Context:
Gabriola, archaeology

Citations:
New-radiocarbon dates for False Narrows, *SHALE* 16, pp.29–42, July 2007.

Errors and omissions:

A more recent article is “Additions and corrections to dates for archaeological sites around False Narrows”, *SHALE* 21, pp.43–52, July 2009.

References:

Date posted:
May 15, 2019.

New radiocarbon dates for False Narrows

by Nick Doe

Introduction

There are well over a hundred registered archaeological sites, and many unregistered ones, scattered over Gabriola, as is commensurate with the thousands of years of uninterrupted occupation of the Gulf Islands by Native people. The largest of these sites is the shell midden at False Narrows (DgRw-4), commonly, but wrongly, known as *Senewélets*.[1]

Dr. David Burley, who did everyone a great favour by writing up and publishing the results of large-scale excavations in 1966/7 (in which he did not participate), identified four components at this site: False Narrows (FN) -I, -II, -III, and -IV.

Based on an analysis of the nature of the recovered artifacts and their associations:

FN-I was assigned a mid-Marpole date in the approximate range 100 BC to 100 AD;

FN-II was attributed to a transitional late Marpole/early Gulf of Georgia component (no date assigned, but let's say for discussion purposes, 100 to 1000 AD);

FN-III was identified as a late Gulf of Georgia component (again no date, but let's say 1000 to 1774 AD); and

FN-IV to a Nanaimo Coast Salish cultural type that immediately followed contact with Europeans, *post*-1774 AD.

Despite the importance of the False Narrows site, only two radiocarbon dates have ever been obtained. A charcoal sample from FN-II was found to be from 240 AD (but see the footnote).[2]

A second more recent dating of a whale bone from FN-I, expected to be older, turned out to be in fact younger at 415 AD.[3]

Associated sites

As several anthropologists and archaeologists have pointed out, DgRw-4 should not be regarded in isolation from surrounding smaller sites, particularly those along the False Narrows bluffs. Together with DgRw-4, these constitute a complex unmatched anywhere in the traditional territories of the Coast Salish people. These additional sites include burials, inland middens, and petroglyphs. Joanne Curtin has published a chart summarizing the radiocarbon dates from some of these additional sites[4]. I have included her chart here, but with the uncalibrated radiocarbon dates re-cast as calibrated calendar dates.

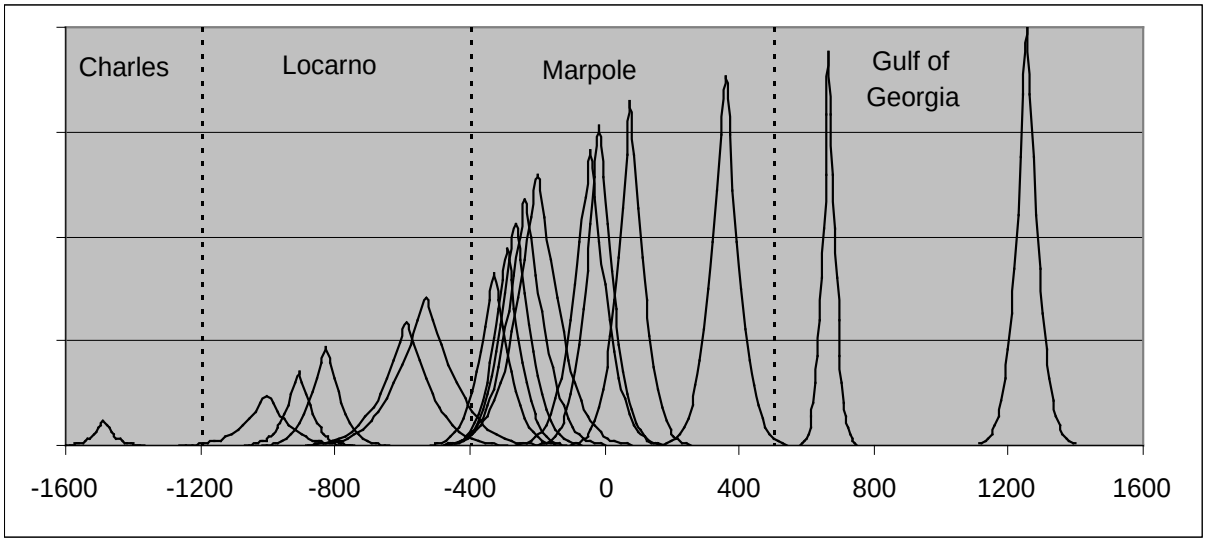
Although it cannot be said with certainty that the dates of these additional sites are also applicable to DgRw-4, it is not a bad working hypothesis that they are. The close association of their village with these sites is unquestioned by the local First Nations.

[1] Variously spelt, it should be *Tle:ltx*^{w}. It is now the El Verano Drive subdivision.

[2] Burley reports this as 240 AD±90 (p.33), which Curtin (p.109) notes as being 1670 BP ^{14}C uncalibrated. However, by my reckoning 1670 BP ^{14}C uncalibrated is 392 AD. 240 AD is 1770 BP ^{14}C uncalibrated.

[3] Curtin (p.109) reports this as 1640 BP ^{14}C uncalibrated.

[4] Curtin (p.115). DgRw-199, DgRw-204, DgRw-210, and DgRw-213.



adapted from A.J. Curtin

Radiocarbon dates from sites around, but not including, the large midden DgRw-4. The scale along the bottom is a calendar, negative values are dates BC, and positive values are dates AD.

The shapes of the entries for the dates (the bell curves) reflect their uncertainty; radiocarbon dating is a statistical measurement. Some measurements are more precise than others, and none can be made with absolute precision.

The vertical scale simply indicates a number assigned to the date starting with 1 for the oldest date on the left and increasing by steps of 1 to 17 for the most recent date on the right.

Half of the dates are older than 275 BC; half are younger.

Sea levels

One of the several interesting findings of the investigations in the 1960's on the DgRw-4 site was that not all four components, FN-I, -II, -III, and -IV were present at all locations. Far from it. Eight "units" were dug, but only four of these—Units 1, 2, 3, and 6—for various reasons yielded enough stratigraphic information to assign components.

