes, although sampling problems are not excluded. The artifact assemblages would not have been significantly affected by post-depositional processes and the burial of cultural materials would have been rapid.

The shell middens analyzed are geographically far apart and emplaced in different geomorphological surfaces. However, artifact lithic assemblages of each site have similar structural and compositional characteristics. Given this fact, we can propose that shell middens may represent places where multiple activities were performed, such as processing, consumption, production and discarding of different materials and resources.

Acknowledgements

The research work was developed in the framework of the project “Estudios arqueológicos regionales para definir la amplitud de los rangos de acción de los grupos cazadores recolectores que usaron la costa norte de Santa Cruz. Patagonia, Argentina” -N 594-UNLP. This research was funded by a grant from CONICET (PIP 0721).

References

Álvarez, M., 2000. La explotación de recursos líticos en las ocupaciones tempranas del Canal de Beagle: el caso de Túnel I. In: Belardi, J.B., Carballo, F.C., Espinosa, S. (Eds.), Desde el país de los gigantes. Perspectivas arqueológicas en Patagonia. Universidad Nacional de la Patagonia Austral, Río Gallegos, 1, 73-86.
Ambrústolo, P., 2011. Estudio de las estrategias de aprovisionamiento y utilización de los recursos líticos por grupos cazadores recolectores en la Costa Norte de Santa Cruz (Patagonia Argentina). Ph.D. thesis. Universidad Nacional de La Plata, Argentina.
Ambrústolo, P., Zubimendi, M.A., Stern, C., 2012. Explotación de obsidiana negra en la costa norte de Santa Cruz (Patagonia argentina). Cazadores Recolectores del Cono Sur 6, 73–81.
Aragón, E., Franco, N.V., 1997. Características de rocas para la talla por percusión y propiedades petrográficas. Anales del Instituto de la Patagonia 25, 187–199.
Aschero, C.A., 1983. Ensayo para una clasificación morfológica de artefactos líticos aplicada a estudios tipológicos comparativos. Consejo Nacional de Investigación Científicas y Técnicas (CONICET), Argentina. Unpublished.
Binford, L.R., 1980. Willow smoke and dog's tails: hunter gatherers settlement system and archaeological site formation. American Antiquity 45 (1), 4–20.
Binford, L.R., 1981. Bones. Ancient Men and Modern Myths. Academic Press, New York.
Borrero, L.A., 1993. Site formation processes in patagonia: depositional rates and the properties of the archaeological record. In: Lanata, J.L. (Ed.), Explotación de recursos faunísticos en sistemas adaptativos americanos. Arqueología Contemporánea, pp. 107–122. Ed Especial, Buenos Aires 4.
Borrero, L.A., Caviglia, S., 1978. Estratigrafía de los concheros de Bahía Solano: campaña 1976–77. V Congreso Nacional de Arqueología Argentina, San Juan.
Borrero, L.A., Lanata, J.L., 1988. Estrategias adaptativas representadas en los sitios de la Estancia María Luisa y Cabo San Pablo. In: Precirculados IX Congreso Nacional de Arqueología Argentina. Universidad de Buenos Aires, Buenos Aires, pp. 166–174.
Bousman, C.B., 2005. Coping with risk: later stone age technological strategies at Blydefontain Rock Shelter, South Africa. Journal of Anthropological Archaeology 24, 193–226.
Boëda, E., 1994. Le concept Levallois: variabilité des méthodes. Monograph CRA n°9. Editions CNRS, Paris.
Butzer, K., 1982. Archaeology as Human Ecology. Cambridge University Press, Cambridge.
Castro, A.S., 1994. Estudios de análisis funcional de material lítico: un modelo alternativo de clasificación tipológica. Ph.D. thesis. Universidad Nacional de La Plata, Argentina.
Castro, A.S., Cueto, M., Frank, A., 2011. New approaches in functional analysis for the discussion of lithic technological organization: cases from patagonia Argentina. In: Paper Presented at the 76th Annual Meeting of the Society for American Archaeology, Sacramento.
Castro, A.S., Moreno, J.E., Andolfo, M., Gimenez, R., Peña, C., Mazzitelli, L., Zubimendi, M.A., Ambrústolo, P., 2003. Análisis distribucionales en la costa de Santa Cruz (Patagonia Argentina): alcances y resultados. Magallania 31, 69–94.
De Nigris, M., 2004. El consumo en grupos cazadores recolectores. Un ejemplo zooarqueológico de Patagonia meridional. Sociedad Argentina de Antropología, Buenos Aires.
Dobres, M.A., Hoffman, C.R., 1994. Social agency and the dynamics of prehistoric technology. Journal of Archaeological Method and Theory 1 (3), 211–258.
Dunnell, R.C., Stein, J.K., 1989. Theoretical issues in the interpretation of microartifacts. Geoarchaeology 4 (1), 31–41.
Favier Duvois, C., Borrella, F., 2007. Consideraciones acerca de los procesos de formación de concheros en la costa norte del Golfo San Matías (Río Negro, Argentina). Cazadores Recolectores del Cono Sur 7, 152–165.
