

2. The geoarchaeology of context: sampling for land snails (on archaeological sites and colluvium)

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As samples for snails are taken more routinely from archaeological sites, specialists cannot always visit and undertake sampling themselves, and consequently the nature of the sample provided for the analysis ranges greatly from the downright useless to excellent. Unfortunately, over the past 15–20 years or so, the number and proportion of poorly taken, not very helpful to virtually useless samples has increased (Table 2.1), as they have been taken routinely, mechanically, without much thought or understanding ... with a 'bag up the soil and specialist will do the rest' attitude. Subsamples from large bulk samples, or worse still, flots alone from bulk samples are more and more commonly proffered for analysis. A general understanding among a larger proportion of field staff that 'snails might help with the understanding the environmental context of the site' is to be welcomed – but how to proceed next is clearly less well understood.

There is no substitute for the specialist being on site; deciding the sampling strategy with the field archaeologists; choosing sample locations, taking samples, and describing and interpreting the sampled deposits. The geoarchaeological description, interpretation and understanding of *deposit formation* is key to sampling and subsequent interpretation. The taphonomy of the deposit is integral to the interpretation of the land snail assemblage acquired from it. Land snail analysts are, therefore, geoarchaeologists; they must understand soil formation (pedogenesis), deposit formation, and site formation processes from the wider landscape such as colluviation (hillwash), alluviation (river floodplain deposits), to the individual feature infill histories that archaeologists regularly excavate and record: ie, ditches, pits, dumps, postholes, scoops, quarries etc.

Selecting contexts to sample is largely, if not wholly, dependent upon the taphonomy of deposition and the ability to date the context (or contained molluscan palaeo-fauna). The most important consideration is how the mollusc assemblage was incorporated into the deposit, and how it represents the fauna of the environment we wish to interpret. So the formation processes of the soil, sediment, feature fill or context (ie, geoarchaeology) are crucial. This chapter attempts to introduce the reader to some of the pitfalls that commonly lead to inappropriate sampling, and provide a useful and thoughtful guide.

Table 2.1. Authors personal observation of the values of different samples taken for land snail analysis, and the approximate change in archaeologists approach to specialist sampling

Sample taken for land snail analysis	Value/limitations	Approx % Pre 1997 (1980–97)	1997– 2007	Last 10 years 2007–2017
Bulk sample (from whole context) often 10–40 litres taken by field staff/site excavators	Often conflate deposits with long durations, which may contain different & differing land-use history records	>10	15–20	37
Sub samples or grab samples from other 'enviro' samples taken by site staff/field archaeologist	Often conflate deposits with long duration. Often an after-thought	12	18	37
Column of samples taken at close/standard intervals by site staff	Good but often (>70%) mechanically taken at 10cm intervals, usually regardless of context boundaries	<5	15–20	35
Column of samples taken at varying close/standard intervals by specialist	Good & taken at varying sample interval taking heed of deposit formation, context & horizons boundaries	>95	80	70

(I suspect that as a snail specialist that I am given the better snail samples, so this probably under-represents field sampling)

Samples

Land snails are small, and shell fragments to 0.5 mm are identifiable and quantifiable, so it is imperative that they are recovered from soil samples processed appropriately, rather than hand-picked on site. Hand-collected shells have limited palaeo-environmental value; they tend to be just the larger and more robust species (Fig. 2.1) which are not representative of the palaeo-fauna. They are often just five or six of the 118 snail and slug species in the British fauna. Samples must be large enough to recover, ideally, at least 100 shells or more ... but not so many as to be overwhelming. On average, therefore, John Evans would recommend a sample size of 1000 g (Evans 1972, 41), though I tend to use 1500 g as my standard. Evans suggested removal of large stones by eye. As a standard I sieve air-dried soil through a 16 mm mesh sieve providing consistent removal of the larger stones. In stony fills, especially primary ditch fills, this may require samples in the field of 2, 3 or 5 kg to achieve that volume.

If large shells are hand collected they may not be entirely valueless. They are often quick and easy to identify and quantify as they are generally just the larger species (eg, *Cepaea*, *Helix*/*Cornu* etc) which may be slightly under-represented in soil samples. Washing the small volume of soil from the interstices of the shells may recover smaller species from which some palaeo-environmental comment may be possible; as