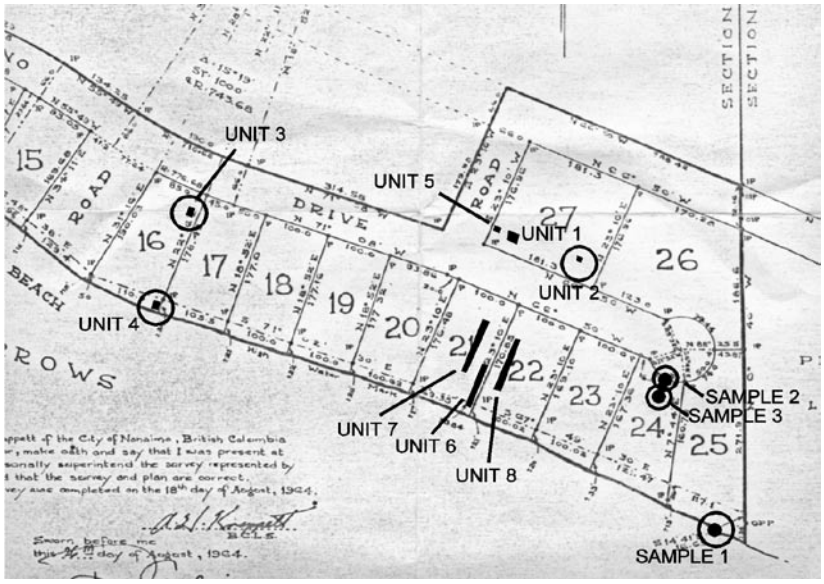
FN-I assemblages were found at two of the units on the bench immediately north of El Verano Drive;[5] and at one unit just south of the road. The fourth unit, down by the sea had only FN-II, -III, and -IV assemblages.

In other words, the oldest component was restricted to the upper and middle benches close to the landward boundary of the midden, while the youngest component was nearest the surface on the lower bench just above the present-day shore.

An eminently reasonable explanation for this was that sea level had in olden times been higher, and that as the level had slowly dropped, the inhabitants had moved down the slope so as to remain close to the shore.

In support of this hypothesis, Burley cites a study by Knut Fladmark who in turn cites conjectures that there may have been a late period of lowered sea levels and that locally in the Gulf Islands, sea levels may have

[5] Septic field renovations on PL.21210 Lot 4 in 2002 revealed the midden fading out at 22 m from the north edge of El Verano Dr. (84 m from the sea).



A superposition of the pre-subdivision *Senewélets* plan (p.14) on a more modern plan (Plan 17835). The three new samples were from Lots 24 and 25.

Senewélets excavation Units 1, 2, and 3 were designated FN-I, and Unit 6 was designated FN-II, -III, and -IV. Unassigned were Unit 4 (water redeposition), Unit 5 (slumping), and Units 7 and 8 (disturbance, but nothing predating FN-I).

changed by ±3 metres in the period 1500–500 BC.[6]

The hypothesis that sea level in False Narrows dropped by about three metres somewhere around 200 AD, would nicely explain why in several places along the eroding shoreline on the Gabriola side, midden deposits sit in direct contact with much older glacial till. If the surface of the till, which erodes only slowly in archaeological (but not geological) timeframes, was until recently kept clean by surf, it would make sense that anthropogenic deposits would begin to accumulate the moment the sea retreated.

Unfortunately this theory has a flaw. Archaeological evidence that has come to light since Burley proposed his theory does not support the contention that sea level locally has dropped in the last two thousand years. On the contrary, practically all of the evidence is that it has been rising.[7]

The details of this rise are not fully understood, but are doubtlessly related to global rises in sea level, subsidence of the east coast of Vancouver Island due to the drag of the subducting Juan de Fuca tectonic plate, and climate-related increases in the heights of storm-surges, which are what define the position of the shoreline.[8]

Samples

Anyone walking the beach today can see in the eroding bank four major horizons: bedrock (mudrock, known as shale); glacial till; midden; the modern root zone.[9] The midden is mostly scattered shell and soil but commonly has lenses of almost soil-free whole shell and layers of fine ash and tiny shell fragments. Shells have also been

[6] 3500–2500 BP. Fladmark (p.148–9).

[7] Appendix 1.

[8] Currently (1993–2003), global mean sea level is rising at 3 mm/year, but the rise in the eastern Pacific is less than this. The land level on Gabriola is also currently (2003) rising, at about 1.5 mm/year, but this rate changes and reverses direction from time to time. Modern changes in relative sea level have little to do with the large changes in relative sea level following the retreat of the glaciers. Post-Ice-Age uplift was already slow five thousand years ago, and now only amounts to 0.5–0.8 mm/year.

[9] Appendix 2.

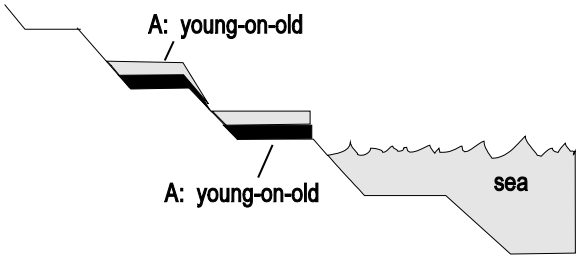
brought to the modern surface by tree and shrub roots, farming, and development.

It seemed to me that, in principle at least, these midden exposures gave me an opportunity to test Burley's hypothesis while observing the over-riding condition that I not dig into, intrude upon, or damage the midden in any way.[10] A comparison of the radiocarbon dates of:
Sample 1, from the bottom of the exposed and eroding midden on the beach, and
Sample 2 at the surface of the middle bench, just below or at the level of the FN-I sites, should provide new information.[11]

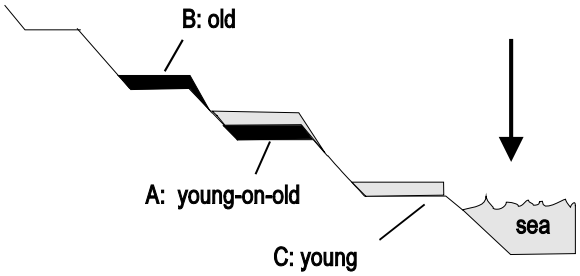
If the falling sea-level scenario were correct, you would expect Sample 1 (closest to the sea) to be comparatively young. It might be about the same age as Sample 2 (corresponding to the time of the seaward migration) or it might be a little older if the inland site had continued to be occupied and both sites continued accumulating material.

If the rising sea-level scenario were however correct, you would expect Sample 1 to be comparatively old corresponding to the oldest surviving record of settlement.

