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Review

Changing Tastes: A Review of Later Prehistoric and Norse-Period Marine Mollusc Exploitation in Scotland's Western Isles

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Abstract

This paper examines the exploitation of marine molluscs in the Western Isles of Scotland, from the Bronze Age to Norse periods (2500 BCE–1266 CE). Through analysis of shell assemblages from thirteen archaeological sites, we investigate changing shellfish exploitation practices across time and space. We consider whether these variations reflect cultural preferences, local availability and environments, or evidence of unsustainable harvesting practices. The research examines not only dietary contributions but also explores potential non-food uses of shells, as well as providing insights into coastal environment exploitation. While limpets (*Patella* spp.) remained consistently important throughout much of prehistory, there was a notable shift toward periwinkles (*Littorina littorea*), beginning in the Late Iron Age and continuing into the Norse period. This transition appears to reflect a combination of cultural preferences and local ecological availability rather than simple resource depletion. The study highlights the value of standardised methodological approaches to shell analysis and the importance of considering individual and community agency in the interpretation of zooarchaeological assemblages.

Keywords: archaeomalacology; marine resource exploitation; shellfish consumption; coastal archaeology; Norse period; iron age; bronze age; prehistoric diet; insular archaeology

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1. Introduction

The shells of marine molluscs are common finds at coastal archaeological sites in the Western Isles of Scotland (also known as the Outer Hebrides or *Na h-Eileanan Siar*). Indeed, eroding deposits rich in marine shells at the coast, or marine shells scattered around the entrance to rabbit burrows, may be the most obvious indication that a buried archaeological site exists [1], (Figure 1). The name of the site, Sligeanach, on South Uist likely derives from the Gaelic *slige* (shell), similarly to Sligachan on Skye [2], perhaps as a reference to visible shell remains from past occupation in the machair soil. The shores of the islands are abundant in marine molluscs, which are an important economic resource today, and their exploitation by local communities was documented by historical sources. For example, Reverend James Hall, writing in 1807, described the abundance of shellfish in the Western Isles, noting how cockles gathered from the sands of North Barra sustained approximately two hundred families during periods of scarcity [3].

Figure 1. Shells visible in eroding sand, Cladh Hallan, South Uist, 2010.

Previous research on Scottish marine shells has focused primarily on the spectacular Mesolithic deposits of the Inner Hebrides, particularly the Oronsay sites excavated since the 1860s [4,5]. However, the smaller but equally significant assemblages from the Western Isles have received less systematic attention, despite their potential to illuminate long-term patterns of coastal adaptation. The marine mollusc assemblages from the Western Isles can help to understand changing exploitation patterns, from smaller scale household collections in the Bronze Age to larger scale settlements and farmsteads in the Iron Age and Norse periods.

Marine molluscs are present at most archaeological sites on the machair, often in great numbers. In contrast to non-marine molluscs, little analysis or broader synthetic work has been carried out on marine molluscan assemblages from the Western Isles. From the 1980s the Farm Mounds project outlined that shells of small marine gastropods were brought onto sites with seaweed or blown by the wind, and these remains were published alongside the non-marine Mollusca [6]. Edible taxa were overlooked, however, and not discussed in the report, even though much of this project's radiocarbon dating was based on dates obtained from common periwinkle (*Littorina littorea*) shells [7].

The presentresearch addresses three key questions:

1. Does preferred shellfish species exploitation vary across time and space in the Western Isles? If so, are these variations culturally mediated, due to local availability, or evidence of unsustainable consumption practices?
2. Were shells exclusively products of food waste, or were marine molluscs used for other purposes in the Hebridean past?
3. What coastal environments were exploited in different places and times across the islands?

2. The Western Isles

The Western Isles is a chain of islands off the north-west coast of Scotland (Figure 2). The archipelago consists of 119 named islands, of which only 14 are permanently inhabited today [8]. The islands stretch 213 km from the Butt of Lewis in the north to Barra Head in the south. The bedrock primarily consists of Lewisian gneiss, a Precambrian metamorphic rock that produces acidic podzols unfavourable for shell preservation [9].

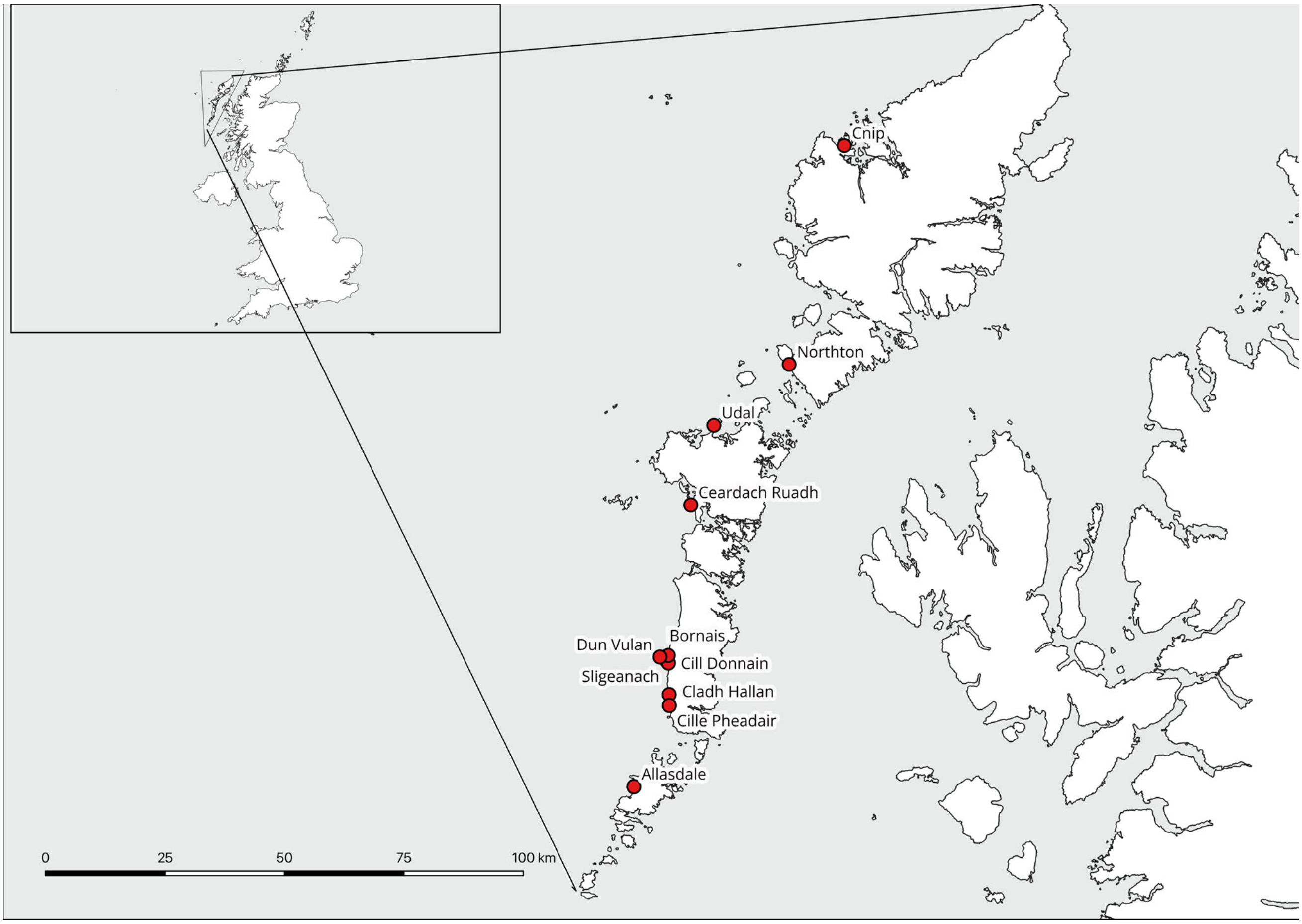

Figure 2. Sites discussed in the paper. Country outlines from GADM (https://gadm.org/ accessed on 1 June 2025).