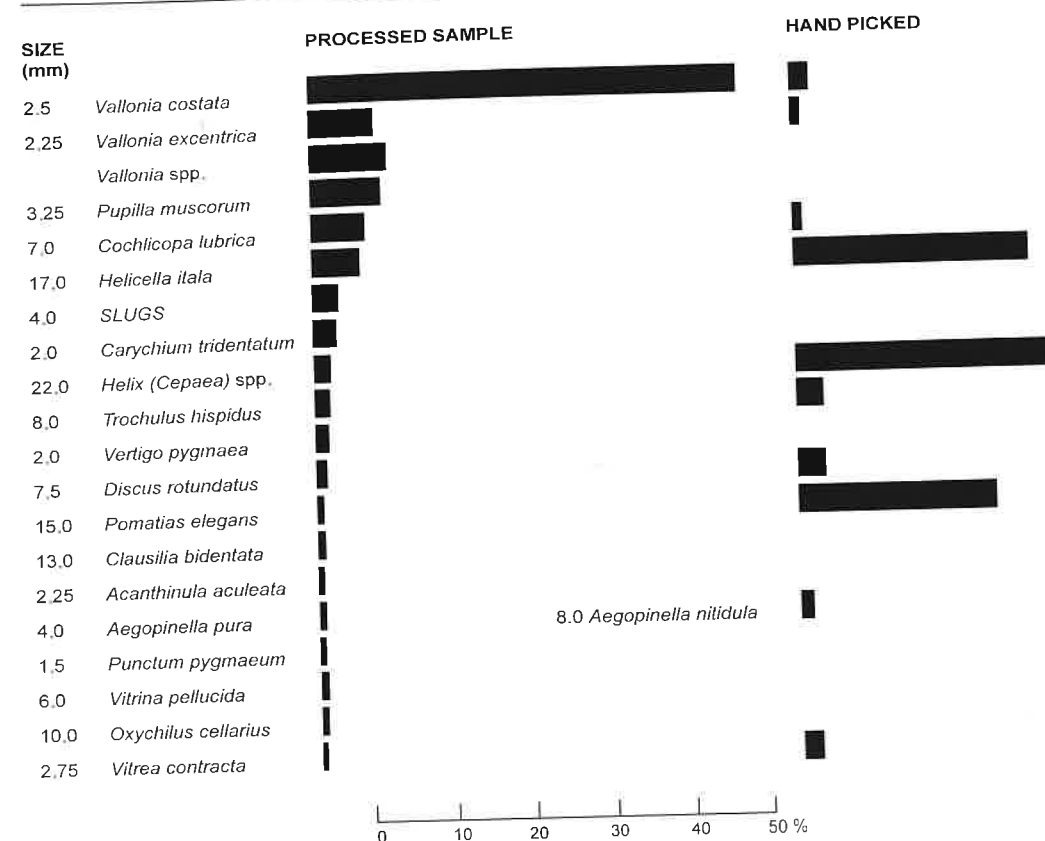


Figure 2.1. Comparison between assemblages; left, processed soil sample, and right, hand-picked (after Evans 1972, fig. 2, and Sparks 1961, fig. 1; illustration: Abby George)

demonstrated by the hand-picked assemblages from Round-the-Down (Allen 1995a; see Allen, Chapter 1), and Lewes Priory (Allen 1997), both early 1970s excavations in East Sussex. They are no substitute for proper soil samples.

Samples and sampling

It is important to obtain snail-specific samples, as the archaeologists and analysts should be addressing site-specific, time-specific and feature-specific questions which will allow themes relating to the wider landscape to be addressed. Sequences of contiguous samples, taken at the appropriate interval for deposit formation, are required from at least one, if not more, locations on site to enable a history of environmental change to be defined.

Bulk samples (typically 10–40 litres) taken routinely from archaeological deposits for charred plant and charcoal remains are usually taken at too crude a depth interval to provide valuable information. Bulk sample flotation processing for the recovery of land

snails is rarely compatible with standard practices which require flots and all residue to be retained to at least 0.5 mm (Evans 1972, 44–45; Davies 2008, 5–6; and see below). Although standard bulk flotation flots meshes of 250 µm or 300 µm are compatible, the fact that residues are often discarded, or are retained on only 1 mm mesh, can result in loss of a significant and biased proportion of the snail assemblage. Even the 0.5 mm to 1 mm fraction often contains a significant portion of the assemblage and I have recorded as much as 64% of the assemblage in this fraction!

Often grab samples are taken by archaeologists for the analyst for snails, and done so asking rather simplistic and not always very helpful questions. Sequences of samples are much more useful (see buried soils, ditch fills and colluvium), together with careful consideration of the taphonomy of the deposits – this may benefit from discussion between the archaeologists and the geoarchaeologist/palaeo-environmental archaeologist/molluscan analysts. Individual spot samples can have some value. If no long sequences are available, a series of carefully taken and selected samples may enable a chronological set of samples to be examined, providing a potted chronology of the sites land-use and environmental history. This may be suitable in defining and characterising local site histories, but not for detailed analysis of land-use changes. The amount of ecological information that can be gleaned from single spot samples is minimal in comparison with sequences of samples, and often does little more than provide general characterisation.

Taking your samples

Sampling is not just a mechanical operation of collecting and bagging soil – it needs careful consideration of the deposit formation. A few hours on site may result in weeks or months of subsequent analysis. Samples need to be taken with care. The identifiable snail fragments are as small as 0.5 mm (look at your ruler!). Any dirt, clods of soil or clay adhering to sampling implements could contain shells and contaminate samples. Using a dirty spade or, in fact, even a clean spade, is generally unacceptable. Sampling must be undertaken, carefully, clinically, and with clean tools (trowel, hand shovel, scoop etc), and these need to be thoroughly scraped clean between samples, if not actually washed with water if the deposit is moist and really sticky. Sloppiness and errors in the field cannot be rectified, nor necessarily identified, in the lab. Minutes of failure in the field potentially wastes not just hours in the lab, but weeks or months of analysis! Time expended on site ensuring detailed description and understanding of the deposits, making good records and photographs, is never wasted. Corners cut at this stage cannot be rectified, will be regretted, and will be detrimental to the time expended later, and results gained.

Ten steps to sampling

Details of how to take a column of samples is given by Evans but a quick 10-step guide list is presented below. Ideally a column of contiguous samples should be removed

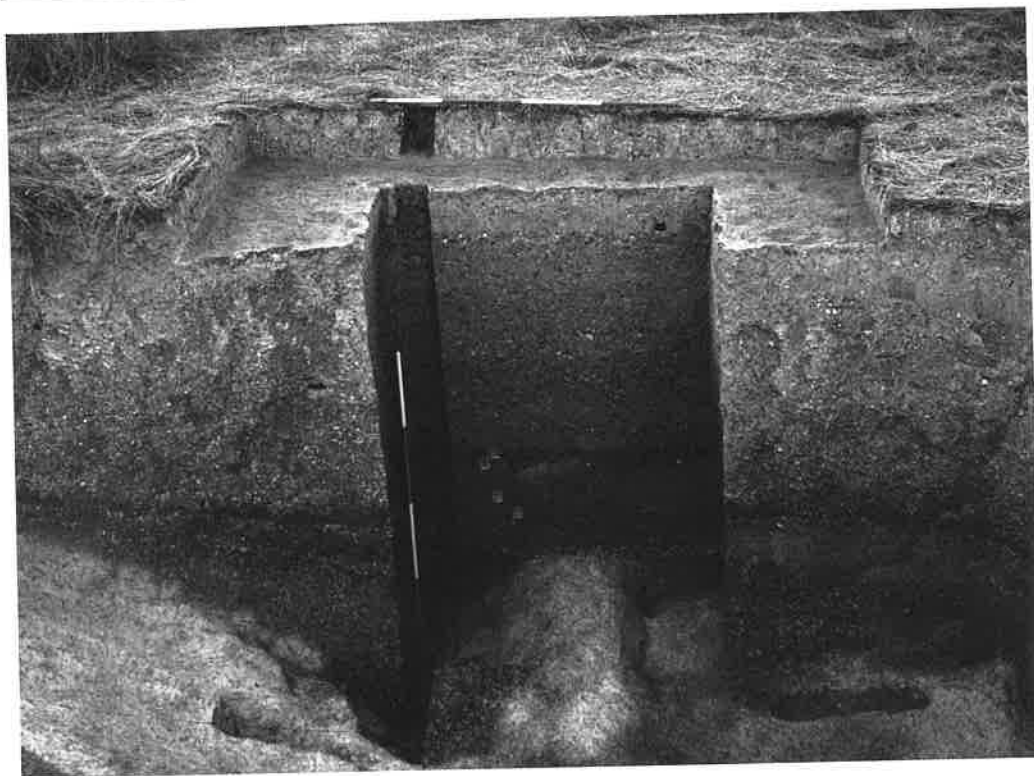


Figure 2.2. Strawberry Hill, Wiltshire. Column of 32 samples covering 3.1 m of colluvium; note complementary samples for soil micromorphology from stone-free lenses (photo: author)