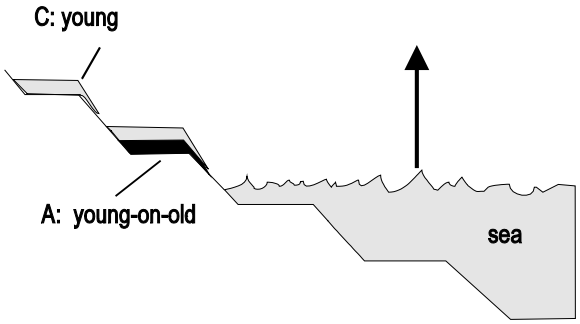
These are the simplest of scenarios of course and don't take into account other possible factors such as changing populations; a more complex topography than a simple sloping beach; unrepresentative excavation sites; more complex sea-level change patterns; site location factors other than distance from the water; disturbance and slumping; but lack of data makes it difficult to evaluate them.



With stable sea-levels, you would expect Type A "young-on-old" deposits everywhere. These were not seen during excavations.



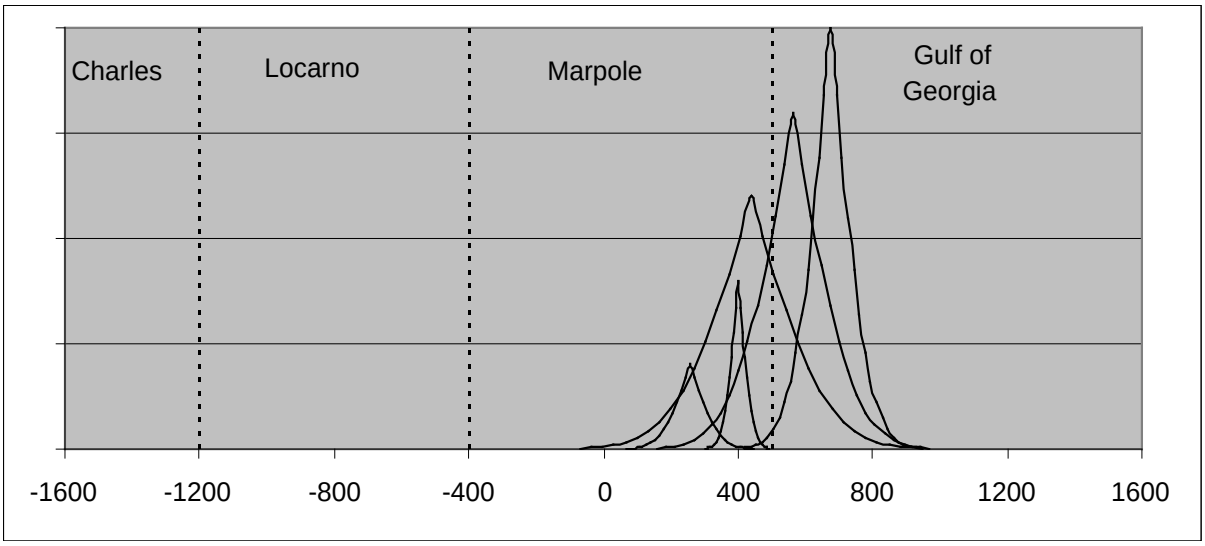
With falling sea-levels, you would expect to see some Type B "old" and Type C "young" deposits as shown. They were.



With rising sea-levels, you would expect Type A "young-on-old" deposits to be accompanied by Type C "young" deposits further back from the sea. They weren't.

[10] I also talked to the Snunéymux[w] and Hulq'umin'um First Nations.

[11] Appendix 3 gives details.



Radiocarbon dates from the large midden DgRw-4. The scale along the bottom is a calendar, negative values are dates BC, and positive values are dates AD.

The shapes of the entries for the dates (the bell curves) reflect their uncertainty. The vertical scale simply indicates a number assigned to the date starting with 1 for the oldest date on the left and increasing by steps of 1 to 5 for the most recent date on the right. The two earliest results are from A.J. Curtin and the three most recent ones are those reported here.

Results

Sample 1 was reported as:
1550 ± 70 BP ^{14}C uncalibrated
which the BARDL interpreted as:

440 AD,[12] 380–540 AD (1-sigma)
1.84 m above HHW datum.

Sample 2 was reported as:

1430 ± 70 BP ^{14}C uncalibrated

which the BARDL interpreted as:

590 AD,[13] 510–660 AD (1-sigma)
10.60 m above HHW datum.

Sample 3 was discarded except as a general indicator of the midden's age—see Appendix 3 for details.

Discussion

Although intended to expose a flaw in the falling sea-level hypothesis, the results actually add further support to it. The most straightforward interpretation of the results is that the lower bench became available for occupation around 440 AD, and occupation of the FN-I area at the back dwindled, finally ceasing around 590 AD.

The graph of all available results[14] shows a curious difference with that given earlier for

[12] I reckoned, less accurately, 511 AD using the Oxford University OxCal 1999 database. BARDL is the Beta Analytic Radiocarbon Dating Laboratory in Florida. The radiocarbon date given here includes both the local reservoir correction for marine samples (390±25 years) and the global reservoir correction (400 years) contained in the MARINE 98 database, but the BARDL result sheet includes only the former, that is, my 1550±70 BP is reported by them as 2340±70 BP conventional, and 1950±70 BP adjusted for local reservoir correction.

[13] I reckoned, less accurately, 606 AD.

[14] Samples 1, 2, and 3 plus 1770±90 BP ^{14}C, 130–384 AD (2-sigma assumed); and 1640±50 BP ^{14}C, 369–432 AD (1-sigma assumed).

results obtained from sites associated with DgRw-4. The clustering around the transition between the Marpole and Gulf of Georgia cultural types could of course have any number of explanations, including the obvious one of unrepresentative sampling, but there may be a hint here that most of the oldest parts of DgRw-4 have been destroyed by the encroaching sea and we are seeing only the recent remnants. However unlikely we also have to keep in mind such factors as that it might have become more "fashionable" around 500 AD to live closer to the sea.

The next move

Clearly we have a puzzler here. Although archaeological research of the site may be out of bounds, there is scope for further geological research[15] into sea level changes and the faint possibility that the area was the scene of considerable seismic disturbance around 500 AD. Could it be that a tsunami has confused the archaeological record by washing away traces of settlement before 500 AD near the shore? If not, then why are the older deposits furthest from the shore when sea level was evidently markedly lower than it is today?