Fortunately, for at least 4000 years, calcareous shell sand has been deposited by wind, especially onto the western shores of the islands, forming a low-lying coastal plain known as the machair [1,10]. The free-draining, fertile, sandy machair soils provide excellent conditions for shell preservation, allowing for the recovery of substantial shell assemblages from archaeological contexts. Further inland, soil types fall into two main zones—the acidic, peaty lowlands known as the 'blacklands' and the acidic moorland found on higher ground [4,6,11]—both of which are inimical to the preservation of shell.

Archaeological Background

The islands have been the subject of human activity over the last 8000 years [12]. Evidence for Mesolithic (9500–4000 BCE) occupation is scarce, however. Many of the post-glacial beaches of the islands, which may have been centres for Mesolithic coastal exploitation, have been submerged by a rise in relative sea level, which in the Western Isles is due to a combination of both eustasy and isostasy [13,14]. A number of Late Mesolithic middens dating to the late Boreal and subsequent Atlantic climatic phases were excavated on Harris between 2010 and 2013, at Northton, Teampuil an Bagh, Tràigh na Beirigh (1, 2 and 9), and Pabaigh Mòr [15–20]. These sites and their precise chronology have not yet been brought to publication.

The only Neolithic (4000–2500 BCE) settlements on the machair belt in the Western Isles are at Northton on Harris and the Udal on North Uist, and in both cases the original settlements were on mineral soils that were later engulfed by shell sand [14]. Otherwise, Neolithic sites are found away from the coastal plain. Recent research has demonstrated the presence of multiple Neolithic crannog sites on Lewis, which suggests greater levels of occupation than previously thought, and indeed that the nature of Neolithic archaeology and site types in the Western Isles is more complex and diverse than previously considered [21]. The same problem of acidic soils, changing coastlines in antiquity, and coastal erosion affecting site visibility bedevils Neolithic archaeology in the Western Isles. This is unfortunate because there is an interesting issue in our understanding of human diet at the Mesolithic-Neolithic transition based on the Inner Hebrides, where bone collagen carbon and nitrogen isotopes from humans suggests that, at this time, marine resources were completely abandoned as a source of food with the onset of farming [22].

The earliest sites that were established on top of the machair sand are Early Bronze Age (2500–1600 BCE) settlements, preserved as low mounds, such as Iochdar on South Uist [23]. It may be that prior to this period, the machair was still too unstable a surface to permit extensive settlement. It is likely that machair settlement was, initially at least, seasonal and related to more permanent settlement on the blacklands [14]. Although settlements developed on the machair during this period, evidence of subsequent Middle Bronze Age (1600–1200 BCE) occupation is elusive, and it may be that activity was centred on the blacklands, and that the machair was abandoned after the initial Early Bronze Age phase [14].

The beginnings of major permanent settlement on the machair were in the Late Bronze Age (1200–600 BCE) and Early Iron Age (600–200 BCE), and, at the beginning of the first millennium BCE, three very substantial sites developed on the machair on South Uist at Machair Mheadhanach, Sligeanach and Cladh Hallan [13]. The central roundhouse at Cladh Hallan was occupied for an especially long period, from c.1100–200 BCE. Iron Age settlement on the machair took the form of wheelhouses, for example at Cnip on Lewis [18], and brochs such as Dun Vulan [24].

The Iron Age (600 BCE–900 CE) is one of the richest archaeological periods in the islands with a range of site types. On the machair, stone-built wheelhouses, which feature internal stone pillars, are a common settlement feature in the islands, including sites such as Cnip on Lewis [18]. Another key feature is the presence of larger monumental brochs such as Dun Vulan [24], considered by some to be higher status sites, requiring extensive labour for construction, and potentially exerting control over the area [25].

The Western Isles are situated along the sea route from Scandinavia to Dublin, and it is clear that contact with or provisioning from the islands was likely on Viking voyages [26]. The islands were known to the Norse as *Suðreyjar* or the Southern Islands, reflecting their position in the Norse world relative to Orkney and Shetland [27]. The first Viking raids in the Western Isles began around 800 CE [28]. In the Uists, Norse settlements are fairly evenly distributed across the machair plain, sometimes on top of Iron Age settlements, as at Bornais on South Uist [14]. This perhaps suggests a continuity of population despite Norse colonisation [14]. Serial construction of houses at the same location was a cultural tradition of the Western Isles that continued into the Norse period [29].

Around the fourteenth century CE, the machair plain appears to have been abandoned, and both Bornais and Cille Pheadair on South Uist were deserted in the fourteenth or fifteenth century, although the settlement at Udal on North Uist continued to be occupied through the post-medieval period [14], becoming the dwelling place of a senior tenant known as a tacksman. This too was subsumed by sand in 1697 [30].

3. Materials and Methods

Records of shell assemblages from 13 sites spanning from the Early Bronze Age to the Norse period were examined (Figure 2). The sites were Cnip on Lewis [31]; Northton on Harris [32–34]; Udal [35], Ceardach Ruadh, and Baile Sear [36] on North Uist; Cladh Hallan [37], Cill Donnain III [38], Sligeanach [39], and Mounds 1, 2, 2A and 3 at Bornais [40–43], all on South Uist; and Allasdale on Barra [36]. Measurements of limpets have also been published from Dun Vulan on South Uist, although full counts of species are not available [43]. Full counts are also not available from Cladh Hallan, although the species are discussed qualitatively [37].

Owing to different research priorities, sampling, collection, and retention policies varied between sites, although the sites investigated as part of Sheffield and Cardiff Universities' South Uist project (Bornais, Cill Donnain, Cladh Hallan, Sligeanach) all used a standard methodology, with shells collected from a 10 mm mesh sieve [44]. The shells from Allasdale and from Cnip were caught on a 1 mm mesh, and the assemblage from Ceardach Ruadh was recovered from samples sieved for non-marine molluscs to 250 µm [31,36]. The use of larger mesh sizes means that very fragmented shells were likely to have been missed. Of the edible taxa, mussels (*Mytilus edulis*) are especially prone to fragmentation due to their fragile shells and may be under-represented at all sites [45].

