Abundance of Pea Clam (Sphaeriidae: *Euglesa* spp.) and possible presence of Pea Mussel (Sphaeriidae: *Musculium* spp.) in watercourses of the Ballaugh Curragh Ramsar Site, Isle of Man

Clare Rogerson, Manx Wildlife Trust, 2024

Abstract

Previous ad hoc records have shown a population of various Pea Clam species (*Euglesa* spp., formerly *Pisidium* spp.) to be resident within the watercourses on the Isle of Man. However, these records provide limited understanding of population density and diversity. Primary research has shown that a population of seven species of Pea Clam have been identified as native to the Island. However, this sporadic sampling over a prolonged period (since 1909) allows only an indication of the overall health of the Island's freshwater mollusc population.

The lack of structured sampling has led to the Ballaugh Curragh being identified, as part of an 'Action for Wildlife' scoping project, as a suitable location to provide a greater understanding of the population and overall health of the species. As an indicator species and a barometer for freshwater health, this data can be directly interpreted to illustrate the overall condition and health of our wetland areas regarding pollutants such as magnesium and potassium and allow us to track temporal and spatial variations in water quality.

Introduction

River quality monitoring is undertaken across the Island, during spring, summer and autumn every year, at 87 monitoring sites by the Isle of Man Government's Department of Environment, Food & Agriculture. This includes biological monitoring (invertebrate sampling) three times per year at a sub-set of sites which provides long term biological data on water quality. The presence or absence of particular invertebrate species is influenced by water quality over a period of time and is representative of overall site and catchment health. Pea Clams have been identified in these samples but only to genus level (see Appendix I). To date, the Ballaugh Curragh area is not included in this monitoring.

The Ballaugh Curragh, as the Island's only designated Ramsar Wetland Site is a location of special interest for determining which *Euglesa* and *Musculium* species the Island may host. A 2020 survey discovered a sample of *Sphaeriidae* (the family to which both *Musculium* and *Euglesa* belong) within the Ballaugh Curragh. Previously, Pea Clams of multiple species have been documented in this area three times in the early 1990s. Across the wider Island, 47 sightings have been confirmed since 1909, almost exclusively in the north (Figure 1).

Given the recognised international significance of the Ballaugh Curragh's wetland habitats, and an identified need for habitat conservation and management of the Ramsar site, further research into the abundance and distribution of Pea Clams could help inform a new Ramsar site management plan.