As they say at the end of all good scientific research reports—further research is obviously required. Stay tuned.

Appendix 1—Sea-level observations

Because of the shallow slope of the beach (6.2°) at False Narrows on the Gabriola side, small sea level changes make a large difference in the position of the high water mark. Each metre change in sea level moves the tideline 9.2 metre [30 ft.] up or down the beach.

Recent

Bank erosion is very active at False Narrows on the Gabriola side and many long-term residents say there has been "several feet" of erosion during their life on the island. One resident recalls seeing an old photograph, now lost, showing a farm track between the row of maples and the top of the beach. There is no trace of the track now, and no room for one. Several large trees have been completely undermined and are only surviving by having root systems extending horizontally into the bank.

Erosion of the bank on Mudge is less than on Gabriola because the Mudge beach is sandstone (De Courcy Formation) while the Gabriola beach is basal till and mudrock. Erosion of the till is discontinuous and mostly by winter storm-wave action, and of the shale by oxidation.[16]

Historic

A manuscript chart[17] of False Narrows by Capt. Richards surveyed in 1859 shows the width of the narrows at the low water mark to be about 320 metres. A modern chart puts it at 410 metres. An increased width is not in itself evidence of a rising sea level—it might be the result of erosion—but it is evidence that sea level hasn't dropped in the past 150 years.

There are mature Douglas fir on Mudge growing right at the modern high-tide mark. These trees are an estimated 270 years old, an indication that sea level has not dropped in that time.[18]

Slightly further afield, First Nations people recall that it was once possible to walk from

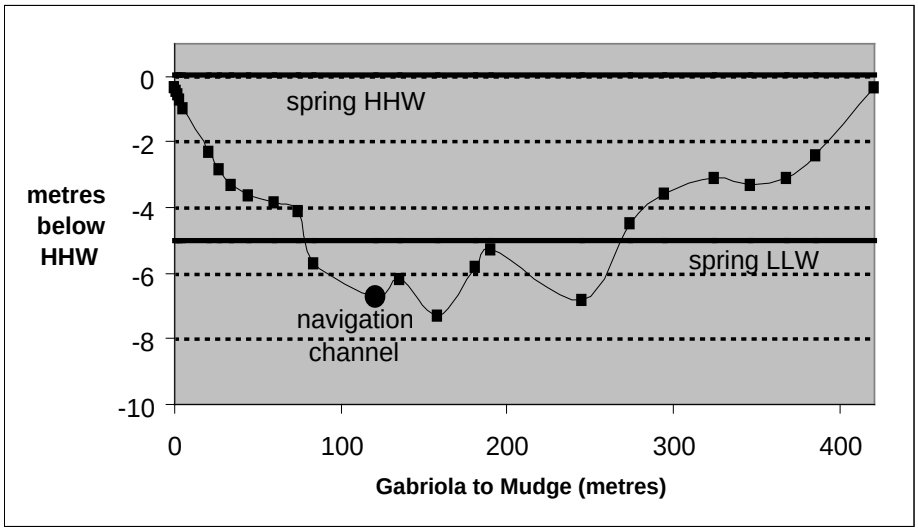
[15] It is unfortunate that older archaeological reports pay minimal attention to the geology of the area, reporting for example, merely "grey soil".

[16] *SHALE* 12, pp.7–29.

[17] UK Hydrographic Office, D6805, Shelf Za.

[18] A tree-ring analysis of a similarly mature Douglas fir (1.42 m dia.) cut down on the El Verano Drive sub-division was traced back to 1728 AD at the 1.12 m high level.

Denman Island to Comox on exceptionally low tides. This is no longer possible.



Prehistoric

At two places in False Narrows, there is midden only just above the high-tide mark and subject to flooding in winter storms. These are Davidson Bay on Mudge, and just east of the boat-ramp on Gabriola. The latter section is now protected by rip-rap built by the property owner in 2004, but a winter storm has on one occasion since sent waves over the top of it.[19] The eroding midden is stratified and shows no signs of having been below sea level.[20]

There are also petroglyphs on Mudge Island in Davidson Bay that are only about two metres above the current high-tide mark. Between them and the sea there is a nearly flat area of soil and midden (DgRw-24) that is occasionally flooded in winter storms.

A recent storm exposed the midden on the Mudge Island side of the bar between Mudge and Link Islands, and it was clear from the exposure that the shell-deposits went down at least 23 cm [9 in.] below the top of the present-day beach. The bottom of the deposits could not be seen.

Archaeological studies in the Mediterranean indicate that oscillations in sea level from 1–1900 AD have not exceeded ±0.25 m.

Channel profile

A profile of the bottom of the channel from Gabriola to Mudge taken at the southeast end (by our house) contains no evidence of a former bench, now submerged; the channel is just too narrow.[21] Presumably, in the past, the area that is now the beach was higher and possibly dry if sea level were also a few metres lower.

Geological

I measured the "apparent dip" of the rock strata (the dip parallel to the cliff faces)[22] along the shore from Brickyard Beach to the Maples. All the measurements were very consistent with the

[19] The area's highest tides occur in mid-winter when a spring flood tide is driven by a strong south-easterly wind up the Pylades Channel, and, at the same time, atmospheric pressure is low due to the passage of the centre of a depression (1 kPa = 4 in. of H_2O, so a drop from the standard 101 kPa to 98 kPa in a depression raises sea level by a foot, not including wave height). Such a coincidence of circumstances does not occur every winter.

[20] This spot corresponds to Excavation Unit 4 in Burley's *Senewélets*, which he records, contrary to casual observation of the eroding surfaces, as being "totally of water redeposited material".

[21] The datum is HHW (spring "high high-water"). Also shown is LLW (spring "low low-water").