Most sites reported minimum numbers of individuals (MNI) only. This is a lowest likely number and will probably significantly underestimate the actual number of shells that were incorporated into a deposit due to fragmentation. At Udal, weights and volumes of all complete shells and fragments of the most abundant species were also recorded, allowing a fuller understanding of quantities of shells recovered [35].

Here, a multi-tiered approach will be used to explore changing trends in marine shell exploitation. Firstly, assemblages with more than 1000 shells per archaeological period will be considered, as these are judged to be more representative of intensive shellfish exploitation rather than incidental collection. Although useful for highlighting broad temporal trends, looking at proportions of species at the site level masks finer chronological details and assumes that the occupants of a given site were always acting as a cohesive unit in terms of food preferences over broad archaeological periods. To overcome these shortcomings, consideration is made in the text of more granular detail, although in some cases, the original data is not available at the context level, or (more often) context dating may be necessarily broad as absolute dates are not available for most deposits. Secondly, species presence, recorded from Hebridean sites per period, regardless of the size of the assemblage, will be considered. This gives a more complete representation of the mix of species recovered from sites on the islands, allowing a more nuanced understanding of collection behaviours and species exploitation.

To gain insights into exploitation of different environmental zones, limpet measurements were considered where they had been recorded by the original researchers. In these cases, the maximum height (apex to aperture) and maximum length (posterior to anterior margin) of intact limpets were measured [46].

4. Results

Table 1 presents the relative abundance of limpets, winkles, and cockles (Figure 3) at published Hebridean sites with >1000 shells per archaeological period. This is also presented graphically in Figure 4.

Table 2 presents all species recorded including smaller assemblages. A site name is in bold where a species is dominant in that period, and in italics if the species is represented by <100 shells.

Table 1. Relative abundance of key species in different phases at sites with >1000 shells per archaeological period. The quantity of the dominant taxon at each site is shown in bold.

Site	Reference	Period	Quantification Methods	Total Shell (MNI as Reported)	*Patella* spp. (%)	*Littorina littorea* (%)	*Cerastoderma edule* (%)
EARLY BRONZE AGE							
Northton *	[32–34]	Beaker 1	Not reported	Not reported	**45**	15	5
Northton	[32–34]	Beaker 2	Not reported	Not reported	**90**	0	5
Udal Phase A, B & C	[35]		MNI: Gastropod apices, bivalve hinge (It is not specified whether this was divided by two) + Weight + Volume	7127	**75.8**	17.9	0.66
BRONZE AGE							
Cill Donnain III Phases 1–2	[38]	Bronze Age	MNI: not described	10,764	31	**66**	3
EARLY IRON AGE							
Northton	[32–34]	Iron Age 1	Not reported	Not reported	**ca.35**	ca.20	**ca.35**
Sligeanach	[39]	Early Iron Age	MNI: Non-repeating elements	3171	**99**	1	0.03
MIDDLE IRON AGE							
Northton	[32–34]	Iron Age 2	Not reported	Not reported	ca.5	ca.20	**ca.70**
Cill Donnain III Phases 3–4	[38]	Middle Iron Age	MNI: not described	18,304	30	**69**	<1%
LATE IRON AGE							
Cill Donnain III Phases 5–8	[38]	Middle—Late Iron Age	MNI: not described	7691	22	**77**	<1%
Bornais Mound 1	[40]	Late Iron Age	MNI: not described	2126	**43.8**	34.5	0.05
Cill Donnain III Phase 9	[38]	Late Iron Age	MNI: not described	86,082	17	**83**	0
NORSE							
Bornais Mound 1	[40]	Norse	MNI: not described	2235	33	**59.9**	0.04
Bornais Mound 2 and Mound 2A	[42]	Norse	MNI: Gastropod non-repeating elements, bivalve highest number of sided umbones	99,139	28.8	**69.9**	0
Bornais Mound 3	[41]	Norse	MNI: not described	15,897	25	**74.3**	0
Cille Pheadair	[37]	Norse	MNI: not described	10,363	36	**51**	**0.4**

* Counts of specimens from Northton were estimated based on graphs presented within the monograph, as raw counts were not available.

Figure 3. Shells of the most common species discussed. (**a**) *Patella vulgata* (apical view); (**b**) *Littorina littorea* (apertural view); (**c**) *Cerastoderma edule* (internal view of left valve); (**d**) *C. edule* (internal view of right valve).

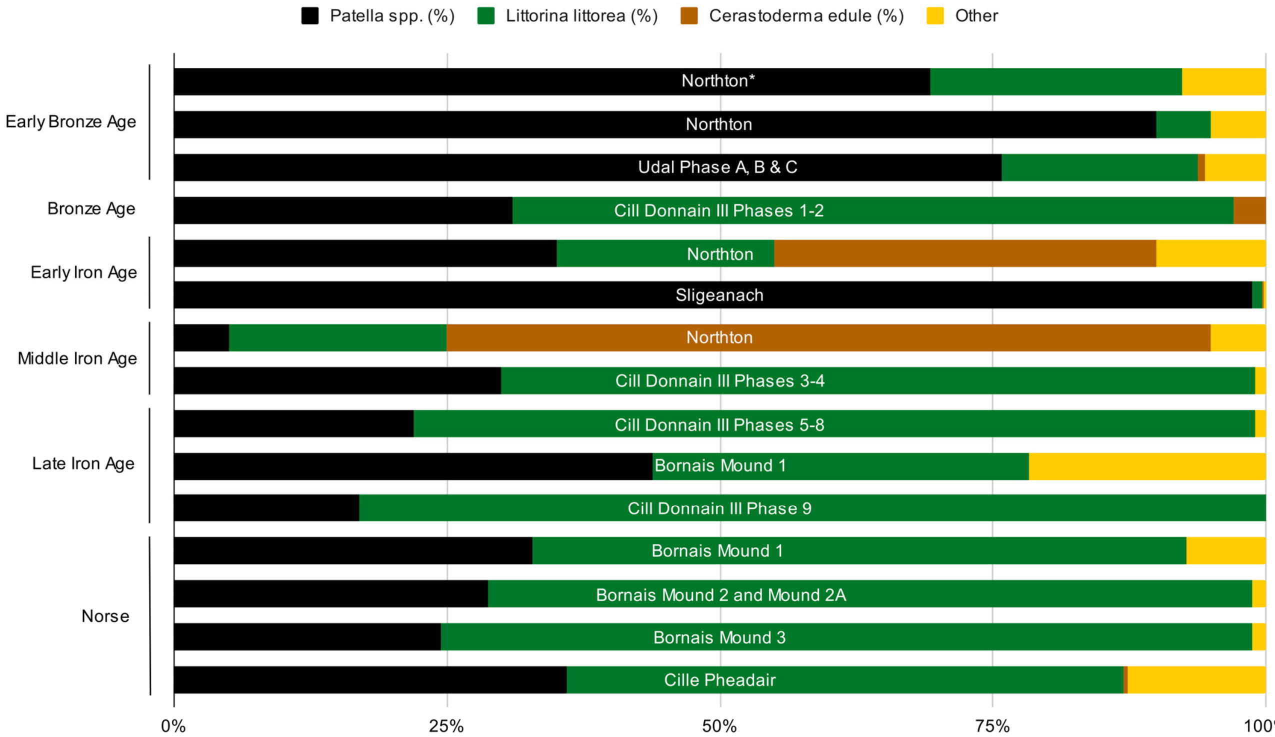

Figure 4. The dominant species in sites with MNI > 1000. * As MNI was not reported for Northton, percentage has been estimated from the published charts.