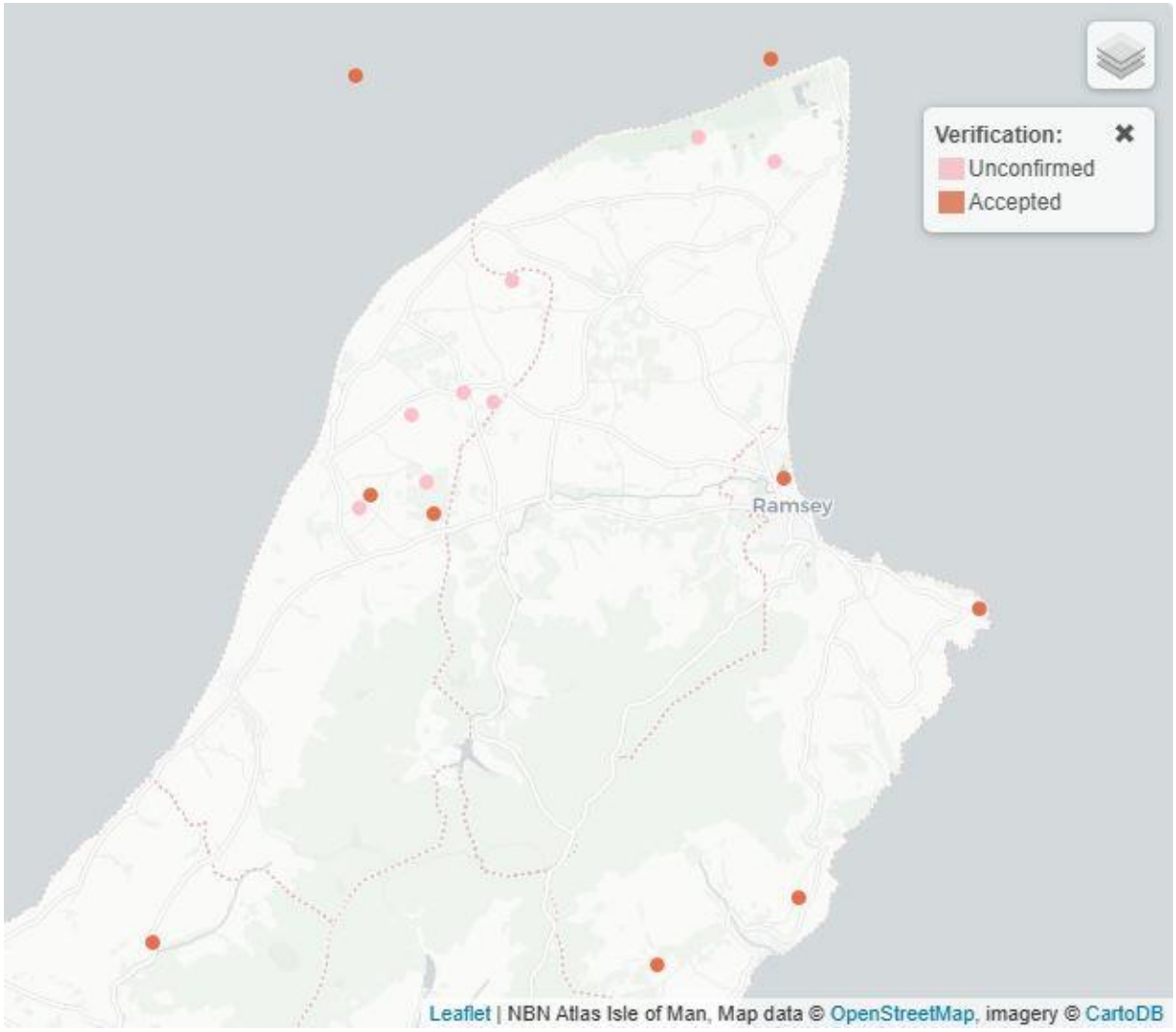

Figure 1. *Sphaeriidae* sightings from 1909 to 2023 (NBN Atlas, 2023). Plots found in the sea are using low resolution grid references.

Pea Clams (*Euglesa* spp.) are a genus of tiny freshwater bivalve mollusc of a size generally less than 1cm with the exception of *Euglesa amnicum*, which has been recorded at sizes just over 1cm). They are "collector-filterers" (Voshell, 2002), using a small siphon to collect miniscule pieces of organic material as well as microscopic organisms on which to feed (Figure 2a). Pea Clams use a tongue-shaped foot to move, much like a snail; they also use this foot to aid them in burrowing beneath the sediment, from which they can protrude their siphon to collect passing food (Figure 2b). Burrowing also enables the clams to survive dry periods, when their usual watery habitats disappear temporarily (Voshell, 2002).

Figure 2. *The foot (a - left) and siphon (b - right) of a* Pisidium *clam. Credit:* www.molluscs.at

Euglesa are hermaphroditic brooding bivalves – they carry their young within their gills and release them only when certain temperature and oxygen conditions are met (Holopainen and Hanski, 1986). The young are formed clams when released, as opposed to the parasitic larvae of other freshwater bivalves (Thorp and Rogers, 2011).

There are 28 species of Pea Clam in Europe (IUCN, 2011), but only 7 have been previously documented on the Isle of Man (Figure 3). Some, such as *Euglesa tenuilineatum*, are endangered in the British Isles (BRIG, 2007) and as such would be of international importance if discovered on the Isle of Man. Pea Clams are an important indicator species and are of particular interest in wetland environments for this reason. Eutrophication and oxygen deficiency have been shown to cause high mortality in the dominant *Euglesa* species and has also been shown to halt individual clam growth (Holopainen and Jónasson, 1983). Study has shown that Sphaeriidae are more abundant in extreme hypoxic conditions with higher reproductive output, perhaps due to the reduction in free radical stress as a result of very low dissolved oxygen (Joyner-Matos *et al.,* 2011). Thus, although low dissolved O_2 is seemingly beneficial at the cellular level, it is likely to affect the diversity of *Euglesa* species due to the competition for O_2 to maintain aerobic metabolism, hence the observed increased mortality of the dominant species in a eutrophic environment.