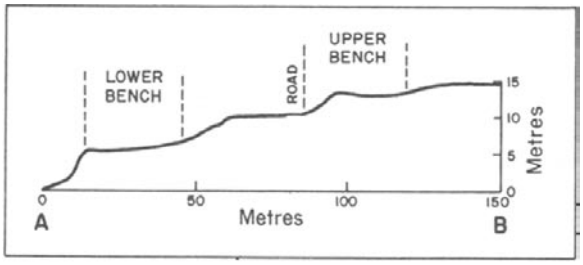
[22] $\varphi = \tan^{-1}(\tan\delta \times \sin\eta)$; φ = apparent dip, δ = true dip, η = offset from the strike. Gabriola has a syncline axis along its long central axis so the strata on both north and south beaches dip towards the island's centre at around 12°; however, you only see this slope in the plane of the cliff face if the cliff you're walking along is going in the direction of the island's centre. Otherwise, the apparent dip is less.

apparent dip being due to the island-wide folding of the late-Cretaceous bedrock believed to have occurred about 42 million years ago. No faults were observed of more than a few inches and all appeared to be far too ancient to have affected the archaeology of this stretch of coast. If there was a large, but local, crustal movement in the last 2000 years, it is not recorded in the small stretch of coastal cliffs I looked at, although, to be honest, I wouldn't have expected it to be.

Land profile

The *Senewélets* report contains a land profile (*above*) identifying three benches at the site.

The upper bench between El Verano Drive [ROAD] and South Road [B] is the conjectured area occupied by the earlier FN-I people. The lower bench between El Verano Drive [ROAD] and the sea [A] is the conjectured area occupied successively by the FN-II, -III, and -IV people.

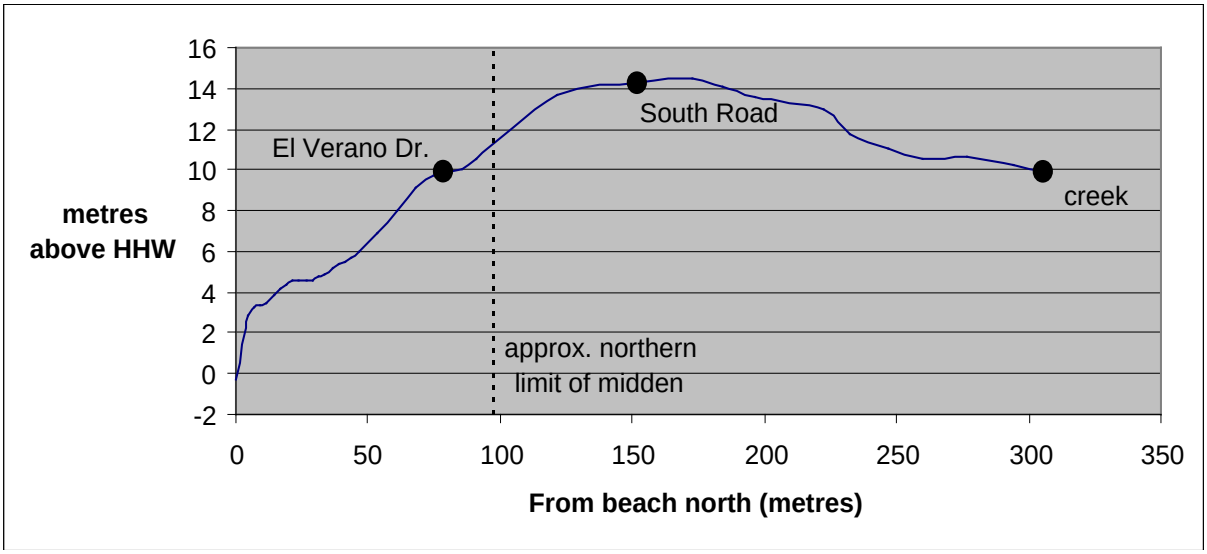


Augering down to the Pleistocene glacial clay at several spots along the bank of the creek where this inlet would have been has failed to reveal any sign of a former beach.[23]

Regional sea-level changes

Much of the research on sea-level changes in southwestern British Columbia and the San Juan Islands supports the idea that sea level has been rising gradually for the past 2000 years and that the cumulative rise in that time is about a metre.[24]

Evidence for this comes from an extensive



Unfortunately, what this profile fails to show is that if you extend it north of South Road (beyond B on the right), (*below)* you can see that if sea level were as high in the past as the present El Verano Drive road (the middle bench), there would have been a long narrow inlet of the sea stretching inland from Brickyard Beach behind the site.

[23] Away from any archaeological site, though there are a few patches of shells in the area. The grey-greenish clay was typically 0.6 m down with 0.36 m of organic-rich topsoil followed by 0.24 m of a similar soil but with some sandy clay.

[24] Stein (ed.), (p.37–40). Mitchell 1972 (p.65–7). The quotes following are from Julie Stein's book.

excavation of a midden on San Juan Island revealing a wave-cut bank 1.0 m lower than the present one; analysis of salt marsh deposits on San Juan Island that show variations in height of not more than 1.0 m in the past 2000 years; coring of peat on Galiano Island showing a rapid rise in sea level (marine transgression) ending 2000 years ago followed by a gradual rise thereafter; dating of a fossil stump 1.0 to 1.5 m below high tide near Victoria also to about 2000 years ago; and an excavation at Cook Street, Victoria, indicating terrestrial conditions 1.5 metres above present sea level during the past 11000 years.

None of the evidence suggest there has been an abrupt fall in sea level in the southern Strait of Georgia in the past 2000 years, while, in contrast, records on the outer coast show evidence of at least six abrupt changes in sea level in the past 3500 years due to large megathrust earthquakes.

Falling sea levels?

Is there any evidence at all that sea level has been falling, apart from that from False Narrows? Perhaps.

The profile of the eroding middens at Dionisio Point at the north end of Galiano Island is fairly similar to that at False Narrows except that the False Narrows basal till appears, from my casual observations, to be replaced there by glaciofluvial deposits of sand with minor gravel, silt, and clay.[25]

Excavations at DgRv-3 tentatively identified three components, Dionisio Point (DP) -I, -IIa, and -IIb. Just as False Narrows:

DP-I, the oldest component (lower TC 6, Bench IV), was confined to the bench furthest from the sea and was cautiously suggested to be of considerable age (essentially pre-Marpole);

DP-IIa (upper TC 6, Bench IV) possibly Marpole;

DP-IIb, the youngest and closest to the sea, (TC1, TC2, TC4, Bench III and II), was possibly Gulf of Georgia.[26]

The radiocarbon dating was:

DP-IIa: **70 AD**, 20 BC–160 AD
6.71 m above HHW.

DP-IIa: **210 BC**, 320–100 BC
6.55 m above HHW.

DP-IIb: **550 AD**, 460–640 AD
1.63 m above HHW.

These dates and heights above sea level are in line with the observations at False Narrows.