Table 2. All species recorded at study sites. A site name is in bold where a species is dominant in that period, and in italics if the species is represented by <100 shells.

Taxon	Summary Environment	Early Bronze Age	Middle–Late Bronze Age	Early–Middle Iron Age	Late Iron Age	Norse
Patella spp. (Limpet/bàirneach)	Rocky shores, intertidal	**Northton**; **Udal**; Cill Donnain III; *Sligeanach*; **Allasdale**	**Northton**; **Allasdale;** Cladh Hallan	**Cnip**; **Sligeanach**; Northton; Cill Donnain III; Cladh Hallan	Northton; Cill Donnain III; **Bornais M1**; **Allasdale**	*Baile Sear*; Bornais M1; M2; M2A; M3
Ansates pellucida (Blue-rayed limpet)	Intertidally, on *Laminaria*, all coasts	*Udal*			*Bornais M1*	*Bornais M1*
Topshells (*Calliostoma* and *Gibbula* spp.)	On rocky shores, on weeds and under stones	*Udal; Cill Donnain III; Sligeanach*	*Cill Donnain III*	*Sligeanach*	*Cill Donnain III; Bornais M1*	*Bornais M1; M2; M2A; M3*
Littorina littorea (Common periwinkle/wulk/faochag)	Rocky shores, intertidal	Northton; Udal; Cill Donnain III; Sligeanach; *Allasdale*	Northton; **Cill Donnain III**; Cladh Hallan; *Allasdale*	*Cnip* *;Northton; **Cill Donnain III;** Cladh Hallan	Baile Sear; **Cill Donnain III**; Bornais M1; *Allasdale*	**Baile Sear; Bornais M1; M2; M2A; M3**
Littorina obtusata/mariae (Flat periwinkle/flat wulk/faochag rèidh)	On seaweed, intertidal	Udal; Cill Donnain III	Cill Donnain III; *Cladh Hallan*	*Cladh Hallan*; Sligeanach	*Baile Sear*; Cill Donnain III; Bornais M1	Bornais M1; M2; M2A; M3
Littorina saxatalis agg. (Rough periwinkle/rough wulk/faochag gharbh)	Rocky shores, intertidal	Udal		Sligeanach		Bornais M2; *M2A; M3*
Trivia arctica (Northern cowrie)	Rocky shores, intertidal	*Udal* **		Sligeanach	*Cill Donnain III; Bornais M1*	*Bornais M1*
Nucella lapillus (Dog whelk)	Rocky shores, intertidal	*Northton; Udal; Cill Donnain III*	*Northton; Cill Donnain III*	*Northton; Cill Donnain III*	*Northton*; Cill Donnain III; *Bornais M1*	*Bornais M1*; M2; *M2A; M3*

Table 2. *Cont.*

Taxon	Summary Environment	Early Bronze Age	Middle–Late Bronze Age	Early–Middle Iron Age	Late Iron Age	Norse
Neptunea antiqua (Red whelk)	Sublittoral, mainly on soft substrata, from 15 to 1200 m		*Cladh Hallan*	*Cladh Hallan*		*Bornais M3*
Buccinum undatum (Common whelk/buckie/faochag mhòr)	On hard and soft substrata, sublittoral down to 1200 m	*Udal*	*Cladh Hallan*	*Cill Donnain III*; *Cladh Hallan*; *Sligeanach*	*Cill Donnain III*; *Bornais M1*	*Bornais M1*; *M2*; *M2A*; *M3*
Hinia reticulata (Netted dog whelk)	Intertidal to sublittoral, on rocky shores	*Udal*		*Cnip*	*Bornais M1*	
Mytilus spp. (Mussel/feusgan)	Upper shore to shallow sublittoral	*Udal*; *Cill Donnain III*	*Cill Donnain III*; *Cladh Hallan*	*Cnip*; *Cill Donnain III*; *Cladh Hallan*	*Baile Sear*; *Cill Donnain III*; *Bornais M1*	*Baile Sear*; *Bornais M1*; M2; M2A; *M3*
Modiolus modiolus (horse mussel/feusgan each)	Low shore to about 100 m					*Bornais M3*
Ostrea edulis (Oyster/eisir)	Lower shore to about 80 m	*Northton*; *Udal*	*Cladh Hallan*	*Cladh Hallan*; *Cnip*; *Northton*	*Northton*; *Cill Donnain III*; *Bornais M1*	*Bornais M1*; *M2A*; *M3*
Pecten maximus (Great scallop/sligechreachann mhòr)	Sand or fine gravel, offshore to 100 m	*Udal*	*Allasdale*; *Cladh Hallan*	*Cladh Hallan*	*Northton*; *Bornais M1*	*Bornais M2*; *M2A*; *M3*
Aequipecten opercularis (Queen scallop/sligechreachann rìoghail)	Sand or fine gravel, offshore to 100 m				*Bornais M1*	*Bornais M3*
Scallop indet.		*Cill Donnain III*; *Udal* ***	*Cill Donnain III*	*Cill Donnain III*	*Cill Donnain III*	
Arctica islandica (Icelandic cyprine)	Offshore in sand or muddy sand	*Udal*				*Bornais M1*; *Bornais M3*
Cerastoderma edule (Cockle/coilleag)	Sandy mud, sand or fine gravel. Mid-tidal level-ELWS	*Northton*; *Udal*; *Cill Donnain III*; *Sligeanach*	*Northton*; Cill Donnain III; Cladh Hallan	**Northton**; Cill Donnain III; Cladh Hallan; Sligeanach	**Northton**; **Baile Sear**; Cill Donnain III; *Bornais M1*	*Bornais M1*; *M2*; *M2A*
Laevicardium sp.		*Udal*				
Ruditapes decussatus (Chequered carpet shell)	Lower shore, in sand and mud				*Bornais M1*	
Lutraria lutraria (Common otter shell)	Soft substrates, lower shore to 100 m.			*Cnip*		*Bornais M2*
Solenidae (Razor clam/spoot)	In fine sand. Lower shore and sublittoral		*Allasdale*; *Cladh Hallan*	*Cladh Hallan*; *Cnip*; *Sligeanach*	*Allasdale*	*Bornais M1*; *M2*; *M2A*; *M3*
Macoma sp. (Tellin)		*Udal*				
Venus sp.		*Udal*				

* *L. littoralis* is recorded at Cnip; this is probably an error. ** 'Cowrie' is recorded at Udal rather than a species-level determination. *** *Chlamys* sp. is recorded at Udal.