Other factors have also been shown to negatively affect the distribution of *Euglesa* significantly, including PO_4^{3-}, Mg^2, and temperature (Dussart, 1979). Warmer, ice-free temperatures can result in an abundance of Pea Clams, and habitats with higher calcium hardness, conductivity, pH, alkalinity and sulphates are more likely to contain a greater proportion of adults brooding shelled larvae (Kilgour and Mackie, 1991). Thus, a small number of *Euglesa* may indicate higher levels of potassium and magnesium *or* that the temperature is not ideal for reproduction; it is therefore imperative that temperature, at least, is also measured when obtaining samples. In this manner, the number of *Euglesa* present may then be used as an indicator of PO_4^{3-} and Mg^2 in the water. These are important to consider, as higher levels are typical indicators of agricultural runoff, and can be targeted for amelioration if found to be negatively impacting the aquatic environment.

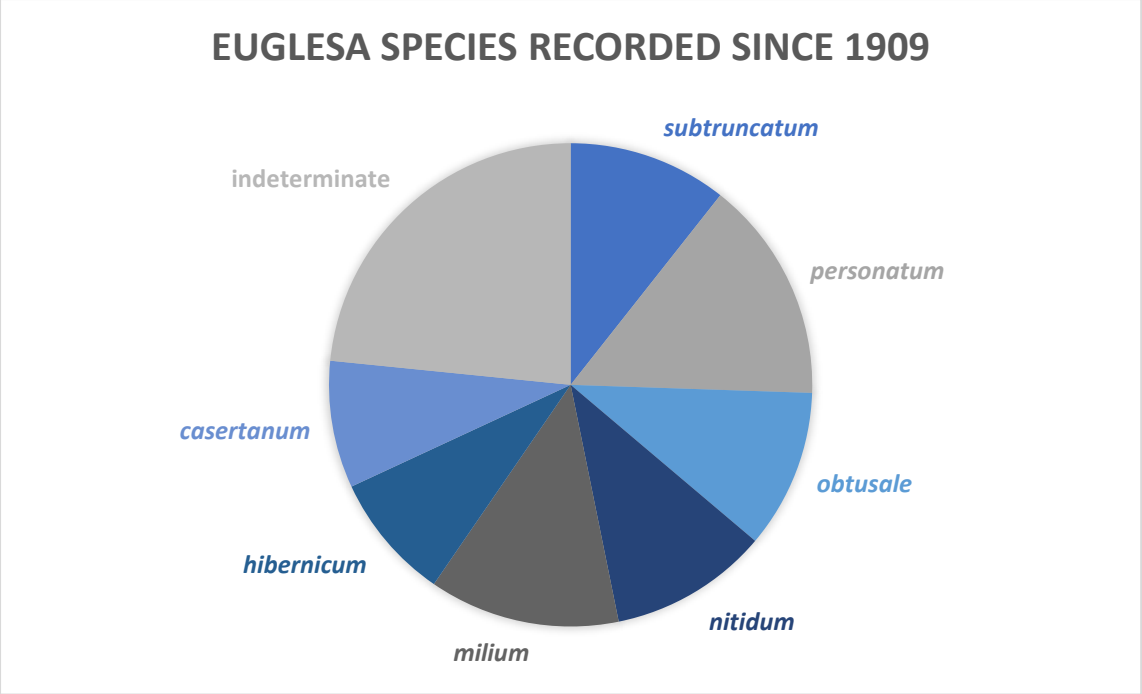

Figure 3. *Euglesa* species recorded from 1909-2017 on the Isle of Man (NBN Atlas, 2017).

Pea Mussels

In the British Isles, there are only two species of Pea Mussel: the Lake Orb Mussel (*Musculium lacustre*) and the Oblong Orb Mussel (*Musculium transversum*) (National Museums Northern Ireland, 2018). Neither are listed on the IUCN3.1 Red List, yet the Lake Orb Mussel is considered Vulnerable in Northern Ireland (IUCN 2011; National Museums Northern Ireland, 2018). The Oblong Orb Mussel was introduced to the UK from North America, and as such is not given any protected or conservation status. Studies into pollution in rivers found that *Musculium transversum* is negatively affected by high levels of heavy metals and un-ionized ammonia (Anderson and Sparks, 1978); further studies found that even low levels of un-ionized ammonia (0.14-1.17 mg/L) could drastically reduce the population (Zischke and Arthur, 1987). Should *Musculium* species be found on the Isle of Man, they could be excellent indicators of heavy metal and ammonia pollution, the latter of which is of particular importance due to surrounding agricultural land and the proximity of the Curragh Wildlife Park.