Flegenheimer, N., Bayon, C., Gonzalez de Bonaveri, M.I., 1995. Técnica simple, comportamientos complejos: la talla bipolar en la arqueología bonaerense. Relaciones de la Sociedad Argentina de Antropología 10, 81–110.
Guráieb, A.G., 1999. Análisis de la diversidad en los conjuntos instrumentales líticos de Cerro de los Indios I (Lago Posadas, Santa Cruz). Relaciones de la Sociedad Argentina de Antropología 24, 293–306.
Hammond, H., 2014. Taphonomic analysis of archaeomalacological assemblages: shell middens on the northern coast of Santa Cruz (Patagonia, Argentina). Intersecciones en Antropología, Taphonomic Approaches to the Archaeological Record 21–34 vol. special 1.
Hammond, H., 2013. Propuesta metodológica para el estudio de conjuntos malacológicos de sitios concheros: su aplicación en la costa norte de Santa Cruz (Patagonia Argentina). La Zaranda de Ideas 9 (2), 77–102.
Hammond, H., Zubimendi, M.A., 2013. Estudio de la composición de sitios concheros en la Costa Norte de Santa Cruz (Patagonia Argentina). In: Zangrando, A.F., Barberena, R., Gil, A., Neme, G., Giardina, M., Luna, L., Otaola, C., Paulides, S., Salgán, L., Tívoli, A. (Eds.), Tendencias teórico metodológicas y casos de estudio en la Arqueología de la Patagonia. Museo de Historia Natural de San Rafael, Mendoza, pp. 405–415.
Hammond, H., Zilio, L., 2014. Un objeto de metal en un conchero arqueológico: procesos de formación de sitio y análisis de composición. In: Castro, A., Funes, M.L., Grosso, M., Kuperszmit, N., Murgo, A., Romero, G. (Eds.), Entre Pasados y Presentes IV, Estudios contemporáneos en Ciencias Antropológicas, Buenos Aires, pp. 629–640.
Jones, G.T., Grayson, D.K., Beck, C., 1983. Artifacts class richeness and sample size in archaeological surface assemblages. In: Dunnell, R.C., Grayson, D.K. (Eds.), Lulu Linear Punctuated: Essays in Honor of George Irving Quimby. Museum of Anthropology, University of Michigan Anthropological Papers, Michigan, pp. 55–73.
Kidwell, S.M., Holland, S.M., 1991. Field description of coarse bioclastic fabrics. Palaios 426–434.
Kornbacher, D.K., 1992. Shell midden lithic technology: analysis of stone artifacts from British Camp. In: Stein, J.K. (Ed.), Deciphering a Shell Midden. Academic Press, Seattle, Washington, pp. 163–188.
Lanata, J.L., 1996. La diversidad artefactual en el Norte de Península Mitre. Tierra del Fuego. Arqueología 6, 159–198.
Leroi-Góurhan, A., 1964. Le geste et la Parole I: technique et language. Albin Michal, París.
Lyman, R.L., 1994. Vertebrate Taphonomy. University Press, Cambridge.
Madsen, M.E., 1992. Lithic manufacturing at British Camp: evidence from size distributions and microartifacts. In: Stein, J.K. (Ed.), Deciphering a Shell Midden. Academic Press, Seattle, Washington, pp. 193–209.
Nash, D.T., Petraglia, M.D., 1987. Natural formation processes and the archaeological record: present problems and archaeological analysis. In: Nash, D.T., Petraglia, M.D. (Eds.), Natural Formation Processes and the Archaeological Record. British Archaeological Reports (B.A.R.), International Series 352, Oxford, pp. 186–204.
Nelson, M., 1991. The study of technological organization. In: Schiffer, M. (Ed.), Archaeological Method and Theory. University of Arisona Press, Tucson, 3, 57-100.
Odell, G.H., 2004. Lithic Analysis. Kluwer Academic/Plenum, New York.
Orquera, L.A., Piana, E.P., 1992. Un paso hacia la resolución del palimpsesto. In: Borrero, L.A., Lanata, J.L. (Eds.), Análisis espacial en la arqueología patagónica. Búsqueda de Ayllu, Buenos Aires, pp. 21–52.
Orquera, L.A., Piana, E.P., 2000. Composición de conchales de la costa del Canal Beagle (Tierra del Fuego, República Argentina) – First Part. Relaciones de la Sociedad Argentina de Antropología XXV, 249–274.
Pal, N., 2008. Aportes al estudio de la integridad del sitio Laguna la barrancosa I (Partido de Benito Juárez, provincia de Buenos Aires): análisis textural y distribucional de los microdesechos líticos. Intersecciones en Antropología 9, 59–75.
Paunero, R., Castro, A.S., 2001. Análisis lítico y funcionalidad del componente inferior del sitio Cueva 1, localidad arqueológica Cerro Tres Tetas, provincia de Santa Cruz, Argentina. Anales del Instituto de la Patagonia 29, 189–206.
Schiffer, M.B., 1983. Toward the identification of formation processes. American Antiquity 675–706.
Skarbun, F., 2009. La organización tecnológica en grupos cazadores recolectores desde las ocupaciones del Pleistoceno final al Holoceno tardío, en la meseta central de Santa Cruz. Ph.D. thesis. Universidad Nacional de La Plata, Argentina.
Stein, J.K., 1987. Deposits for archaeologyst. In: Schiffer, M.B. (Ed.), Advances in Archaeologycal Method and Theory. Academic Press, San Diego, pp. 337–395.