4.1. Bronze Age and Early–Middle Iron Age

In the Bronze Age, limpets predominate at all sites except Phases 1 and 2 at Cill Donnain III (Tables 1 and 2, Figure 2), accounting for between 31 and 90% of the assemblages recorded. In addition to the large Early Iron Age assemblages discussed below, there are very small assemblages of marine shell from Early Bronze Age contexts at Sligeanach (contexts 4, 18, and 158). The former two are dominated by limpets; the latter comprises only 4 shells of periwinkle [39].

Measurement of limpet shells from early Iron Age contexts at Sligeanach showed they were consistently small and quite squat, suggesting collection from the mid-to-low shoreline [39]. A small number of limpet shells bore encrustation from spirorbid worms, primarily on larger, more pointed shells. Since most species of spirorbid worms live below the mid-tide mark, this suggests that these limpets were collected from lower shore positions, similar to findings at Le Yaudet in Brittany, where Campbell concluded that spirorbids are associated with seaweed and that limpets were more stressed under seaweed cover and thus grew more pointed shells [47]. In Bronze Age and Middle Iron Age samples from Cill Donnain III (there is no Early Iron Age settlement at Cill Donnain III) and in Middle Iron Age deposit 242 at Sligeanach, winkles were dominant. Limpets are the most common species within the small collection of shells from two Iron Age domestic midden deposits at Allasdale, although winkles are almost as numerous in one [36].

At Ceardach Ruadh, Baile Sear, there was a relatively high proportion of cockles, which are typically present in low numbers in most archaeological shell assemblages from the Western Isles [36]. Limpets and common periwinkles are molluscs from rocky shores, whereas cockles live buried at shallow depth in intertidal sand and mud in estuaries and bays [48], suggesting that a range of different habitats were harvested for shellfish, or that environmental changes led to fluctuations through time in the availability of sandy and muddy intertidal areas, for example, as a result of sea level rise. Cockles made significant contributions to Bronze Age assemblages at Cill Donnain and Cladh Hallan but declined in importance at both sites during the Iron Age. This is understood to be because a suitable habitat for cockles existed on the coast between Cladh Hallan and Cill Donnain, but by the Middle Iron Age had transformed into a series of brackish or freshwater lochs [37]. This pattern is reversed at Northton, where cockles decline in the Beaker levels after a significant presence in the Neolithic II horizon, before becoming more numerous again in the Iron Age II horizon [32,33].

Of particular note is the presence of great scallop (*Pecten maximus*) shells in the cultivation layer and possibly Late Bronze Age post-abandonment topsoil at Allasdale, Barra. Unlike other edible taxa represented, great scallops are not harvested from the shore but are collected by diving or dredging. Alternatively, the empty shells may have been collected from the shore as curios. Two shells of the northern cowrie (*Trivia arctica*) in wind-blown sand context may also represent curios, as they are not edible species, or they may have been transported by birds.

4.2. Late Iron Age

Limpets similarly dominate most samples from Late Iron Age contexts at Mound 1, Bornais [40], whereas winkles are the most prevalent species at Cill Donnan III. On Barra, limpets are the most abundant species within the small collection of shells from two Late Iron Age domestic midden deposits at Allasdale, although common periwinkles (*Littorina littorea*) are almost as numerous in one context.

4.3. Norse Period

At the Norse settlements at Bornais, South Uist, limpets remain abundant in samples but are only dominant in the earlier phases at Mound 2A and in Block FB at the south end of Mound 3 [42,43]. In later phases at Mound 1, Mound 2, Mound 2A, and elsewhere in Mound 3, periwinkles become the dominant taxon, accounting for 59.9 and 74.3% of the recorded assemblage [41–43].

This shift toward periwinkles appears to be a feature of Scottish island sites around the time of Norse occupation, or perhaps slightly before. At Buckquoy, Orkney, periwinkles overtake limpets in abundance during the Pre-Norse phases, though this pattern reverses during the Norse occupation [49]. At Quoygrew, Orkney, limpets are initially dominant, but winkles become increasingly prevalent in Phases 2 and 3 of the Farm Mound and in the coastal midden [50].

On mainland Scotland, at the Iron Age hillfort of Broxmouth, East Lothian, limpets started as the dominant taxon but declined and were replaced by winkles in the later phases. This was linked to over-exploitation of limpets as a famine food [51]. Measurements of periwinkles at Quoygrew showed a slight increase in size through time, which was interpreted as indicating efforts to increase yield by more widespread collection of a second-choice species [52].

There are, however, exceptions to this apparent trend. The Norse midden at Freswick Links, Caithness, was dominated by limpets, with winkles making a smaller dietary contribution [53]. At Cill Donnain, South Uist, winkles were the dominant taxon from the Bronze Age to the Late Iron Age, though limpets were also numerous and declined in popularity over time [38]. At Old Scatness, Shetland, limpets remained dominant until Late Norse Phase 9, when winkles took over, although winkles had begun to grow in significance during Viking Phase 8 [54]. At the site of The Cairns, South Ronaldsay, Orkney, limpets predominated during the 1st century BCE—1st century CE occupation of the Broch and similarly dominated the Late Iron Age cooking pit [55].

4.4. Limpet Measurements

To explore the preferred size of limpet collected at archaeological sites, Table 3 shows the mean size of measured limpet shells from sites on South Uist. Evans and Spencer note that it is the shell length that gives the best indication of the amount of meat within a limpet, as most of the animal is at the ventral part of the shell [49]. Two samples of 100 limpet shells from Sligeanach were measured, giving mean lengths of 37.9 mm and 36.1 mm [39]. This is roughly consistent with a limpet aged three to four years, growing under good conditions at a low tidal level. These measurements are slightly smaller than those given for Iron Age Dun Vulan [43] and markedly smaller than that of two samples measured from Late Iron Age Mound 1 at Bornais [56]. Several of the limpet shells at Norse Mounds 2 and 2A at Bornais are smaller than 2 cm in their largest dimension [42] and are therefore young individuals. It may be that younger limpets were sought owing to their texture or flavour. Intriguingly, Sloan states that larger limpets, above 48 mm in length, are preferred by the modern population of Oronsay [51].

Table 3. Mean measurements (maximum height and maximum length) of limpet shells.

Site	Period	Mean Height (mm)	Mean Length (mm)	Reference
Sligeanach <9039>	Early Iron Age	12.6	37.9	[39]
Sligeanach <9042>	Early Iron Age	11.8	36.1	[39]
Dun Vulan (508)	Middle Iron Age	13.8	38.7	[43]
Dun Vulan (784)	Middle Iron Age	11.2	34.8	[43]
Bornais M1 Block CB (453)	Late Iron Age	17.11	44.48	[56]

Table 3. *Cont.*

Site	Period	Mean Height (mm)	Mean Length (mm)	Reference
Bornais M1 Block CB (457)	Late Iron Age	15.92	40.31	[56]
Bornais M2A <10664>	Norse	12.8	40	[42]
Bornais M2A <7230>	Norse	13.7	40.1	[42]
Bornais M2A <10409>	Norse	10.6	32.6	[42]
Bornais Mound 3 Block DD	Norse	13.5	37.9	[43]

Mean measurements of limpet shells, where reported, are presented in Table 3.