from the exposed section (Fig 2.2). If the column is 20 cm wide then samples of 10 cm thickness allow reasonably easy recovery of samples of 1–2 kg. Sample interval, however, must be dictated by the speed and nature of deposit formation. Samples should *never* cross horizon boundaries. Too often now samples are taken routinely, systematically, mechanically and unthinkingly at 10 cm intervals, and then provided to the specialist. This denies many of the key aspects laboured by Evans in his excellent but now 40-year-old book (1972), that the geoarchaeological record is as much a part of the interpretation as the snails themselves.

A note on nomenclature: Often a 'column of samples' for land snails is taken through a deposit or through a feature. Unfortunately this can be confused with a monolith of undisturbed sediment, which archaeologists often call a 'column sample'. On a number of occasions a column of samples has been requested, only to be provided as a monolith (ie, column sample). Consequently, I advocate *never* using the term 'column sample' but only using monolith, undisturbed sample (kubiena sample) and 'column of samples' so as to avoid this potential, and unfortunate, confusion.

1. Review the project aims and site with the field archaeologist, and select your key, dated or phased sequences, ensuring that each profile has already been appropriately recorded (drawn, photographed) by them
2. Clean the section without smearing; break off soil lumps, rather than trowel a smooth polished surface, to expose pedological structure, and then photograph
3. Inset a datum nail and run a tape from the datum to the base of the profile. Make your own sketch section and describe in detail by depth, using pedological notation (eg, Hodgson 1997 and Munsell colour chart) ie, depth, colour, texture, structure, stoniness (size, shape and abundance), inclusions, archaeology boundary, interpretation
4. String out a sample column – typically 20 cm wide. Run a tape from a datum at the top of the column
5. On the basis of the sediment interpretation based on your descriptions and observations (and those of the archaeologists) decide on appropriate sample intervals (which may vary through the profile). If in doubt take samples at closer intervals: they can always be amalgamated in the lab, but not separated.
6. With measurements from top down, start sampling from the bottom upwards, taking extreme care to keep within horizons/context boundaries. Work neatly and systematically, removing large stones from the sample as you go. In general aim to acquire samples of similar size throughout the column, regardless of the thickness of the samples, or sampled deposit (obvious exceptions are stony primary fills or obviously very rich shelliferous layers)
7. Label each bag with sample and depth. Seal and set aside
8. On completion ensure the sample column, and any additional samples, are marked on a section drawing. Or at the very least that the datum point/s are clearly recorded on the site section drawing
9. Photograph the sampled column
10. List all the samples for your, and the archaeologist's, benefit

Processing samples

The processing of land snails is described by both Evans (1972) and Davies (2008), and has been published elsewhere and is summarised below.

Processing small 1–2 kg samples for land snails is a relatively easy process but does require fastidiously clean (laboratory) work environment, precision laboratory test sieves (Endecott style), and facilities to dry sieves where the light contents will not be disturbed, or contaminated (ie, a drying cabinet). Samples are registered into laboratory records (accessioning system), and set out to air-dry; samples can lose up to c. 20% of weight on air-drying. Air-drying makes samples more archive stable, but importantly provides a dried constant. Although when sampling (see above) large stones are removed, I sieve all air-dry samples through a 16 mm mesh to provide metrical consistency between samples. This is also useful in rock-rubble deposits such as the primary fill of ditches, ensuring that more of the processed material potentially contains snail shells, rather than large chalk stones.

Pre-weighed samples of constant weight are placed in a bucket and soaked in warm water and stirred. The immediately floating shells are decanted onto a 0.5 mm mesh sieves. Washing and decanting is repeated until no more shells float, and/or the water goes clear. It can be beneficial then to tip the sample through a small stack of 0.5 mm

and 4 mm mesh sieves to remove all the large stones (which are set aside to dry), and some of the easily removed >0.5 mm mud fraction. The 0.5 mm sieve is flushed with water and shaken to wash through as much soil as possible before being returned to the bucket with warm water. A disaggregant (eg, hydrogen peroxide (H_2O_2), decon 90, or sodium pyrophosphate for very organic samples, or less favourably anhydrous sodium hydroxide, or potassium hydroxide) can then be added and the sample stirred and left to soak ideally for 12 or 24 hours, stirring occasionally. (Note that Calgon no longer works as well as a disaggregant as the active ingredient sodium hexametaphosphate is no longer included. Also, the use of any disaggregant which may contain phosphates should be avoided as they are difficult to extract from waste water and when water is discharged back into the water system, such as a river/lake, this can cause eutrophication. It also can cause some surface shell damage). All new flots should continue to be decanted onto 0.5 mm mesh sieves, with the bucket refilled and decanted five or six times, or until the water is clear and no further material floats. The residue (ideally just clean stones), should then be washed/flushed through a stack of 0.5 mm, 1 mm, and 2 mm mesh sieves; each residue being carefully and individually washed through the stack of sieves before being set aside to drain, and then dry. A rapid scan of the flots will determine the likelihood of the samples to contain anything like enough shell; bearing in mind that up to 60% of the assemblage may still reside in residues. Formal assessment of the flots can be undertaken by the specialist, prior to selection of samples for sorting, extraction and analysis.