As well as utilising data of fresh-water mollusc occurrence and abundance as an indication of water quality, it is important to sample and taxonomically classify *Euglesa* and *Musculium* species. The conservation status of the Sphaeriidae are poorly understood, and as such 24.7% of freshwater molluscs are considered “data deficient” when considering their vulnerability to extinction (Figure 4). Freshwater molluscs are currently the taxa most at risk to extinction throughout Europe, with at least 43.7% of species being classified as Threatened, 20.4% as Vulnerable, 10.5% Endangered and 12.8% Critically Endangered (IUCN, 2011). In a Manx context, it is hoped that through further data gathering, our limited understanding of these invertebrates and their habitat could be rectified.

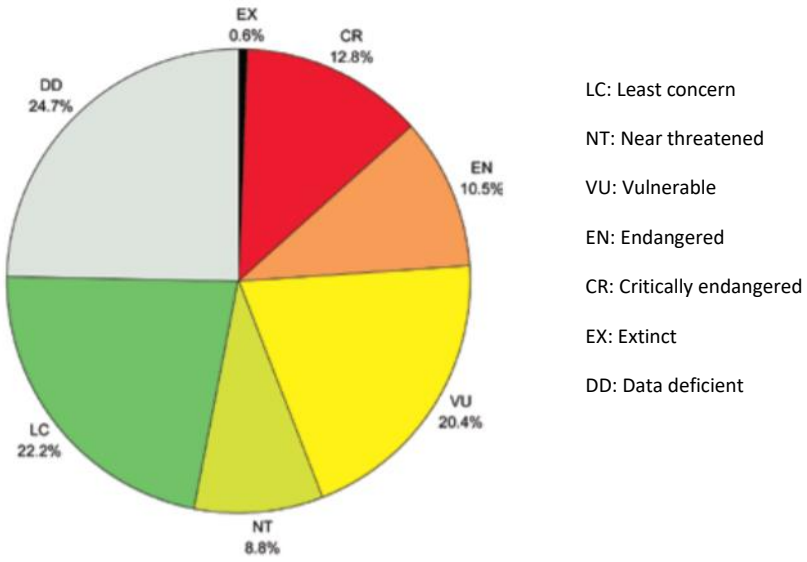

Figure 4. *IUCN Red List status of freshwater molluscs in Europe* (IUCN, 2011).

Methods

Pea Mussels can be found in a variety of aquatic habitats, from lakes, rivers and ponds, to bogs and vernal or ephemeral pools. They appear to prefer silty waters, possibly due to the presence of other specimens such as freshwater shrimp (*Gammarus spp*.), which decrease the abundance of, and therefore competition with, other freshwater mussel species.

Samples taken at each of the sites within the Ballaugh Curragh (Figure 7) were sorted to extract the Pea Clams present. Microscope identification to species level was undertaken and the location and abundance of individual species recorded.

The exact location of sampling was recorded using handheld GPS along with a detailed habitat description (Figures 5 & 6).

Although *Euglesa* spp*.* are reported to breed all year round, the fieldwork was undertaken at the same time of year on each sampling occasion to remove any effects of seasonal variation.

Collection Method

Equipment List:

- Dip nets – of 0.5mm mesh size
- Dissection tray
- Plastic sample pots
- Forceps with soft or curved tip
- Sieve – 0.5mm gauge
- Handheld GPS
- Thermometer
- 70% ethyl alcohol
- Microscope & associated slides

Collecting Samples:

A dip net was used to prod the surface of the sediment, digging 3cm into the sediment for about 15 seconds. Anything collected in the net was emptied into the dissection tray for sorting. Larger material, such as vegetation was carefully removed to ensure nothing biological specimens were adhering to the surface. When required, water was added to the tray to help separate the clams from other debris and sediment. Forceps were used to help identify the samples and to aid their collection. Where necessary the material in the trays was sieved through a 0.5mm mesh with water to remove further sediment and separate any clams. They were then placed in a specimen pot with 70% ethyl alcohol and labelled with the location and date of sampling. Great care was taken to not damage the clams. Notes were taken at each site to include date, time, water temperature, habitat description and weather conditions.

Figure 5. Location of Ballaugh Curragh Ramsar Site outlined in blue (Google, 2021).