5. Discussion

5.1. The Role of Limpets in the Prehistoric Economy

The dominance of limpets in prehistoric shell assemblages raises questions about their role in the economy. Unlike today, when limpets are rarely consumed in Britain (though they remain a delicacy in places like the Azores [57]), they appear to have been an important resource in the past. On sheltered shores, limpets feed partly on young fucoid seaweeds containing polyphenolic compounds that may make them taste unpleasant, though Sharples describes them as "not unpleasant eating" [43], and Payne (pers. comm.) suggests they are "quite nice with butter". Limpets are not especially calorific; Evans and Vaughan calculated that 100 shells provide approximately 0.15 kg of cooked meat, equivalent to 97.5 calories [58]. It should also be noted that, for a community living close to rocky shores, limpets are a somewhat convenient food. In relation to the abundance of limpets compared to winkles or dog whelks in the Mesolithic middens of Oronsay (Inner Hebrides), Mellars made two observations. Firstly, he noted that winkles and dog whelks have a higher shell:meat ratio than limpets, and secondly, he noted that of the three species, limpet meat is easiest to extract from the shell, so simple efficiency may explain the preference [4].

Their use as fish bait in the Western Isles is historically documented, with crushed limpets used to create a bait called *soll* for rocky shore fishing. Special limpet holes known as a leepit or *toll sollaidh* would be carved into rock to store *soll*. In other cases, limpets would be shelled and placed directly on hooks, or they would be chewed or partially boiled for use with lines or *tabh* (poke-nets) [56,59,60].

However, as Sharples has argued, large deposits of relatively intact limpet shells at inland sites are unlikely to represent waste from fishing, as limpets used as bait would typically not be transported far from the shore [43]. At the 10th–13th Century CE Viking period site of Quoygrew on Orkney, two shell middens were excavated. One of these was inland and interpreted as food waste, while another was at the shore and interpreted as waste from bait during a period when cod fishing became more important [50], indicating the importance of geographical location of deposits when considering interpretations.

The possibility that limpets served as pig fodder has been suggested, an idea perhaps supported by the lower δ^{13}C values and elevated δ^{15}N isotope values in some of the pig bone collagen from Middle Iron Age and Norse Dun Vulan and from Late Iron Age and Norse Bornais compared to other omnivorous mammals from Scottish islands [61,62]. Pigs would not necessarily require limpets to be removed from their shells, however (indeed, doing so is likely to be an unnecessary expenditure of effort), and few fish or shellfish remains were found at Dun Vulan [61], although there were plenty of both at Bornais.

Historical records from Scottish islands attest to limpets' status as a food source, particularly in times of hardship. Thomas Pennant, writing in 1772, described the floor of a ruined castle at Arran as "strewed with the shells of limpets, the hard fare of the poor people who occasionally take refuge here." He also observed women and children collecting "their daily wretched fare, limpets and periwinkles" on the Small Isles of Jura and noted that on Skye, during periods of crop failure, people "prowl like animals along the shore to pick up limpets and other shellfish" [63].

5.2. Cultural Preferences Versus Local Availability

The apparent shift from limpets to periwinkles in the Late Iron Age and Norse periods initially suggested a culturally mediated change in taste, potentially associated with Norse influence. This interpretation is supported by evidence from the Viking diaspora, including the puzzling presence of *Littorina littorea* shells in pre-Columbian contexts in Nova Scotia, where the species is not native [64]. Three of these occurrences are of exceptionally early dates; two from below the L'Anse aux Meadows Norse settlement that were not radiocarbon dated and have been subsequently lost, and another from southwestern Nova Scotia that was dated between 33,000 BP and 44,000 BP from its presumed in situ presence in mid-Wisconsian deposits, and which are thought to represent an extended range of the species during the Pleistocene [65]. The remainder have been dated by association with artefacts or by radiocarbon to between AD 1000–AD 1500 [64]. This raises the intriguing possibility that periwinkles were initially introduced to North America by Vikings, either accidentally in ship ballast or deliberately as a provision, before becoming locally extinct and being reintroduced in the nineteenth century [65].

The soft clam *Mya arenaria* is a species that became extinct in European waters during the late Pleistocene, but which survived in the north-west Atlantic. The presence of its shells in pre-Columbian contexts in northern Denmark, in the Greifswalder Bodden on the German Baltic coast, and in the Netherlands potentially adds weight to the idea that Vikings transported live shellfish on long journeys [66–68]. An anomalous hand-collected specimen of *Mya arenaria* from a Bronze Age context at Baleshare, Western Isles, is likely intrusive [6].

However, exceptions to the apparent trend of winkles replacing limpets suggest a more complex picture. They are not universally dominant in Norse contexts, and they do not appear to be an integral part of a "Viking" cultural package, given their minor presence in Viking-age York despite its status as the largest and wealthiest town in Viking Britain [69,70]. It may be that winkles were more closely associated with rural, coastal populations.

The difference in preference at Cill Donnain III throughout its time of occupation (winkles are always dominant) compared to contemporary sites at Bornais Mound 1 and Sligeanach, which are each less than a kilometre away, is interesting and may perhaps be indicative of a difference in the status of winkles compared to limpets throughout later prehistory, although there is no clear difference in status between Cill Donnain III and the other sites at any period.

Instead, local availability seems to be a major factor determining shellfish exploitation patterns. The overall picture suggests that shore areas adjacent to sites were treated much like gardens, with locally available resources being harvested. As Evans cautioned, "in models which are both progress-oriented and micro-regionalised, one tends to underestimate the diversity of settlement and subsistence strategies engendered by the playing out of interactions within individual communities" [71].

A preference for younger limpets may make exploitation resource depletion (sensu Charnov et al. [72]) a possible factor in the decline of limpets in Hebridean shell assemblages. Size at sexual maturity within a prey taxon has an influence on its resilience to over-exploitation [73], and limpets are especially likely to be susceptible to exploitation resource depletion as they are close to sessile. If human populations prefer limpets that have not yet reached sexual maturity, this will have a detrimental effect on population size; however, limpets are protandrous and males with shells as small as 10 mm in length have been found to be sexually mature [74,75].

The beginnings of the Norse period in the Western Isles led to a number of significant changes in economy. Cereal crop production seems to have become more intensive, and rye (*Secale cereale*) was introduced to the islands, and there was a striking rise in the significance of fish [76]. Herring (*Clupea harengus*) were the dominant species in the Western Isles, a marked contrast to the Norse settlements of Orkney where large white fish were preferred [76].