Flots and residues are then fully sorted and shell extracted under magnification of $\times 10$ to $\times 30/45$ using a stereo-binocular microscope. Only apical (or apertural) and representative diagnostic fragments (including slug plates) need be recovered. This then enables identification, quantification, tabulation and the application of any statistical analysis (see Law, Chapter 3) such as species diversity (eg, Shannon Index (H'), Brillouin Index (HB)) (see Allen 2003; 2007a), or delta indices ($\Delta 2$ and $\Delta 4$) (see Enwistle & Bowden 1991), or other tests (see Thomas 1985; Magurran 1988).

Sampling: addressing the archaeological deposits

Columns of contiguous samples should be taken, where possible through a range of deposits to build up, principally, a chronological sequence of the site. Some deposits may be more relevant and useful to sample, others are almost pointless. Some indication of the taphonomy, value and consideration for typical key, and commonly encountered, deposits are given below; the two most significant are buried soils and ditch fills (Table 2.2).

The point has already been made but cannot be over emphasised that samples must always be context specific, and never cross context boundaries. They must be large enough to yield 100–200 specimens. Sample thickness is dependent on the speed of deposition of the deposit: rapid deposition (primary fill) may require samples of 15 cm, 20 cm or more thickness, while a slow laminated silt may require sampling at 2 cm or 4 cm. The deposit represents time, and you are sampling a portion of that time.

Table 2.2. Simplified summary guide of aims and sampling strategy for a variety of commonly encountered contexts, deposit types and features

	Typical key aims	Typical sampling strategy
Buried soils	High quality pre-monument environment information	Close-interval contiguous column
Ditches	Pre, contemporaneous and post monument and site environment	Combination of principally a contiguous column augmented with 'spot' samples
Large Pits	Context specific micro-environments and postpit land-use environment	Contiguous column through 'natural' colluvial infills
Small pits	—	Generally poor contexts and only context-specific sampling
Postholes	—	Rarely worth sampling, unless very large postpits
Treeshollows etc	Detailed contemporaneous land-use and environment, <i>but</i> commonly prior to the archaeological activity	Sequence and spot samples from specific contexts
Banks & mounds	—	Basal soil, and turves only (see buried soils)
Middens	—	Generally poor contexts
Colluvium	Long stratified sequences of land-use	contiguous column
Alluvium	Long stratified sequences of land-use	contiguous column

Buried soils

Buried soils usually represent long periods of time for which their burial can often be well-dated. They are however, complex in their formation, and may contain considerable pedogenic, biological, physical and chemical reworking which have implications for shell survival, breakage and movement within the profile (Carter 1990). Soils can have clear horizons, *not* layers, which are formed *in situ*, and the recognition of this of soil formation (pedogenesis) is imperative. On burial the soil may 'collapse' or become squashed as voids collapse, but the soil fauna may still survive for a while; some of the soil may be worm-worked into the base the bank, barrow or rampart, as Macphail demonstrated under the Iron Age rampart at Barksbury, Hampshire (Macphail 1986). Soils need to be carefully examined, understood and appropriately, and often carefully close-sampled. Single 'bulk' samples encompassing the whole profile can combine different snail assemblages covering thousands of years in which there may be significant change. A bulked sample across this will provide a subfossil assemblage which is nonsense in terms of any former snail population or fauna. Buried soils, more than any other type of context routinely encountered on site, need more careful consideration and sampling.

It is important to define in the field, and appropriately sample, these soil horizons and recognise any post-burial alteration. Selecting the sampling location of an exposed

buried soil should try and include the best preserved profile, avoid cut features, and include, where possible, a Holocene treehollow or subsoil hollow *beneath* the soil. A bank has little value. It is normally comprised of the parent material (geology) and will essentially contain no shells. The origin of those few it does contain cannot be determined; they may relate to any or all of soil or archaeological deposits scooped up during construction, or shells fallen in crevices, cracks, voids and rootholes, in the bank or from soils forming over the bank. Typically the Ah horizon (turf), A horizon (topsoil), B horizon (rest of the profile) and B/C or B/R horizon at the base of the soil should be defined, and samples of 4–5 cm, or even 2 cm taken contiguously through them. Typically samples are narrower in the turf (say 2 cm), and larger in the main part of the profile (B horizon). The cruder the sampling interval (say 5–8 cm) through these long-developed sequences, the more likely there will be conflation of very different mollusc faunas.

Ditches

One of the most commonly sampled, but also complex, types of context are ditch fills. The taphonomy of the assemblages is related to the tripartite ditch infilling sequence as defined by Evans (1972, 321–8) and Limbrey (1975, 290–300). These provide the key sedimentary units as defined by product (Evans) and process (Limbrey), and summarised by Allen (1995b). Not all ditches contain all three fills and the ditches are not necessarily uniform in the distribution and nature of such fills along their length. The recognition of primary, secondary, and tertiary fills has significant archaeological and interpretative implications and is a convenient method of grouping together a number of contexts which belong to the same episode or phase of ditch infill (but are not necessarily directly tied to the phases of archaeological activity). In addition to this I have added an 'initial deposit' and formally included the stabilisation horizon and buried soil separately rather than just as the end of the secondary fill.

The taphonomy of the snail assemblage can be considered by each of these defined units (Fig 2.3).

Initial Wash: this thin parent-material derived deposit (ie, typically a calcareous mud) represents the first rainwash. It principally includes shells washed from the soil through which the ditch was cut. Fallen turves may also lie on or in this deposit (see Crabtree 1971; Bell 1990; Bell *et al.* 1996). The deposit is often only a few centimetres thick, so sampling can be challenging, and may require the overburden to be removed or excavated in order to sample this deposit in plan. After taking a contiguous column of samples, it is often possible, with the archaeologist's agreement, to excavate a portion of the ditch fill to expose this thin deposit for sampling.

Primary Fill: the majority of this is clastic material derived from the weathering of the sides – resulting in typically in chalky or stony rubble at the base of the ditch. Initially just occurring at the sides of the ditch, before infilling, often the majority of the ditch.

