TROCHOIDEA ELEGANS IN SURREY, ENGLAND WHEN DID IT ARRIVE?

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Abstract *The introduction of the snail* Trochoidea elegans *to one of its three known sites in Britain has been investigated.* ^{210}*Pb dating suggests that it has been present at Chaldon, Surrey, at least since the first decade of the twentieth century; it may have been deliberately translocated to this site by the Rev. Canon J. W. Horsley.*

Key words *Trochoidea elegans, introduction, Surrey, England*

INTRODUCTION

The top snail, *Trochoidea elegans* (Gmelin, 1791), was first observed in Britain in 1890 (Cox, 1891) 'in the neighbourhood of Dover [Kent] ... in a retired locality ... far from houses or gardens'; both living and dead specimens were found. Although the exact site was not stated, it was later shown to be near Lyddon, about 7km north-east of Dover. Kennard (1929) found that it had a wider distribution in Kent than previously thought, and that a colony at Kearsley was 'of long standing'. The mollusc then became 'lost' in this county until rediscovered by Kerney (1978) nearly 50 years later. It has now been found living in three localities in Kent (National Biodiversity Network).

This species has only been recorded in two other British counties. At Chaldon in Surrey it was found in May 1931 (Wilkins, 1931), and observed at a Conchological Society field meeting the following month. Wilkins stated: 'The late Canon Horsley was known to have taken a fatherly interest in the [Kent] colony ... and tried to introduce it into other localities; was Chaldon one of his experimental sites?' The third population was found near Denton, Newhaven, Sussex, in 1967 (Jones, 1968), where it was present in good quantities 'at a number of spots ... over about 100 yards.' Living specimens have been found at both of these latter colonies in recent years (National Biodiversity Network).

Trochoidea elegans is a snail found in dry and exposed calcareous habitats, usually on steep, grassy, slopes; it is a southern European species, ranging in a band along the Mediterranean coastal belt and islands from southern Spain to central Italy, but also extending across southern France to the Bay of Biscay. In northern Europe, in addition to the British sites, there are scattered populations along the continental coast from Normandy to Belgium (Kerney & Cameraon, 1979; Welter-Schultes, 2012).

In order to investigate the timing of introduction of this species of snail to Surrey we investigated the Chaldon site in more detail to determine when they were first present. We did this through a series of site investigations, trenches and dating of the accumulated sediments.

THE *TROCHOIDEA* SITE AT CHALDON, SURREY

Park Ham, part of Quarry Hangers Nature Reserve at Chaldon, is an SSSI reserve owned and managed by the Surrey Wildlife Trust. It lies on the south-facing escarpment of the North Downs (Fig. 1), close to the junction of the M25 and M23 motorways (grid reference TQ 315538). The habitat is rich chalk grassland with a wide variety of fauna and flora, and is, from the molluscan point of view, well known for its thriving population of *Helix pomatia*.

A visit to the site in April 2010 failed to find any living specimens of *T. elegans*, although in July that year a single living juvenile was found on the escarpment after two hours searching. However, a third visit in November 2011 found large numbers of living specimens exposed on the lower, less steep, grassy slopes, often climbing the grass stems, which were up to 30cm in height. It would appear that conditions for the animal to venture into the open were only suitable on this last visit. No living shells were

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Figure 1 Park Ham reserve at Chaldon, showing the escarpment on which *Trochoidea elegans* is found.

found on the higher, steeper, escarpment during the 2011 visit although some were observed in September 2015.

In contrast to living shells, dead shells were very abundant over a wide area of the Park Ham hillside. What was of interest is that these were mainly observed eroding from the sides of the numerous rabbit burrows (Fig. 2), down to the underlying chalk natural at about 15cm below the ground surface. The depth at which the shells were found raises the possibility that they could have been present for considerably longer than the 80 years since the initial observation at Chaldon, despite possible disturbance to stratigraphy resulting from bioturbation by rabbits. It was therefore decided to investigate this further to determine whether it was possible to establish when the species was first present on the hillside.