Other major sites

Any "local" change in sea level would presumably have also affected neighbouring islands also. There are midden sites on several of these, particularly Mudge, Valdes, and Thetis.

On Valdes Island, there are several middens on the Vancouver Island side. The only one I'm familiar with is at Blackberry Point. The sandstone cliffs nearby are the Geoffrey Formation, so it is likely the low-lying points on the inner side might well be underlain with Northumberland Formation mudrock too. The midden is 0.66 m thick, 0.11 m above datum at its lowest point (16-in. above top of the beach), but overlaying weathered sandstone rather than glacial material. This difference makes it less useful from a non-archaeological perspective.

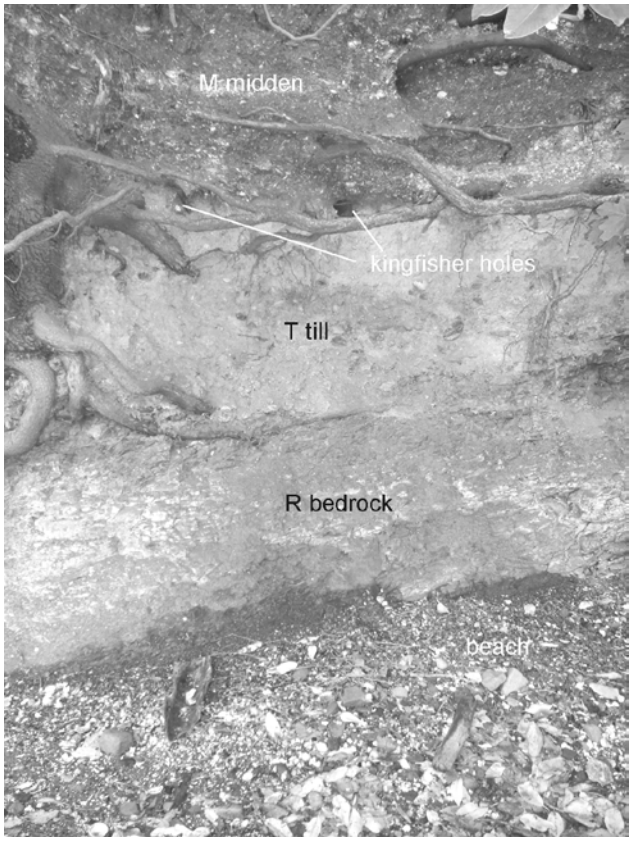
[25] There is also a distinct interlayer, Mt, of brown soil (See Appendix 2) much favoured by tree roots.

[26] Mitchell assumes progradation (seaward extension of an occupied site as rubble accumulates) saying, rather cryptically to a non-archaeologist, "the general principle underlying bench and beach dating, of course, is that age increases with height and distance from the shore". The implication presumably is that sites are only preserved when sea level is stable or falling. The drift of beach sand in False Narrows is westward into the Northumberland Channel, and because of strong tidal currents and exposure to southeast winds it's hard to imagine progradation taking place in the narrows. Certainly the disposition of sandstone boulders on the tidal flats to the southeast indicate that cliff erosion has been going on there for a very long time.

There are however deep caves in the cliffs on Valdes that might yield geological evidence of major earthquakes.

In North Bay on Thetis Island, there is exposed midden with a profile just like that at False Narrows, including hard-packed till. The underlying rock in the bay is also the same Northumberland Formation mudrock.

On Mudge, just across from DgRw-4, the bedrock beneath the midden is sandstone, which is part of the De Courcy Formation of the Nanaimo Group. There is much less till than on Gabriola, except at the southeast end of the island facing Link Island, where the till is so thick it forms bluffs. Mudge is a good place to be looking for middens that are at or even slightly below the present-day sea level. Finding such a deposit significantly older than 500 AD would be a boost for the rising-sea level hypothesis, while one younger would show that sea levels have indeed dropped and risen again since 500 AD.



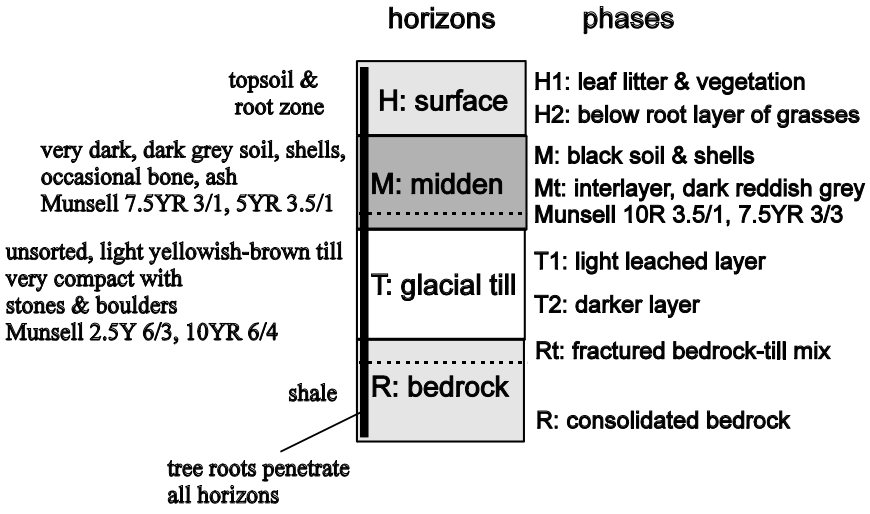
Appendix 2—Stratigraphy

Midden

The exposed midden along the shore has four major horizons H, M, T, and R, easily recognizable by a casual stroller.

The bottom horizon R is mudrock—known as shale on Gabriola. The rock is part of the Northumberland Formation of the Nanaimo Group, and is about 72 million years old.

Above the bedrock, there is a layer of compacted yellowish-brown glacial till T, which was deposited at the base of a glacier. The basal till is, on average, about half a metre thick.[27] It is unsorted containing everything from clay to large boulders. Volcanic and intrusive rocks are present in a typical Coast Mountain mix.



[27] Average: 0.57 m; max. 1.24 m; min 0.00 m.

At the west end of the midden, the till is sometimes absent and midden is in direct contact with bedrock as at the right side of the photograph. Hard to see in black-and-white, but Mt? is silt bound by rootlets, clay, and moisture—75 mm thick, and Rt is weathered bedrock coloured umber by clay.

The bedrock surface is at least 13000 years old, but the midden is not more than 3000 years old, so, for some reason, there's no record of the intervening 10000 years.