Process	Product
INITIAL FILL: a thin parent material-derived wash on the very base of the ditch, & possibly accumulating at the bottom of the sides. It may also include or contain fallen turves. <i>Duration:</i> probably the first 1–2 winters.	
Rain wash of a) some soil material through which the ditch was cut, and b) of the exposed parent material of the ditch sides.	Thin parent-material derived wash.
PRIMARY FILL: Weathering of the ditch sides. This can be as much as 70% of the ditch infilling where loose & unstable geologies are concerned. In some cases this may superficially look like the 'natural' <i>Duration:</i> These fills can occur in about 30–60 years.	
Weathering & frost shattering of the newly cut ditch sides, the soil & turf line, & weathered natural (regolith). May include the results of immediate settling & erosion of any adjacent bank. i) Trample in final stages of digging ii) Initial rainwash of cut geology (chalky marl) iii) Weathering & frost shattering of the ditch sides iv) Falling of topsoil/turves derived from the soil surface through which the ditch was cut	Weathering results in the accumulation of 'clean' angular, rock debris largely in the corners (flat-bottomed ditches) or the base (V-shaped ditches). Turves & (top) soil may fall into the ditch & come to rest of its sides or base, appearing as relatively well defined dark humic patches. The primary fill may have a laminated appearance. Primary fills can be thin bands or occupy as much as 60–70% of the ditch. i) Dark line, perhaps soil ii) Fine wash iii) Angular rock debris, screes, accumulating from the corners of the ditch
SECONDARY FILL: Weathering back of the poorly vegetated ditch sides <i>Duration:</i> Decades to centuries.	
Gentle gradual & continued weathering of the ditch sides & surrounding soil when covered in patchy plant cover. Natural accumulation of ditch silts, often occupying the main body of the feature. Slows with time slows as the angle of slope decreases & the infilling material becomes colonised with patchy vegetation.	Finer, more humic sediments which tend to become less stony higher up the ditch profile & may show traces of bedding. The rate of infill may slow, enabling vegetation colonisation to increase to such an extent that a stable soil horizon may develop which, in turn may show evidence of worm sorting into stone-free or small stone lenses.
STABILISATION HORIZON/BURIED SOIL: Slowing of sedimentation rates, stabilisation of the ditch sides & herbaceous vegetation grown in the ditch & sides, leading to pedogenesis & soil formation. <i>Duration:</i> Centuries.	
Speed of sedimentation decreases & almost stops, allowing typically herbaceous vegetation to take hold, & soil formation to occur.	A less stony, & possibly almost stone-free, horizon at the top of the secondary fill. Possibly slightly darker in colour (humic), with weak ped structure, & often more dense artefacts content due to the longevity of the deposit formation.
TERTIARY FILL: final ditch fill, generally derived from ploughing & plough wash or deliberate backfill <i>Duration:</i> Centuries to millennia.	
Homogeneous colluvial material, resulting from cultivation or deliberate infill of the surviving, shallow, ditch & associated with farming, clearance, or landscaping activities.	Finer colluvial & soil material with few large stones and common small stones.

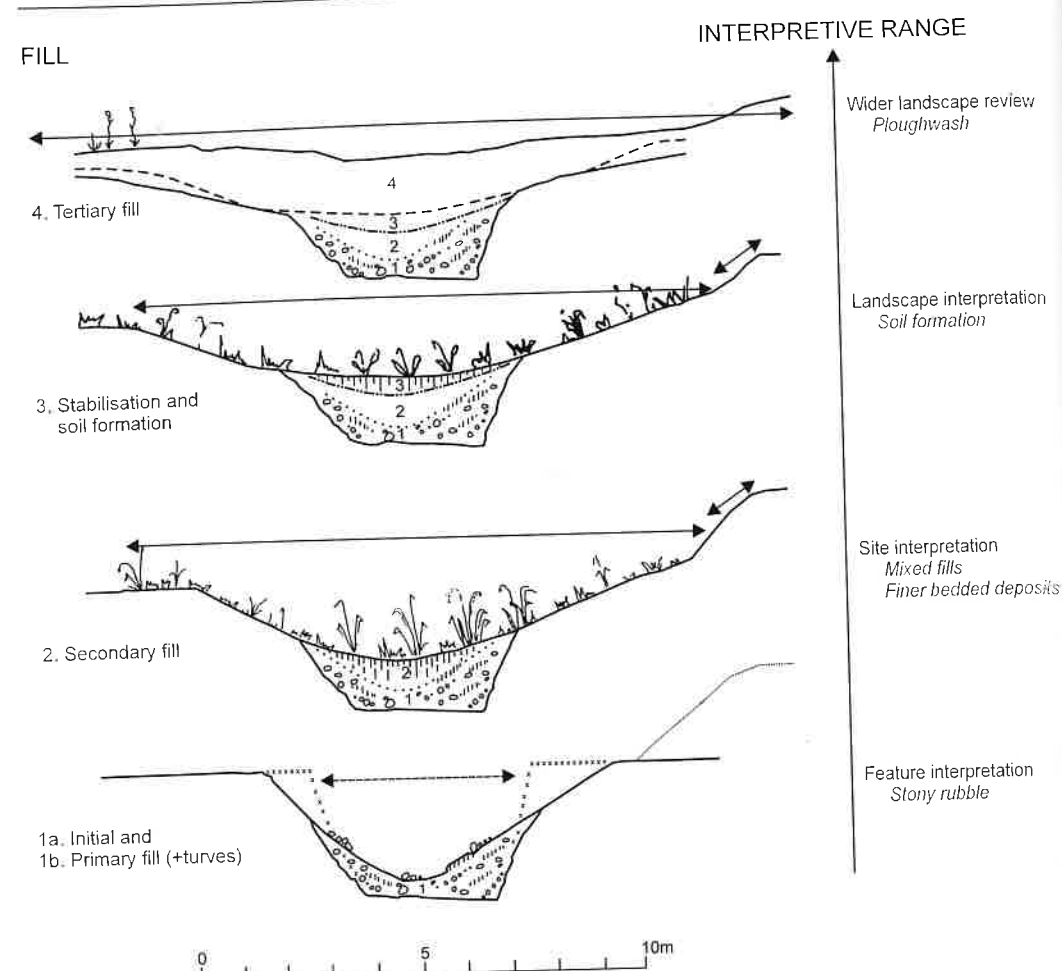


Figure 2.3. Schematic drawing of ditch infilling process, summarising process, product and origin of subfossil land snail assemblage based on Evans (1972, fig. 123) with modifications and additions. Horizontal arrows indicate the immediate micro-environmental range the snails reflect (illustration: Abby George)

Most of the shells here are derived from the soil through which the ditch was cut (palaeo-fauna), and turves fallen into the ditch (see Bell *et al.* 1996, fig. 4.6). Only a few snails are likely to inhabit the short-lived inhospitable ditch micro-environment, and those that do originate from the soil surface. The assemblages largely relate to the pre-ditch environments. The stony nature and rapid mode of infilling requires large samples up to 5 kg and at intervals of perhaps 15–20 cm thickness or more.