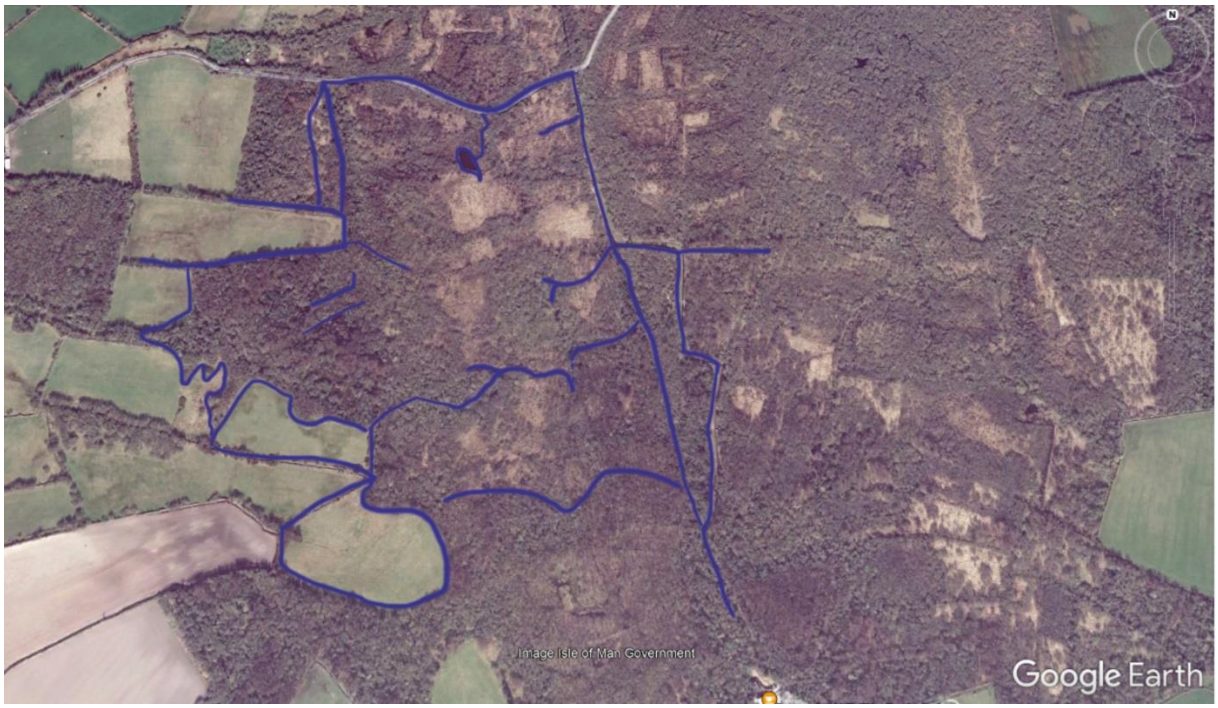

Figure 6. Detail of the Ballaugh Curragh Ramsar site showing watercourses in blue (Google, 2021).