The midden itself, M, is a grey (black when wet) organic-rich soil[28] containing shells, broken and whole, sometimes scattered, but commonly in dense almost soil-less lenses. The average thickness is a little over one metre.[29]

Above the midden, there is some litter, topsoil, and the root zone of the grasses and shrubs, H.

Each of these four horizons is divisible into minor phases, but these are commonly not easy to discern or are absent.

The bedrock R may have at its surface, rock fragments in a till matrix, or fractures permeated with fine till (clay), Rt.

The till, T, is often streaked with thin discontinuous layers of clay, silt, or sand with a different oxidization colour. Some of this is presumably due to groundwater seepage. There is sometimes a lighter band, T1, above the darker bulk, T2, which likely has to do with different moisture content.

Between the midden M and till T, there is, in places, a thin interlayer, Mt. This is characteristically free of shells except perhaps for tiny fragments. Under a microscope, the soil appears to be grains of till (rock flour)[30] that have been lightly weathered—specks of iron oxides on mafic minerals give it its reddish tinge. The layer is fairly well to well sorted but with occasional pebble-sized stones in a fine-sand to silt matrix. The interlayer appears in lenses 140-mm thick at their thickest, but it is also commonly absent.

My guess is that these are water-borne deposits, either in puddles on the paleo-surface of the till, or modern deposits formed by drainage water flowing beneath the midden over the top of the relatively impermeable clay-rich till. At one spot, I saw a shard of spalled, case-hardened sandstone, something that might have been used as a crude tool; it was embedded with an unnatural vertical orientation. Something somebody dropped into a muddy puddle perhaps?—but it's easy to think up other explanations too.

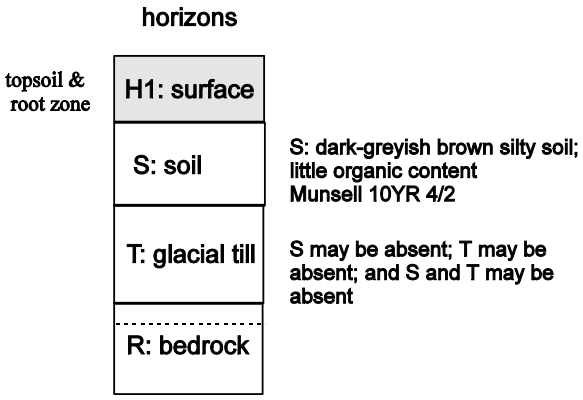
Away from the midden

The area immediately surrounding the midden has a similar profile, the main difference being

[28] Defined as *Neptune soil* in the British Columbia Soil Survey vol. 4, *Soils of Gabriola and lesser islands*, Report No. 43, 1990.

[29] Average: 1.12 m; max. 2.13 m; min 0.46 m.

[30] Roughly the same minerals as in *granodiorite* or the volcanic equivalent, *dacite*.



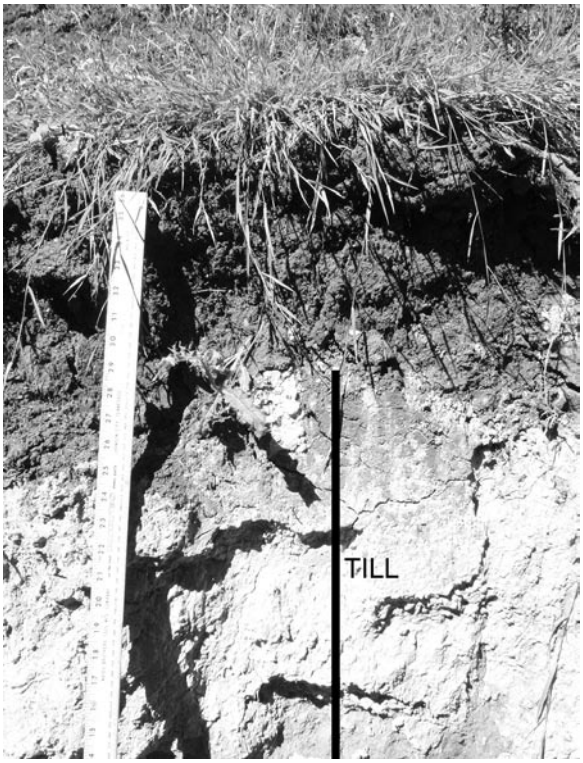
the replacement of the midden horizon M by a thinner soil horizon S. The S horizon is also the H2 phase. There is nothing equivalent to the Mt interlayer. The soil S is weathered till.[31]

Appendix 3—Samples

In this note, HHW (high high-water) technically means my surveying datum. This is the top of a smooth sandstone boulder used as a stepping stone from our property on to the beach, marked with a white paint spot. It is estimated to be 4.81 m [15.8 ft.] above the LLW datum at Ladysmith used for Chart 3475, and roughly 0.3 m above the level of the "top of the beach" (where the sand meets the bank or cliff). In winter storms, the water (not including waves) may be more than a foot above HHW. Inland locations are relative to the SW corner of the asphalt surface at the Turnabout Drive (El Verano) road end, 49°08.083'N, 123°46.586'W, 9.76 m above datum.

Sample 1 (photo next page)

Taken without digging from the exposed eroded bank at the top of the beach beneath the maples, just above the bottom of a dense shell lens that lays immediately above a 120-mm thick shell-free interlayer, Mt, above till, T, about 8 m west of the beach path of Lot 25, Plan 17835,



Away from the midden, the soil is thin and overlays glacial till, though this is sometimes absent and there is soil down to bedrock.

49°08.032'N, 123°46.569'W. The sample was estimated to be 1.84 m above datum and roughly a metre down from the top surface of the bank (there is some slumping). The midden horizon, M, is about 900 mm thick.

