THE CRYPTOGENIC RIVER SNAIL *VIVIPARUS VIVIPARUS* EXPANDS ITS RANGE IN IRELAND: CASE OF A RE-INTRODUCTION?

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Abstract *The river snail* Viviparus viviparus *was known in Ireland from deposits in the Shannon and Barrow river catchments almost a century ago. It was only recently, since 1995, that living populations were found in the upper Shannon. Since these records further snails were found at separate localities along the length of the Shannon and Erne catchments and from near Lough Neagh. It would appear that this snail might be a reintroduction to Ireland. The modes of transmission that might have been involved in its arrival are discussed.*

Key words *River snail, Shannon, Erne, Introduction, Expansion*

INTRODUCTION

Until 1995 the river snail *Viviparus viviparus* (Linnaeus, 1758) was known from Newtownards, Co Down (Brown, 1818) and would seem to have died out following what might have been an introduction. Since then it was found as shell material from sediments removed from tidal regions of the lower Shannon. Fogarty (1909) found a single shell and a further shell was recovered in 1922, reported by McMillan and Stelfox (1961). Further shells were recovered from the Barrow and Suir rivers during 1913 to 1917, but these may have been sub-fossils (reviewed by Cotton, 1996). Shells were found in a lignite deposit close to Lough Neagh, Co Antrim, but since this deposit was laid down during a previous interstadial period the current status of the snail was unclear. Since then a moribund snail was found on the shore of Lough Neagh (Anderson, 2014). Cotton (1996) also refers to a record from Naas, Co Kildare. It was unclear whether these were shells from re-worked deposits or evidence for existing populations. In August 1995 Cotton (1996) found the first living specimens in the shallows of Acres Lake near Drumshambo and in the following year they were present at a density of approximately $80m^{-2}$. Since Cotton's finding some new sites were found in the region of his find with populations located at Carrick-on Shannon, Rockingham in Lough Key and on the canal leading into Acres Lake, all within the upper Shannon catchment (Minchin *et al*., 1998). Since these records Anderson (2014) reported the finding of a recently dead specimen with a 23mm spire height on the shores of Lough Neagh. Anderson also refers to a finding by G.A. Holyoak of a 'colony at Lough Oughter'.This account reports the existence of further populations from the Erne and Shannon catchments and discusses the possible modes of arrival to Ireland, should it have been introduced.

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METHODS

Snails were retrieved in summer from sampling lakeshores at a time when water-levels were low. Large cobbles and stones, to which the snails were attached, were retrieved from depths of about 50cms using a rake to pull these to the surface. Snails were also found by removing stones while wading in water and by scraping vertical surfaces using a pole and pocket net. The spire height of snails was measured to the nearest millimeter.

RESULTS

Viviparus viviparus was encountered when sampling for the zebra mussel *Dreissena polymorpha* occurring in all sites where zebra mussels were present. When present the snail was obvious either on account of their large size or because of the distinctive shell banding, most readily seen on the shells of smaller individuals.

Snails were retrieved in summer by sampling lakeshores at a time, very often, when water-levels were low. Waterlogged tree remains, large cobbles and stones, to which the snails were attached, were retrieved from depths of ~50cms. Snails were also found attached to stones in lake shallows and on quay walls and pillars. Several large specimens were observed on the vertical surface of a quay wall in June 2007. Some of these were attached a few centimeters above the water surface to the south of the Drumleague Lock, on the canal between Battlebridge and Acres Lake.

New records of snails were retrieved at the following sites:

The Shannon Catchment

Lough Allen Lower (54°02'56.27"N, 08°03'05.04"W) June 2007, July 2013
Snails were removed from smooth submerged tree branches and limbs that lacked bark. These surfaces had an algal film on which the snails were found in large numbers. Small snails were clustered together mainly on the underside of these limbs where these were raised off the muddy bottom. A size frequency histogram of this population is shown in Fig. 1.

Acres Lake (54°02'17.58"N, 08°02'58.00"W) July 1998; May 2007, July 2013
Several snails were removed from vertical pillars of the berthing area and many were seen in the shallows with some stranded on the shore. Some had expired.