5.3. Marine Molluscs and Sea Level Change

Changing trends in marine mollusc exploitation from different tidal zones have the potential to inform on changing sea levels. Evans linked variation in the marine shell assemblage at Northton to environmental changes related to sand deposition, suggesting a change in the nearshore marine environment [33]. The Neolithic II horizon contained frequent cockle (*Cerastoderma edule*) shells, suggesting that large tracts of intertidal sand were available to be exploited. There were very few cockles in the Beaker horizons, however, and a change in exploitation of rocky shore species, suggesting a rise in sea level had occurred, destroying the cockles' preferred habitat [33,34]. Cockles became more common again in the Iron Age II horizon, suggesting a fall in sea level. Evans noted that when cockles are most abundant, the most machair sand accumulates in the section, implying that a larger area of intertidal sand was available [33]. Thomas has criticised this interpretation, however, noting that changes in the abundance of cockles were also mirrored in changes in the abundance of mussels (*Mytilus edulis*), dog whelk (*Nucella lapillus*) and common periwinkle (*Littorina littorea*), all of which live on rocks on the shore [77]. There may instead have been some environmental change that was particularly detrimental to limpets, such as fluctuations in abundance of food sources [78], or the changes may simply reflect changes in the tastes of humans at the site.

5.4. Non-Dietary Uses of Marine Shells

While most shell assemblages likely represent food waste, there is evidence for other uses of marine shells. The presence of great scallop shells at Allasdale may indicate collection as curios rather than food, particularly given the effort required to obtain them through diving or dredging. Similarly, the northern cowrie shells found in a wind-blown sand context at the same site may represent collection as curiosities rather than food waste.

In the absence of limestone, shells are a useful source of lime, which has been used to make mortar by burning the shell with peat fuel. Marine mollusc shells have been used as a raw material in medieval and later structures in the Western Isles. For example, burnt cockle shells are readily visible in the mortar matrix of various medieval buildings on Barra, including Kisimul Castle [79].

Artefacts are also occasionally manufactured from mollusc shells. At Late Iron Age Mound 1, Bornais, there are discs, possibly gaming counters, made of scallop (*Pecten maximus)* and whelk (*Buccinum undatum*) shells [80]. Interest in shells as curios appears to die out in the Norse period, with no evidence for worked shell in Norse deposits at the site [80].

5.5. Minor Species

Minor species from the sites show that a range of habitats continued to be exploited at all periods (Table 2). Razor shells, for example, are found on sandy shores rather than on rocks. They are burrowing species capable of digging at great speed, which presents a challenge when harvesting them [81]. Temporal trends are hard to identify, although some species such as horse mussel (*Modiolus modiolus*) and chequered carpet shell (*Ruditapes desussatus*) have yet to be found before the Norse period, and surprisingly the widely eaten queen scallop (*Aequipecten opercularis*) is currently unknown before the Late Iron Age.

Great scallop (*Pecten maximus*) shells found in the southeastern area of House 801 at Cladh Hallan were interpreted as utensils for food preparation on contextual grounds [37].

The site also yielded a cache of cowrie shells (*Trivia arctica* and *Trivia monacha*) from floor 1311 of House 401, which were interpreted as keepsakes [37]. These examples highlight the cultural uses of marine shells within Hebridean populations, and the broader integration of shellfish within a variety of aspects of insular life.

5.6. Exploited Habitats and Social Implications

By looking at the habitats of species consumed at archaeological sites, we can infer areas that shellfish collectors would have visited, and from that consider territoriality and social connections. Most of the shells, especially the dominant limpets and winkles, come from rocky coasts. The area with the highest concentration of sites examined, the machair of South Uist around Bornais, Cill Donnain, and Sligeanach, lies to the east of predominantly sandy beaches, with a rocky outcrop surrounding Dun Mhulan (Dun Vulan), and a second area of rock south of Cill Donnain, called Trolaisgeir (Figure 5). On Barra, Allasdale lies due east of the interface between rocky shore and sandy beach. Baile Sear is bounded entirely by sandy beach (the habitat of the dominant cockles), with rocky outcrops over 5 km north-west on North Uist or 6 km south on Benbecula. Toe Head, Northton, has rocky outcrops and sandy beaches.