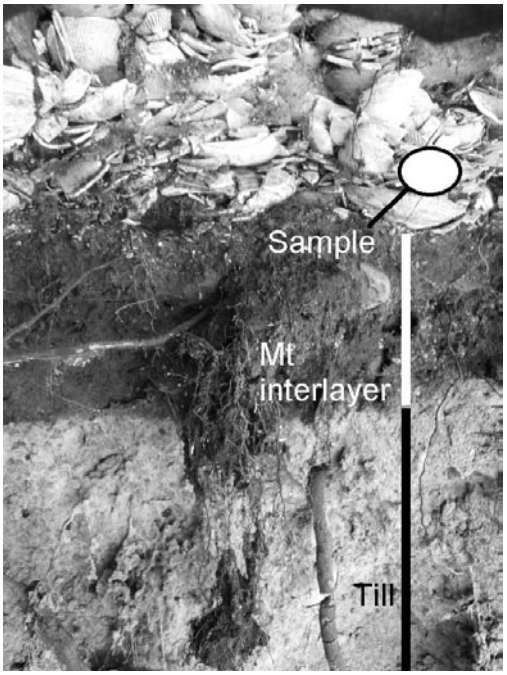
Sample 2

Taken without digging from the top surface of the soil, below litter and duff close to an old fir tree. Light topsoil, broken shell in large fragments lying mostly flat (undisturbed?).

The sample was estimated to be 10.60 m above datum, and about 64 mm below the surface, which was 0.91 m above the near edge of the road. Location relative to the end-corner of the road: 6.40 m back down the road and 7.57 m in from the edge (S23°W) on Lot 24, Plan 17835.

Taking samples from the surface obviously runs a very high risk of being a disturbed sample. In this case, the location was on a knoll that had not been ploughed as all the surrounding land had. There are trees on and around the knoll that are

[31] Defined as *Galiano soil* in the BC Soil Survey (*ibid*); however, the parent material is till, not shale. At one building site, the thickness of S was 0.15–0.45 m, and typically 0.30 m.



Sample 1 at the bottom of the exposed midden layer on the beach.

likely at least 200 years old. Less certain is whether the site had escaped disturbance during the building of the road and house.

Sample 3

Taken with one pass of a ¾-inch diameter auger penetrating inches into the bottom of a waterline trench re-opened for wellhead renovation on Lot 24, Plan 17835.

The sample was estimated to be 8.25 m above datum, and 2.08 m below the surface, which was 0.60 m above the near edge of the road. Location relative to the end-corner of the road: 10.06 m back and 8.03 m in from the edge (S23°W). It was 0–25 mm above the till and consisted of very small shell fragments. These had to be analysed by AMS because the collected sample was so tiny.

The 2089 mm column (the wall of the trench plus the auger) from the surface to the surface of the till consisted of mainly a soil and shell mix:

0-76	0.08 m leaf litter
76-533	0.46 m dark soil; broken shells
533-584	0.05 m ash; burnt fir bark
584-1651	1.07 m granular brownish soil; shells
1651-1753	0.10 m fine ash; crushed shells
1753-2054	0.30 m fine grey soil; shell fragments
2054-2064	0.01 m interlayer; shell-free fine soil
2064-2089	0.03 m fine soil; tiny shell fragments; sample zone
2089-	till (compact, yellowish).

Sample 3—result

Sample 3 was reported as:
1330 ± 50 BP ^{14}C uncalibrated

which the BARDL interpreted as:
670 AD[32]
640–700 AD (1-sigma).

This is an (unpleasantly) surprisingly recent date, all the more so because it is actually younger than the sample taken at the surface and therefore stratigraphically fraught.

Upon reflection, I decided to discard this result, except as a general indicator of the age of the midden. It seems likely that the sample was taken too close to the till in an Mt interlayer, and that these interlayers may be a part of the drainage system of the midden. It is conceivable that a tiny fragment, such as the sample was, could have been washed down through the midden by rain and horizontally by groundwater flowing over the surface of the relatively impervious till that underlies the midden. Disappointing; it was the sample that cost most and was taken with care, but a lesson learned.

Appendix 4—Vegetation

Gabriola side

The dominant tree on the midden is the bigleaf maple (*Acer macrophyllum*), probably on account of the calcium in the soil, but Douglas

[32] I reckoned, less accurately, 690 AD.

firs are also common (*Pseudotsuga menziesii*). Also present, though not abundant, are grand firs (*Abies grandis*) and arbutus (*Arbutus menziesii*). Naturally-growing western red cedar (*Thuja plicata*) is rare to absent on the midden itself. Also absent, but abundant elsewhere, is red alder (*Alnus rubra*). Beyond the midden to the east, the maples and Douglas firs rapidly give way to Garry oak (*Quercus garryana*) and arbutus.

Small shrubby trees are mostly the common Indian plum (*Oemleria cerasifomis*), and at the eastern end, oceanspray (*Holodiscus discolor*). There are also a few specimens of blue elderberry (*Sambucus caerulea*), black hawthorn (*Crataegus douglasii*), mock orange (*Philodelphus lewisii*), cascara (*Rhamnus purshiana*), and bitter cherry (*Prunus emarginata*). Just beyond the midden on the dry slopes, there is some soopolallie (soapberry) (*Shepherdica canadensis*) along with the poppies (*Eschscholzia californica*).

The understory, when not a domestic garden, is full of snowberry (*Symphoricarpos albus*). Patches of laurel-leafed daphne (*Daphne laureola*) are also very common and conspicuous in winter. The woods on the north side of South Road, away from the midden, have sword fern (*Polystichum munitum*), but you don't see them south of the road.

The dominant plants on the slopes of the midden are the introduced periwinkle (*Vinca major*) and English ivy (*Hedera helix*). Both are good slope stabilizers and help hide exposed midden from pothunters. The only native plant that co-exists with these is vetch (*Vicia americana*).

When not full of groundcover, the plants on the slopes are the tall variety of Oregon grape (*Mahonia aquifolium*), roses (*Rosa nutkana*), snowberry, trailing blackberry (*Rubus ursinus*), and small contained patches of Himalayan blackberry (*Rubus discolor*).

The most venturesome plant on the beach by the midden, especially around the boat-ramp, is beachgrass (*Ammophila arenaria*), but further east, American glasswort (*Salicornia virginica*) grows even closer to the sea.

A bit further back, but still on the beach is knotweed (*Polygonum aviculare*), which grows quite tall, and, above the high-tide mark, clover (*Melilotus alba*), agricultural grasses, and various other weedy plants—mugwort, hawkweed, etc.—that would be at home in any neglected garden.

Mudge side

The dominant large tree is the Douglas fir. Bigleaf maples are present but there are fewer of them on this side. There are a few smallish arbutus trees.

The understory is more open than on Gabriola, mainly due to the relative lack of snowberry. Weeds are also fewer, and American glasswort is the main beach plant. There is a patch or two of red-flowering current (*Ribes sanguineum*).

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