Lough Allen Canal (54°02'06.80"N, 08°03'51.41"W) June 2007, July 2013
This canal that extends from Battlebridge to Acres Lake and then from Acres Lake to Lough Allen. Snails were seen close to and a few centimeters above the canal water level attached to the masonry

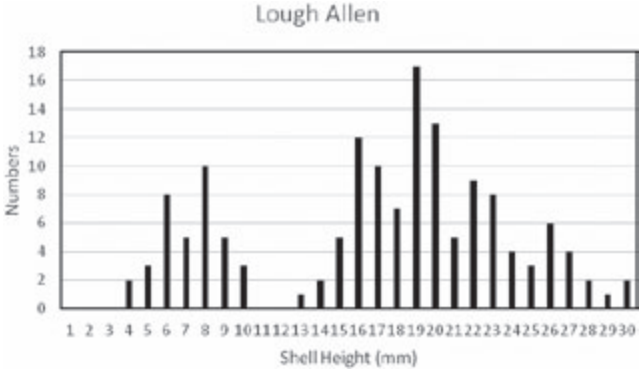

Figure 1 Size distribution of river snails recovered from the shallows of Lough Allen.

Leitrim Quay (53°59'24.50"N, 08°03'54.61"W) July 2007
Two adults of 33mm and 26mm spire height and one juvenile of 8mm were attached to the stonework of the canal wall.

Rockingham, L Key (53°59'13.12"N, 08°14'18.32"W) August 2000, August 2003; July 2007
Many snails were collected from the pillars of a leisure craft berthing area. This included juveniles from 7mm spire height. Solitary individuals were recovered from the lake mud at 2 to 2.5m depth near a small islet approximately 150m away from the main concentration. These had become encumbered with attaching zebra mussels; two snails of 7g and 5g wet weight had 6g and 1g of attached zebra mussels respectively.

Carrick-on-Shannon (53°56'35.43"N, 08°05'53.26"W) June 2007, September 2009, October 2010
Since the finding of the concentration of snails in 1998 only occasional and single specimens were found >100m downstream of this site attached to a quay wall. Further downstream approximately 400m a collection, from <1m depth, of ten individuals ranging from 10–24mm spire height was obtained and many more were seen attached to stones and to the surface of the laminae of *Nuphar lutea*.

Lough Bran (53°58'29.45"N, 08°03'17.04"W) July 2003
Snails were removed from the shallows on the eastern side of the lake attached to stones at <1m depth, there were several attached to the undersurface of stones.

Jamestown Canal (53°55'06.52"N, 08°01'54.65"W) July 2007
A single individual of 18mm spire height was removed from a stone jetty wall.

Shannon River (53°10'02.95"N, 08°04'51.30"W) July 2012
At the navigation lock (Meelick) both shell and live specimens were recovered using a basket dredge.

Terryglass Harbour, Lough Derg (53°03'38.092"N, 08°12'23.86"W) July 2005
Tens of specimens were removed from the vertical surface of the sheltered inside of the pier at the public berthing area in a bend of the pier from a depth of ca 2m (Lough Derg Science Group, 2007). Specimens were not recovered at distances less than 50m to either side.

Dromineer Quay, Lough Derg (52°55'33.31"N, 08°16'44.60"W) July 2005, January 2011
A single live specimen was removed from the exposed side of the quay wall and within 50m two shells were found washed ashore, one 30mm spire height and the other with a broken spire.

The Erne Catchment

Lough Oughter (53°59'48.73"N, 07°28'47.68"W) July 2006
On the southern shore snails were found in abundance on a shore of stones and small boulders. Many were found on the under-surfaces of stones. There were several hundred present.

Discussion

The numbers, and repeated findings in some lakes and rivers and some other records from canals over several years indicate that the species is well established in Ireland and at some localities it was the dominant species. The smaller numbers encountered on the lower Shannon might indicate more recent appearances. The apparent highly localised extent of many of the populations is notable most probably explained by the lack of a pelagic life-history stage. It might be expected that its pedal activities and possible spread attached to drifting plant materials, the species might have spread over a greater area. In Lough Key individuals were found >150m from the main concentration and this is after five years from the finding of an already established concentration located in 1998 in this lake. At Carrick-on-Shannon smaller numbers were found in the river downstream to at least 400m of the main concentration which occurred above a bridge. The concentration in Lough Allen/Acres Lake and in the interconnecting Allen Canal occurred over a greater area.