Secondary Fill: this a mixed fill, usually containing the majority of the artefacts as it relates to the period of site use and occupation. Fills are finer, less stony, and sometimes

weakly banded. Snails represent both the ditch micro-environment, with some patchy herbaceous vegetation, but mainly the immediate ditch environs. These deposits form gradually and incrementally and sample intervals of 10 cm are common; and generally 8–12 cm.

Stabilisation/Soil Formation: soil formation commonly occurs at the top of the secondary fill as the ditch sides stabilise, weathering and infilling slows, and the ditch becomes more vegetated. The snails are more representative of the wider landscape, with the exception of any more mesic long vegetation within the ditch itself. The slowing of deposition rates and longer time span it represents should be reflected in the sample intervals, typically of 4 or 5 cm or less, dependent on how well pronounced is the horizon.

Tertiary Fill: a ploughwash, formed after the abandonment of the ditch as a feature, or monument, or of any accompanying settlement. The finer, generally poorly sorted, homogeneous colluvial fills are representative of the wider local landscape, and samples are commonly 10 cm thick.

A completed sequence of samples, which may include spot samples from primary fill in the corner of the ditch profile and a column of contiguous samples through the deepest and most representative deposits, should aim to be cover the entire infill history. It does not need to sample every layer, but sample 'time'.

Pits

Generally only large pits with colluvial infills are worth sampling. Many of the contexts often represent re-deposited or dumped material, rather than natural sedimentation. They may contain material derived from unknown, or undefined, locations (Shackley 1976). The origin of these snails is unknown; they do not reflect the environment of the pit, and they may originate from several different micro-environments conflated into a single discard deposit, and thus are not useful for palaeo-environmental reconstruction. Open pits will create a localised micro-environment that may encourage specific species to inhabit and thus not necessarily, reflect that of the wider environs. Deposits to concentrate upon are any basal or primary fills, and the upper natural colluvial infilling ('tertiary fill'); an example of useful sequence through such are shown in the large Mesolithic postpits at Stonehenge (Allen 1995c), and of progressive opening of the landscape in the top of the Neolithic pit at Easton Lane, Hampshire (Allen 1989; Fig. 2.4). Spot samples through the colluvial infill of the very large rotted post in the Neolithic postpit Greyhound Yard, Dorchester, were able to indicate a locally open woodland environment after the monument's demise (Allen 1993).

Postholes

In general postholes are poor and not useful contexts to sample for snails. Unless these are very large postholes, or postpits, like that at Stonehenge (Allen 1995c) or Greyhound

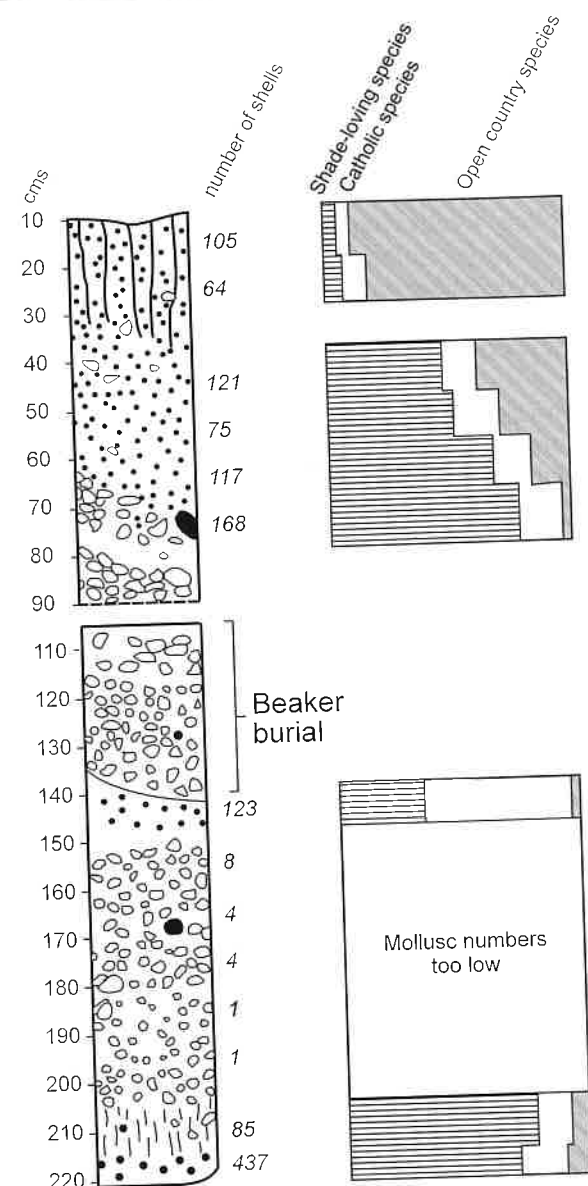


Figure 2.4. Summary of the land snail evidence from Easton Lane pit 1017, showing progressive opening of the local landscape (after Allen 1989, fig. 108; illustration: Abby George)

Yard (Allen 1993), there is no indication of when the shells got into the features. They could derive from the soils through which the posthole was cut, from the environment during the life of the extant post, or when the post had rotted or was removed.

Treehollows and tree-throw hollows

Differentiation between a treehollow and tree-throw hollow is important. They are very different features with quite different fills and fill histories. A treehollow, or subsoil hollow, is the natural hollow created by subsurface weathering of the parent material by the roots. These create subcircular or sub-oval features, commonly with weakly defined edges and bases and mixed, but often homogeneous fills comprising chalky and 'colluvial' fills (see Allen 1995d, fig. 69; Allen 2000, figs 42 & 43). In contrast a tree-throw hollow is a pit or open feature created by a fallen or toppled tree; with a large root plate ripped from ground, and tipped vertically with a large void behind. These create crescentic shaped features, with contrasting fills (see Macphail 1987; Macphail & Goldberg 1990).