Figure 2 *Trochoidea elegans* exposed in rabbit burrows.

Methods

Consent from Surrey Wildlife Trust was granted for three small pits to be excavated on the chalk hillside and samples were obtained in November 2010. The locations of the pits were selected to avoid any visible rabbit activity, and no evidence of disturbance was seen in any of the pit sections. All three pits were dug on the escarpment with 75m between the sites. Each pit measured 50×50cm and reached fragmented chalk bedrock at depths of 14cm, 13cm and 15cm, respectively. Monoblock samples (10×10cm) were obtained from the ground surface down to the underlying chalk.

Direct dating of very recent molluscs is difficult but dating of the sediment in which the shells are found is an alternative method to establish a chronology. One way to do this is by the radiometric technique of measuring the decay of the nuclide lead-210. This is part of the ^{238}U (uranium) decay chain, which progresses through a series of unstable nuclides to the stable isotope ^{206}Pb (lead). Within this chain the isotope ^{226}Ra (radium) has a half life of 1600 years, following which it decays through a series of short-lived isotopes including ^{222}Rn (radon) to ^{210}Pb, the latter having a half-life of 22.26 years. As ^{226}Ra decays to the gas ^{222}Rn in the ground some of the gas escapes into the atmosphere. This ^{222}Rn then decays through to ^{210}Pb which, after a short period, falls back to the surface, mainly in the form of precipitation, and accumulates in sediment sequences (Ivanovich, Latham & Ku, 1992). There is then an excess of 'unsupported' ^{210}Pb in relation to ^{226}Ra within the upper parts of the sediment or soil sequences (Ivanovich & Harmon, 1992). The amount of unsupported ^{210}Pb decreases with depth as it radioactively decays, and measurement of the amount of unsupported ^{210}Pb permits the age of the sediment to be calculated, up to about 110 years (5 times the half-life of ^{210}Pb; (Wise, 1980). If it is assumed that there is a constant rate of supply of ^{210}Pb from the atmosphere over the time period being studied (Appleby & Oldfield, 1978) then it is possible to establish the chronology of sediment deposition.

In the laboratory the block columns were divided along their lengths into 1cm thick

subsamples, and 12–13g portions of each subsample weighed into petri dishes which were then placed in a gamma detector (Harwell Instruments Broad Energy Detector – BeGe). Sample counts were accumulated over a period of up to 3 days, following which the activity of ^{226}Ra and ^{210}Pb were determined.

Each 1cm sub-sample was also examined to quantify the number of shells of *T. elegans* present, and whether they were evenly distributed throughout the depth of each pit.

Results

The number of *T. elegans* shells in each subsample is shown in Table 1. There was a total of 116 shells, some being present in the majority of samples, although none were found in any pit in the most superficial 1cm, nor in the underlying chalk. Specimens were found throughout the depth of each section down to the natural although the distribution was variable with depth, with higher numbers at 4–6cm and 9–11cm.

The ^{210}Pb dating method was used in this study and showed excess levels of ^{210}Pb in subsamples down to 13cm in Pit 1, 8cm in Pit 2 and 12cm in Pit 3.

Using the ^{210}Pb dating method it is possible to construct age-depth distributions for each sequence. This relies on taking one of the three models of accumulation (Constant Flux, Constant Sedimentation, CFCS; Constant Rate of Supply, CRS and Constant Initial Concentration, CIC). We chose to use the CFCS model as this best represents the accumulation mechanism in soil and is shown in Fig. 3. From this figure it is clear that the three pits are consistent in their accumulation rates (0.12–0.14 cm/year) with a slight non-linear accumulation which is consistent with previously published accumulation rates of soil sequences (Ivanovich & Harmon, 1992). All the sequences show progressively increasing age with depth, indicating that there has been little or no disturbance of the sediments since deposition, although this may be responsible for the slightly uneven curve in Pit 2. Extrapolation of the curves to the depth of the natural shows that the earliest layers where *T. elegans* occurs corresponds to dates of 1919 +/- 10 (pit 1), 1903 +/- 14 (pit 2) and 1908 +/- 12 (pit 3), showing a consistent series of dates.