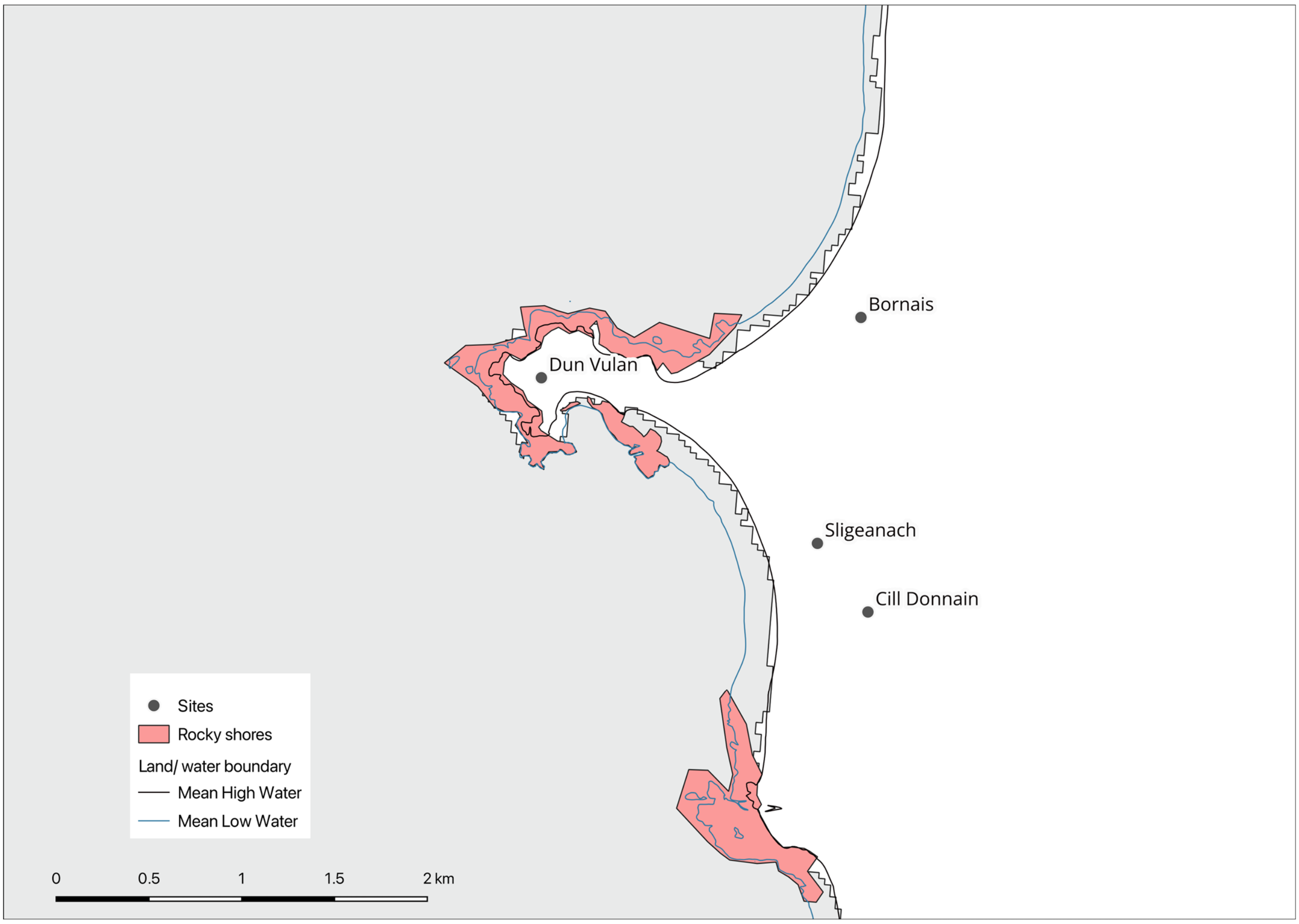

Figure 5. Map showing coastal rock outcrops around the Cill Donnain/Bornais area of South Uist, which may have been sources of limpets and winkles. Contains Ordnance Survey data. Crown © and database right 2025.

Sharples has previously discussed the fact that visits to shores to procure driftwood and other resources would have been routine, perhaps especially for women and children, and that shellfish collection would provide a guaranteed return from the visits [29]. Many of the sea mammal bones found in Hebridean sites are also likely to be from these beachcombing excursions [82], which would have been sources of material like driftwood, seaweed, and drift pumice as well [83].The unpredictable nature of, for example, driftwood landings, would have required vigilant monitoring of the shore, and that the bringing of shellfish from the shore to the settlement creates "a relationship between the community and particular parts of the shore whose exploitation is likely to have been carefully controlled" [80].

To take the Middle Iron Age as an example, for the inhabitants of Bornais, and perhaps also Cill Donnain and the later inhabitants at Sligeanach, it seems reasonable to infer that the procurement of shellfish was part of a wider network of social and economic interaction with the community of Dun Vulan, who presumably would have controlled the most immediate source of limpets and winkles. That said, Sligeanach lies roughly equidistant between two areas of rock, and Cill Donnain III is slightly closer to the southern outcrop (Trolaisgeir) (Figure 5).

Most of the shellfish species consumed are upper shore, intertidal species, which would have been easy to harvest at low tide. Lower shore species, such as oysters or whelks like *Buccinum undatum*, do not occur in high numbers, nor do razor shells, which require skill to harvest as they burrow rapidly into sand when disturbed. At Ardnave on Islay, Evans saw this as evidence that shellfish were only ever collected on a casual basis [45], perhaps reinforcing Sharples's point about harvesting shellfish as being part of a wider strategy of resource procurement from the shore [80].

Cussans notes another potential reason for the avoidance of bivalves: a food taboo based around their tendency to accumulate toxic phytoplankton [54]. It may be that such a taboo existed, particularly around the summer months when phytoplankton blooms are likely to be at their highest, but cockles and mussels appear throughout the Hebridean assemblages in numbers that would suggest the taboo, if it existed, was not total.

If we assume that the scallops, *Pecten maximus* and *Aequipecten opercularis*, were collected live and eaten, that implies that there was some offshore diving or dredging for shellfish, possibly from the Bronze Age where the former appears at Cill Donnain III. The alternative, however, is that the shells were collected empty either as curios or functional vessels. Evans considered the latter to be the case for the scallops and *Arctica islandica* shells (which occur in high numbers there) for the assemblage from Ardnave, Islay [45]. He noted the fragmentary nature of the thick shells of *A. islandica* there, which suggested that they may have been heated. Many of the *Pecten* shells and a *Lutraria lutraria* shell from Bornais were similarly fragmentary [42], perhaps suggestive of heating. This may mean that they had been used as utensils or cooked for consumption.

5.7. Further Developing Insular Shellfish Research

A significant challenge in constructing regional syntheses of shellfish exploitation is the variation in sampling, collection, and retention policies between excavations. At some sites, such as the Central Excavation Unit's 1980s excavations on North Uist and Benbecula, shells were abundantly present (as evidenced by their use for radiocarbon dating) but not systematically recorded or retained.

Mesh size significantly impacts the recovery of smaller shells and fragments, potentially biasing assemblage composition. The adoption of standardised methodologies for shell collection and analysis, such as the use of stacks of 10 mm, 4 mm, 2 mm, and 1 mm sieves as proposed by Campbell [84], would facilitate more robust comparisons between sites and regions.

An area for further development in shellfish research in the islands would be the application of biomolecular and stable isotope methodologies. In particular, $\delta^{18}O$ techniques have been shown to enhance understanding of the seasonality of shellfish collection strategies of prehistoric populations [85]. Similarly, studies of $\delta^{18}O$ within limpet shells have highlighted the potential of such methods to estimate past sea temperatures, providing insights into paleoclimatic changes [86]. Such approaches align closely with the Scotland Archaeological Research Framework (SCARF) core objectives of applying scientific techniques to understand more about people and the environment, and specifically palaeoclimatology [87].

Seasonality studies have been carried out using macroscopic growth checks and microscopic growth increments combined with $\delta^{18}O$ in the shells of the three main species discussed here [88–90] and have been applied to limpet and winkle shells from Orkney [52,89,90]. So far, from the Western Isles, only an as-yet unpublished study has been carried out on limpets from Bornais on South Uist [56]. A confounding factor for studies on limpet seasonality studies is that there appears to be some geographical variation in the factors determining growth rates, and at some sites a simple correlation with seasonal growth rates can be made, but at other sites, non-seasonal factors may be more significant [56,91]. Winkles have been less thoroughly explored, but a recent study suggests that, for Orkney at least, they may be suitable archives of summer temperatures but less reliable for winter temperatures [90].

6. Conclusions

This study has demonstrated the value of shell assemblages for understanding past human–environment interactions in the Western Isles. Despite different approaches taken to sampling and quantification by the different researchers, a degree of comparison is possible. While certain broad trends exist, such as the increasing importance of winkles from the Late Iron Age onward, shellfish exploitation patterns were fundamentally influenced by local availability and potentially by individual and community preferences.

The shift from limpets to winkles in many contexts appears to reflect a complex interplay between cultural preferences and ecological factors rather than simple resource depletion. The continued importance of limpets throughout the later prehistoric and Norse periods in the Western Isles, despite their relatively low calorific value, suggests they held cultural significance beyond mere subsistence.

Future research would benefit from more standardised collection and analysis methodologies, as well as from integrating shellfish data with broader paleoenvironmental and archaeological evidence. The potential for shells to provide insights into coastal environment exploitation, cultural preferences, and even long-distance connections highlights their value as archaeological resources.

By approaching shell assemblages not merely as food waste but as products of human choices influenced by cultural, environmental, and individual factors, we gain a more nuanced understanding of past coastal communities and their relationship with marine resources.

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