Banks, mounds and dumps

Banks and mounds are principally parent material (geology) and soil thrown up to create upstanding relief. They are very poor contexts, and not worth sampling. Only intact turves on the old land surface or those within these structures are worth sampling (see buried soils).

Quarries, ponds, scoops and hollows

A range of larger negative features such as quarries, ponds, scoops and hollows will have essentially a primary weathering fill and tertiary colluvial fill. As such they can largely be dealt with like shortened ditch fill sequences.

Middens

In general middens are poor contexts of dumped accumulated material. Buried soil beneath middens may be of value. This may be especially true of shell middens which may result in preservation of snail shells in otherwise poor preservational, only weakly calcareous, environments. Although shell middens may also preserve land snails within them, temptation should be resisted to sample them as the palaeo-environmental value of these shells is usually generally poor.

Colluvium, ploughwash and lynchets

Colluvium (or hillwash) occurs at plateau edge, footslope locations and in dry valleys (Bell 1981, fig 5.1, Allen 1988, fig. 6.5; French 2015, fig. 6), and as ploughwash in lynchets (Fowler & Evans 1967, fig 3c, Evans 1972, fig. 119). These are usually off-site deposits, but are more routinely encountered in either commercial archaeology or landscape

research projects, rather than 'set-piece' excavations. The majority of the deposits are unsorted homogeneous hillwash, with occasional rills or gravel fans (see Allen 1988; 1992), and sampling can be relatively uniform at 10 cm intervals, but at finer intervals when stasis or stabilisation horizons are identified (see for instance Strawberry Hill, Wiltshire, Fig. 2.2). Occasionally the dryland edge of floodplains contains predominantly colluvial deposits which are darkened by alluviation and may contain only some indications of the floodplain presence (see Bourne Valley, Allen 2007b), rather than full floodplain sequences (see Chapter 7, Robinson).

Lynchets are colluvial accumulations of ploughwash at the edge of the field. Sometimes they may have a boundary (ie, wall or hedge), in other cases the field edge can be defined by a negative lynchet (Evans & Fowler 1967, fig. 3c). It is unusual to have a basal buried soil (*contra* Evans 1972, fig. 119), and the Bishopstone lynchet, East Sussex (Bell 1975, 252–64), and the Stepleton lynchet on Hambledon Hill, Dorset (Bell *et al.* 2008, 432–3) provide good examples. Like colluvial sequences, samples through the body of the lynchet are typically taken at 10 cm intervals; ideally contiguous, but that may depend on the size of the lynchet and the research question posed. Mollusc diagrams from dated lynchets can be seen from Hambledon Hill (Bell *et al.* 2008, fig. 5.9), and the Bourne Valley, Eastbourne, East Sussex (Allen 2007b, figs 18 & 21). Negative lynchets may look like ditches and are shallow colluvium-filled scarps at the head of the lynchet; the fills of which usually post-date tillage.

A sampling strategy and beyond

A programme of land snail samples needs to be devised and set within that for other palaeo-environmental proxy data such as pollen, phytoliths, waterlogged remains and charred plant and charcoal. The complete suite of land snail samples should encompass the key archaeological periods of interest, and provide information of the environment prior to key archaeological activity. Some features or layers may raise context-specific questions, which need to be evaluated within the context of the overall aims of the project. Sometimes this can be undertaken on site, but it can be re-considered on completion of sampling and during reviewing the samples after the completion of fieldwork. Although an outline generic sampling programme can be provided prior to fieldwork, all sampling needs to be reactive, and re-designed in accordance with the excavation discoveries. On large excavations which may cover several areas, or be undertaken over several months, it may be necessary for the specialist to visit the fieldwork on several occasions to ensure full and appropriate sampling. Samples are not sacred. A site can always be oversampled, the samples reviewed, prioritised and some set aside or even discarded, but it is much more difficult to recompense for sequences, features or contexts not sampled. Some contexts may no longer exist. The balance of samples taken needs to take account of the resolution of land-use history required, and the amount of research capital (finance) available; land snail analysis is time consuming – about eight samples can be processed per day, and just a few extracted and identified per day. Whole programmes of analysis are commonly weeks to months in extent.

At the completion of fieldwork, a programme of sample processing will allow the flots to be scanned and assessed. Features, sequences or samples with too few snails for statistically viable analysis can then be reviewed, and selection of samples for analysis made. In some cases, even samples with slightly too few snails might be worth pursuing if they form part of stratified sequence, as some of the snail histograms in the previous chapter show. The completion of analysis, any statistical examination, and graphic representation should then allow the analyst to address the aims defined at the outset, whether they be context- or feature-specific, or form part of the wider land-use history of the site. Comparison of these interpretations with published data and grey literature data (if available) then allow the land-use history and archaeological narratives to address wider regional and period-related narratives, if not individually, certainly collectively (see Allen, Chapter 9).

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References

- Allen, M. J. 1988. Archaeological and environmental aspects of colluviation in South-East England. In Groenmann-van Waateringe, W. & Robinson, M. (eds), *Man-Made Soils*, 69–92. Oxford: British Archaeological Report S410.
- Allen, M. J. 1989. Land snails. In Fasham, P. J., Farwell, D. J. & Whinney, R. J. B., *The Archaeological Site at Easton Lane, Winchester*, 134–140. Winchester: Hampshire Field Club and Archaeological Society Monograph 6.
- Allen, M. J. 1992. Products of erosion and the prehistoric land-use of the Wessex chalk. In Bell, M. G. & Boardman, J. (eds), *Past and Present Soil Erosion: archaeological and geographical perspectives* 37–52. Oxford: Oxbow Books.
- Allen, M. J. 1993. The land snails. In Woodward, P., Davies, S. & Graham, A., *Excavations at Greyhound Yard Dorchester 1981–4* 340–345. Dorchester: Dorset Natural History & Archaeological Society Monograph 12.
- Allen, M. J. 1995a. Land-use history of Round-the-Down; the molluscan evidence, 13–16. In Butler, C., *The excavation of a Bronze Age round barrow at Round-the-Down, near Lewes, East Sussex, Sussex Archaeological Collections* 133, 7–18.
- Allen, M. J. 1995b. Ditch and feature fills. In Cleal, R. M. J., Walker, K. E. & Montague, R., *Stonehenge in its Landscape; twentieth century excavations*, 4–6. London: English Heritage Archaeological Report 10.
- Allen, M. J. 1995c. Before Stonehenge. In Cleal, R. M. J., Walker, K. E. & Montague, R., *Stonehenge in its Landscape: twentieth-century Excavations*, 41–63. London: English Heritage Archaeological Report 10.
- Allen, M. J. 1995d. Land molluscs. In Wainwright, G. J. & Davies, S. M., *Balksbury Camp Hampshire Excavations 1973 and 1981*, 92–100. London: English Heritage Archaeological Report 4.