Table 1 Numbers of *Trochoidea elegans* found in each pit.

Depth (cm)	Pit 1	Pit 2	Pit 3
0–1	0	0	0
1–2	1	1	0
2–3	1	2	0
3–4	4	1	1
4–5	5	4	5
5–6	8	5	7
6–7	3	1	3
7–8	7	0	1
8–9	3	1	0
9–10	9	3	2
10–11	8	1	3
11–12	2	5	3
12–13	3	2	3
13–14	2		5
14–15			1
15–16			

The bold lines indicate the depth at which the natural chalk was encountered.

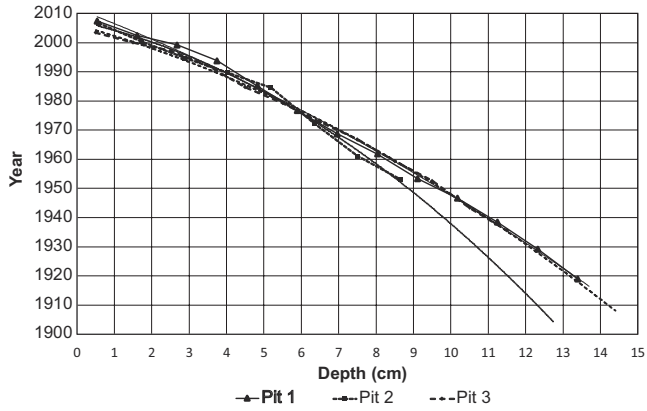

Figure 3 Age/depth graph of the sediments containing *Trochoidea elegans* in each of the pits. The depths in Pits 1 and 2 have been normalized to provide a constant depth of the natural at 15cm.

Discussion

Many species of non-marine mollusc have been introduced into Britain during the Holocene (Kerney, 1999), and it is generally considered that humans are responsible for most of these introductions (either deliberately or accidentally), although carriage of small shells or their eggs on the feet of migrant birds cannot be excluded. Examples of introduced species are *Helix pomatia* and *Cornu aspersum*, both probably brought to this country during the Roman occupation of Britain (Evans, 1972); a recent example is

Hygromia cinctella, originally seen in South Devon in 1950 (Comfort, 1950). These shells now have wide distributions in Britain, and all are present at Park Ham (personal observation).

Trochoidea elegans, first found in Kent in 1890 (Cox, 1891), has remained very restricted in its British distribution, probably because of its very specific habitat requirements of open chalk hillsides with good drainage. It is accepted that the population near Dover is likely to be the point of introduction to Britain as that was the initial site of discovery, but the date of its introduction is not known. Kennard, in 1929, wrote that 'It is clear that the colony is of long standing ...' but does not clarify his concept of 'long'. At the time of discovery, consideration was given to whether the species had been deliberately introduced by the Rev. Canon J. W. Horsley, an allegation which he denied (Cox, 1891).

Whether the other two populations, near Newhaven in Sussex and Chalden in Surrey, were *de novo* introductions to Britain, or were translocated from the original Dover colony has not been investigated. The Newhaven shells were not known until the 1960's (Jones, 1968), but no suggestions were offered as to when or how those shells arrived at the location. At Chalden, however, there is the tantalizing reference to the possibility that the species was deliberately introduced by Horsley (Wilkins, 1931), although he makes no such admission in his book 'Our British snails' (Horsley,1915 [as *Helix terrestris*]). He certainly knew of the snail's existence in Kent, as a hand-written note in the present author's copy of Adams' *Land and Freshwater Shells* (1896) states that the then owner, one Adrianna S. Philpott, was given '2 nice sp.' from Dover by Canon Horseley [*sic*]. The present investigations may throw some light on this.