Its occurrence in Lough Derg in the lower Shannon might be a remnant from a pre-existing population based on the evidence of the early records almost a century earlier that might have represented a post glacial population. However, it is difficult to believe that its presence, as living snails, was overlooked by naturalists, such as A.W. Stelfox (1883–1972) and his associates before the sighting by Cotton (1995). While it is possible, due to turbid waters, the species could have been overlooked. However, it occurs in shallow water and occasionally becomes stranded. All indications are that the snail is a recent arrival. Indeed it is possible this snail was introduced via a number of means to, and within, Ireland and is polyvectic (See below). However, there is no direct evidence of an arrival. On account of the widely separated localities overland transport has clearly already taken place involving either, or all, of the potential modes of spread. This includes a natural spread to Ireland that might have arisen from bird transport. For this reason *V. viviparous* should be considered to be a cryptogen until further evidence becomes available.

It is clear that there is a greater density in the northern regions of Ireland when compared with the sparse findings in the south, suggesting that the seminal inoculation might have taken place in the northern region. This region is widely recognised for angling cyprinids. Many anglers come from overseas, especially from Britain where the snail is known to be widely distributed (Ross, 1984). Records also occur where there are boating activities, however, in a study of over fifteen years this snail has not been observed on a boat hull.

It is predicted that further isolated populations are likely to become revealed in the coming years.

Potential modes of spread and arrival of *V. viviparus* to and within Ireland

Arrival and spread with angling activities
Introduced either as angling bait or unintentionally moved with fishing gear such as keep nets which are often stored in bags (stink-bags), and may be transported to a new angling site. Anglers from Britain make frequent visits to Ireland to fish cyprinids and it is possible that the Asian clam *Corbicula fluminea* may have been introduced with angling gear in this way (Minchin, 2014) but snails might also be spread as well. *Viviparus viviparus* occurs directly at some sites where angling has been seen to take place in the current study. There are examples from elsewhere; the

snail *Potamopyrgus antipodarum* has most probably been spread by angling equipment and with stocking of fishes in Australia (Loo *et al*., 2007).

Arrival and spread with leisure craft

Snails might be transported with imported craft, from the midlands of Britain, arriving in much the same way as the zebra mussel *Dreissena polymorpha* (Pollox *et al*., 2003). Snails might lodge in a hull bow-thruster and carried there during transport. However, in the present study snails have not been observed attached to boat hulls. In Canada Davidson *et al*. (2008) suggested that the New Zealand mud snail *Potamopyrgus antipodarum* might have been spread to parts of Vancouver Island by leisure craft and fishing equipment.

Arrival following release from aquaria/ aquatic garden plants

Specimens may have been imported from Britain and/or continental Europe for aquaria or ponds. This might have been with aquatic ornamental plants for ponds or with aquaria, as such species are on sale (Anon, 2014). The banding of the shell and its size may have been features that might have been valued. Large snails such as the ramshorn snail *Planorbarus corneus* are also available for sale (Anon, 2014). Snails generally occur within aquaria and could have been inadvertently introduced. In a study of aquaria in New Zealand *Planorbarus corneus* was found in eleven of fifty-five freshwater aquaria (Duggan (2010) and other *Viviparus* species are stated to have been introduced to the wild from aquaria (Kappes & Haase, 2012).

Arrival and spread by natural means

Snails have been transmitted between water bodies overland as well as along waterways. It is unknown whether birds, or mammals, could transport snails. There are accounts of snails being entrapped amongst feathers or on caked mud on birds feet or could survive passage through a gut. Snails can occur in shallow water as well as be stranded and thus might become carried by wading birds. Kawakami *et al*., (2008) have suggested that snails might survive passage through a birds gut and in this way spread the snail, a process of endozoochory. However, ectozoochory, the spread other than by the gastric tract, is known for several species of snail (van Leeuwen and van der Velde, 2012). Spread along water-ways could be with drifts of plants to which snails have attached. *Viviparus viviparus* was seen attached to *Nuphar lutea* laminae close to and downstream of Carrick-on-Shannon. Localised dispersal may take place by small incremental opportunistic events, for many snail species of 0.3 to 1.0 km/year (Kappes &Haase, 2012).

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References

ANDERSON R 2014 *Viviparus viviparus* (L.) (Mollusca: Gastropoda) in Lough Neagh. *Irish Naturalists' Journal* **33**(2): 134.