- Allen, M. J. 1997. Land molluscs. In Lyne, M., *Lewes Priory, Excavations by Richard Lewis 1969–82*, 163–67. Lewes: Lewes Priory Trust
- Allen, M. J. 2000. Wood, farm and field: landuse history of Twyford Down – land snail evidence, the pre-Bronze Age environment. In Walker, K. E. & Farewell, D. E., *Twyford Down Hampshire: investigations on the M3 motorway corridor from Bar end to Compton, 1990–93*, 139–142. Winchester: Hampshire Field Club Monograph 9
- Allen, M. J. 2003. Appendix 1: definition of the Shannon, Brillouin and delta indices 233–234. In French, C., Lewis, H., Allen, M. J., Scaife, R. G. & Green, M., *Archaeological and palaeo-environmental investigations of the Upper Allen valley, Cranborne Chase, Dorset (1998–2000): a new model of earlier Holocene landscape development*, *Proceedings of the Prehistoric Society* 69, 201–234
- Allen, M. J. 2007a. Molluscan diversity. In French, C., Lewis, H., Allen, M. J., Green, M. Scaife, R. G. & Gardiner, J. 2007. *Prehistoric Landscape Development and Human Impact in the Upper Allen Valley, Cranborne Chase, Dorset*, 263–271. Cambridge: McDonald Institute Monograph
- Allen, M. J. 2007b. Evidence of the prehistoric and medieval environment of Old Town, Eastbourne: studies of hillwash in the Bourne valley, Star Brewery Site, *Sussex Archaeological Collections* 145, 33–66
- Allen, M. J. 2017. Land snails in archaeology. In Allen, M. J. (ed.), *Molluscs in Archaeology*, 6–29. Oxford: Oxbow Books
- Allen, M. J. 2017. The southern English chalklands: molluscan evidence for the nature of the postglacial woodland cover. In Allen, M. J. (ed.), *Molluscs in Archaeology*, 144–164. Oxford: Oxbow Books
- Bell, M. 1977. Excavations at Bishopstone, *Sussex Archaeological Collections* 115
- Bell, M. 1981. Valley sediments and environmental change. In Jones, M & Dimbleby, G. W. (eds), *Environment of Man: the Iron Age to the Anglo-Saxon period*, 75–91. Oxford: British Archaeological Report 87
- Bell, M. G. 1983. Valley sediments as evidence of prehistoric land-use on the South Downs, *Proceedings of the Prehistoric Society* 49, 119–150
- Bell, M. 1990. Sedimentation rates in primary fills of chalk features. In Robinson, D. (ed.), *Experiment and Reconstruction in Environmental Archaeology*, 237–248. Oxford: Oxbow Books
- Bell, M., Fowler, P. J. & Hillson, S. W. (eds), 1996. *The Experimental Earthwork Project 1960–92*. York: Council for British Archaeology Research Report 100
- Carter, S. P. 1990. The stratification and taphonomy of shells in calcareous soils: implications for land snail analysis in archaeology, *Journal of Archaeological Science* 17, 495–507
- Crabtree, K. 191. Overton Down experimental earthwork, Wiltshire 1968, *Proceedings of the Bristol Speleological Society* 12, 237–244
- Davies, P. 2008. *Snails: archaeology and landscape change*. Oxford: Oxbow Books
- Entwistle, R. & Bowden, M. 1991. Cranborne Chase; the molluscan evidence. In Barrett, J., Bradley, R. & Hall, M. (eds), *Papers on the Prehistoric Archaeology of Cranborne Chase*, 20–48. Oxford: Oxbow Monograph 11
- Evans, J. G. 1972. *Land Snails in Archaeology*. London: Seminar Press
- Fowler, P. J. & Evans, J. G. 1967. Plough-marks, lynchets and early fields, *Antiquity* 41, 289–301
- Law, M. 2017. Numerical approaches to land snail palaeoecology. In Allen, M. J. (ed.), *Molluscs in Archaeology*, 48–64. Oxford: Oxbow Books
- Limbrey, S. 1975. *Soil Science and Archaeology*. London: Academic Press
- Macphail, R. I. 1986. Palaeosols in archaeology: their role in understanding Flandrian pedogenesis. In Wright, V. P. (ed.), *Palaeosols: the recognition and interpretation*, 263–290. Oxford: Blackwell Scientific Publications
- Macphail, R. I. 1987. The soil micromorphology of tree subsoil hollows, *Circaea* 5, 14–17

- Macphail, R. I. & Goldberg, P. 1990. The micromorphology of tree subsoil hollows: their significance to soil science and archaeology, In Douglas, L. (ed.), *Soil Micromorphology: a basic and applied science*, 431–440. Amsterdam: Elsevier
- Magurran, A. E. 1988. *Ecological Diversity and its Measurement*. London: Chapman and Hall
- Robinson, M. 2017. Molluscs from the floodplain alluvial sediments in the Thames Valley. In Allen, M. J. (ed.), *Molluscs in Archaeology*, 112–126. Oxford: Oxbow Books
- Shackley, M. L. 1976. The Danebury project: an experiment in site sediment recording. In Davidson, D. A. & Shackley, M. L. (eds), *Geoarchaeology*, 9–21. London: Duckworth
- Thomas, K. D. 1985. Land snail analysis in archaeology: theory and practice. In Fieller, N. R. J., Gilbertson, D. D. & Ralph, N. G. A. (eds), *Palaeoenvironmental Investigations: research design, methods and data analysis*, 131–157. Oxford: British Archaeological Report S266

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