^{210}Pb dating suggests that *T. elegans* was present on the hillside at Chaldon as early as the first decade of the twentieth century, around 15 years after its initial discovery in Kent, and at the time when Canon Horsley is alleged to have had an interest in establishing experimental sites, although its earlier presence cannot be excluded. Given the chronology established here the hypothesis of deliberate translocation is supported. There are, however, some concerns about the dating method that must be addressed. The Chaldon sample site is on a steep hillside where rabbit activity is much in evidence. Care was taken at site selection for the sample pits to avoid obvious burrows, and no such disturbance was seen in the pit sections. The consistency of the age-depth plots also mitigates against significant disturbance. Downward movement of the shells by earthworm activity is possible but the pit sections did not show any clear evidence of earthworm sorting, there being a seemingly even distribution of stones throughout the sections.

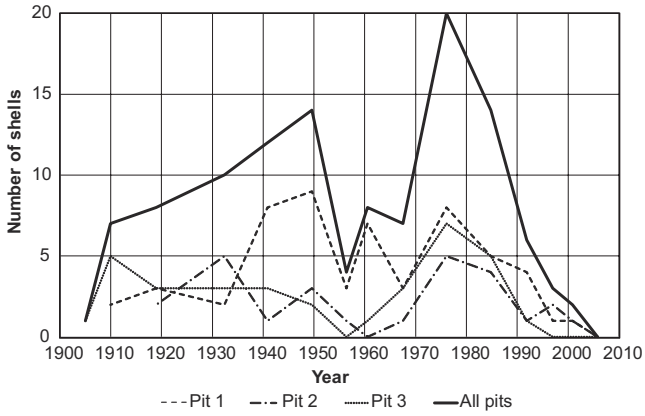

Figure 4 The variation of shell numbers over time.

The figures in Table 1 show variation in shell numbers at different depths. When correlated with the chronology there are peaks at about 1950 and 1975 (Fig. 4), with marked decline following each peak, and an explanation is sought to explain this. Enquiries concerning land use of Park Ham indicate that the area was heavily grazed by sheep until the second World War, when grazing ceased, with consequent development of extensive scrub over the hillside. This may explainsthe decline in *Trochoidea* numbers in the 1950s, as the species is very much an open country mollusc associated with exposed grassland and dunes (Kerney & Cameron, 1979; Welter-Schultes, 2012), and coverage of its habitat with scrub would rapidly reduce numbers. Some of the decline in the early 1950s could also be attributed to the dramatic reduction of the rabbit population between 1953 and 1955 due to myxomatosis, which reduced the rabbit population in Britain by about 95% (Bartrip, 2008), allowing taller vegetation to thrive.

During the 1960s and 1970s a programme of scrub clearance commenced with slow return of the hillside to open grassland, with reintroduction of sheep grazing; mollusc numbers climbed to reach a peak in the late 1970s, following which there has been a marked decline such that no

shells were found in the topmost 1cm of sediment, and living shells on the present turf of the hillside are scarce. There is no ready explanation for this decline in the last quarter of the 20th century although overgrazing is a possible cause.

Conclusions

^{210}Pb disequilibrium dating suggests that the sediments on the escarpment at Chaldon were stabilized in the first decade of the twentieth century. Shells of *Trochoidea elegans* were present within these earliest deposits, and in all levels up to the ground surface with the exception of the most superficial 1cm. The stability of the sediments overlying the natural implies that the shells became incorporated contemporarily with the sediment deposition; if this is correct then the shells were first at this location around 1903–1908. This is only some 15 years after the species was first observed near Dover in Kent, and during the time that Canon Horsley was an active conchologist. While the earliest population of *T. elegans* may have been a new introduction from continental Europe, it is possible that Chaldon was one of Horsley's 'experimental' sites.

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