ANON 2014 Aquatic plant catalogue 2013/2014. British Growers of Aquatic Plants. http://www.angloaquatic.co.uk/docs/anglo%20aquatic%20plant%20catalogue%20low%20res.pdf (Accessed, 12 February 2015)

BROWN T 1818 Account of the Irish Testacea. *Memoirs of the Wernerian Natural History Society* **2**: 501–536.

BYRNE A, MOORKENS EA, ANDERSON R, KILLEEN IJ & REGAN EC 2009 *Ireland Red List No. 2 – Non-Marine Molluscs*. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland. 54 pp.

COTTON D 1996 First Irish record of a living population of the river snail *Viviparus viviparus* (L.) (Gastropoda: Prosobranchia), in the Shannon catchment Co Leitrim. *Irish Naturalists Journal* **25**: 278–280.

DAVIDSON TM, BRENNEIS VEF, DE RIVERA C, DRAHEIM R, GILLESPIE GE 2008 Northern range expansion and coastal occurrences of the New Zealand mud snail *Potamopyrgus antipodarum* (Gray, 1843) in the northeast Pacific. *Aquatic Invasions* **3**(3): 349–353.

DUGGAN IC 2010 The freshwater aquarium trade as a vector for incidental invertebrate fauna. *Biological Invasions* **12**: 3757–3770.

FOGARTY H 1909 *Viviparus* (dead shell) in Co Limerick. *Irish Naturalist* **18**: 159.

KAPPES H & HAASE P 2012 Slow but steady: dispersal of freshwater molluscs. *Aquatic Science* **74**: 1–14.

KAWAKAMI K, WADA S & CHIBA S 2008 Possible dispersal of land snails by birds. *Ornithological Science* **7**(2): 167–171.

KERNEY MP 1976 *Atlas of the non-marine Mollusca of the British Isles*. Institute of Terrestrial Ecology, Cambridge.

LOO SE, KELLER RP & LEUNG B 2007 Freshwater invasions: using historical data to analyse spread. *Diversity and Distributions* **13**: 23–32.

Lough Derg Science Group 2007 *Investigation into the distribution and abundance of alien biota in Lough Derg: an assessment of impacts, 2005–6.* A Report to the Shannon River Basin District Steering Group. http://www.shannonrbd.com/pdf/SRBD-Alien-Species-Report-Lough-Derg-2007.pdf

McMillan NF & Stelfox AW 1961 *Viviparus viviparus* (L.) in Ireland. *Journal of Conchology* **25**: 117–121.

McMillan N & Zeissler H 1990 Recent and fossil mollusca of the rivers Barrow, Nore and Suir, south-east Ireland. *Bulletin of the Irish Biogeographic Society* **13**: 189–199

Minchin D 2007 Aquaculture and transport in a changing environment: overlap and links in the spread of alien biota. *Marine Pollution Bulletin* **55**: 302–313.

Minchin D 2014 The distribution of the Asian clam *Corbicula fluminea* and its potential to spread in Ireland. *Management Of Aquatic Invasions* **5**(2): 165–177.

Minchin D, Floerl O, Savini D & Occhipinti-Ambrogi A 2006 Small craft and the spread of exotic species. John Davenport and Julia L. Davenport, (eds). *The Ecology of Transportation: Managing Mobility for the Environment,* 77–97, Springer, The Netherlands.

Minchin D, Dodd D, Lucy F & Levine I 1998 Is *Viviparus viviparus* (Linnaeus) (Gastropoda: Prosobranchia) a native species to Ireland? *Bulletin of the Irish Biogeographical Society*, **22**: 229–234.

Økland J 1990 Lakes and snails: Environment and Gastropoda in 1500. *Norwegian, ponds, lakes and rivers.* Backhuys, Oslo, Norway. 516 pp.

Pollux B, Minchin D, Van der Velde G, Van Allen T, Moon-Van der Staay SY & Hackstein J 2003 Zebra mussels (*Dreissena polymorpha*) in Ireland, AFLP-fingerprinting and boat traffic both suggest an origin from Britain. *Freshwater Biology* **48**: 1127–1138.

Ross HCG 1984 Catalogue of the land and freshwater mollusca of the British Isles in the Ulster Museum. Ulster Museum, Belfast, Publication No 251, 159 pp.

Van Leeuwen CHA & van der Velde G 2012 Prerequisites for flying snails: external transport potential of aquatic snails by waterbirds. *Freshwater Science* **31**(3): 963–972.