Stein, J.K., Telster, P.A., 1989. Size distributions of artifact classes: combining Macro- and Micro-fractions. Geoarchaeology 4 (1), 1–30.
Torrence, R., 1989. Retooling: toward a behavioral theory of stone tools. In: Torrence, R. (Ed.), Time, Energy and Stone Tools. Cambridge University Press, Cambridge, pp. 57–66.
Trola, V., Hammond, H., Aguinaga, M.C., Bogan, S., Ciampagna, M.L., 2007. Análisis preliminar de dos sitios concheros en la localidad arqueológica de Cabo Blanco, Costa Norte de Santa Cruz. In: Actas del XVI Congreso Nacional de Arqueología Argentina. Universidad Nacional de Jujuy, Jujuy, Argentina, 3, 665–669.
Wood, W.R., Johnson, D.L., 1978. A survey of disturbance processes in archaeological site formation. Advances in Archaeological Method and Theory 315–381.
Zubimendi, M.A., 2012. La variabilidad del registro arqueomalacológico en la costa norte de Santa Cruz (Patagonia Argentina): resultados exploratorios a partir de estudios estratigráficos. Intersecciones en Antropología 13, 359–374.
Zubimendi, M.A., 2010. Estrategias de uso del espacio por grupos cazadores recolectores en la Costa Norte de Santa Cruz y su interior inmediato. Ph.D. thesis. Universidad Nacional de La Plata, Argentina.
Zubimendi, M.A., Castro, A., Moreno, J.E., 2004. Una aproximación hacia la definición de modelos de uso de la Costa Norte de Santa Cruz. Magallania 32, 85–98.
Zubimendi, M.A., Castro, A.S., Moreno, E., 2005. El Consumo de moluscos en la Costa Norte de Santa Cruz. Intersecciones en Antropología 6, 121–137.
Zubimendi, M.A., Hammond, H., 2009. Análisis de los restos malacológicos en el sitio Los Albatros, bahía del Oso Marino (Provincia de Santa Cruz). In: Salemme, M., Santiago, F., Álvarez, M., Piana, E., Vázquez, M., Mansur, M.E. (Eds.), Arqueología de Patagonia: una mirada desde el último confín, pp. 865–877. Utopías, Ushuaia, Argentina.
Zubimendi, M.A., Mazzitelli, L., Navarro, A., Zilio, L., Hammond, H., 2010. Primeras excavaciones en el sitio Palo Alto, Bahía Lángara, Costa Norte de Santa Cruz. In: Bárcena, J.R., Chiavazza, H. (Eds.), Arqueología Argentina en el Bicentenario de la Revolución de Mayo, Facultad de Filosofía y Letras. Universidad Nacional de Cuyo, CONICET, Mendoza, Argentina, 5, 2011-2016.
Zubimendi, M.A., Ambrústolo, P., Beretta, M., Mazzitelli, L., Hammond, H., Zilio, L., Ciampagna, M.L., Plischuk, M., Castro, A., 2011. Sitio Cueva del Negro: un caso de aprovechamiento intensivo de los recursos marinos en la Costa Norte de Santa Cruz (Patagonia Argentina). Revista de Estudios Marítimos y Sociales 4, 51–62.