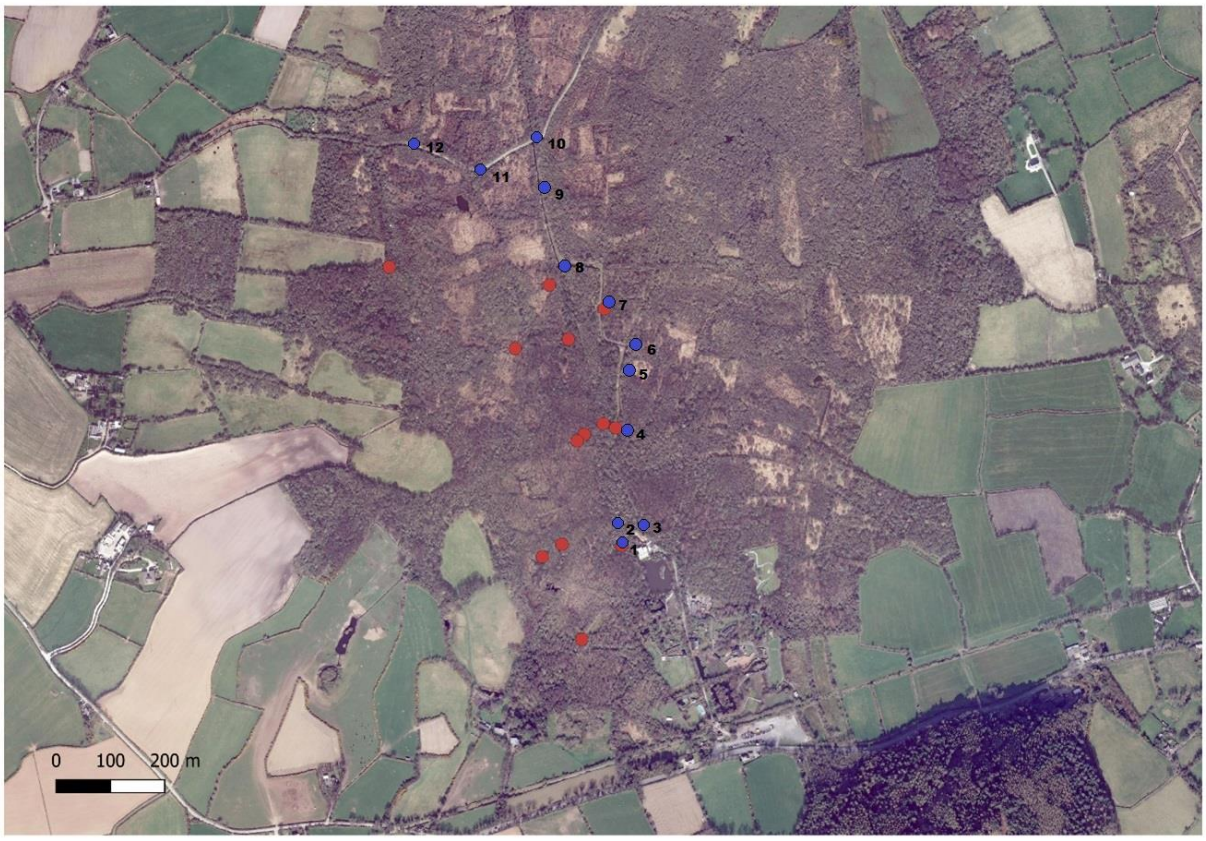

Figure 7: Location of Sphaeriidae sampling sites within the Ballaugh Curragh Ramsar site. Red = 2021, Blue = 2022

Results

The repeat (2022) collection of samples at each of the sites surveyed in 2021 was not possible due to the drying-up of the water course in many of these locations. Therefore, the sample sites marked in blue were selected as being of closest geographical, geological and physical similarity (Table 1).

Table 1 – Location of Sphaeriidae sampling sites within the Ballaugh Curragh Ramsar site.

Site	OS grid reference	GPS Coordinates (DD.DDD)	Easting	Northing	Pea Clams present
1	SC364944	54.3197287, -4.5155757	236481	494491	P
2	SC365944	54.3196923, -4.5149158	236524	494485	P
3	SC364946	54.3212755, -4.5156739	236481	494663	P
4	SC364947	54.3221044, -4.5155240	236494	494755	P
5	SC364948	54.3226355, -4.5154707	236499	494814	-
6	SC364948	54.3233504, -4.5161513	236458	494895	P
7	SC363949	54.3239266, -4.5174696	236375	494962	P
8	SC364944	54.3194269, -4.5154684	236487	494457	P
9	SC363951	54.325221, -4.5181060	236338	495107	P
10	SC363952	54.326060, -4.5181489	236339	495201	-
11	SC362951	54.325484, -4.5198655	236225	495141	P
12	SC361951	54.325859, -4.5216894	236108	495187	P

The results showed the presence of *Euglesa* in 10 of the 12 sampling locations (Table 2).

Table 2 – Species identified at Sphaeriidae sampling locations within the Ballaugh Curragh Ramsar site.

Site	Sphaeriidae identified	Number of individuals
1	*Euglesa* sp.	4
2	*Euglesa* sp.	3
3	*E. casertana*	6
4	*E. nitida*	4
5	N/A	0
6	*E. casertana*	6
7	*E. nitida*	13
8	*E. subtruncata*	4
9	*E. subtruncata*	3
10	N/A	0
11	*Euglesa* sp.	2
12	*E. subtruncata*, *E. milium*	1 & 1

In total, four different *Euglesa* species were identified: *Euglesa casertana*, *E. nitida*, *E. subtruncata* and *E. milium*. Identification of the specimens collected at sites 1, 2 and 11 was difficult due to the small size of the Pea Clams present, therefore their identification was only recorded to genus.

The most individual Pea Clams were recorded at site 7; *n* = 13.

No pea clams were collected at sites 5 and 10.

These results show that the Ballaugh Curragh area supports a minimum of four different *Euglesa* species, suggesting that the water quality in terms of potassium, magnesium and dissolved oxygen levels is suitable to continue to support a Pea Clam population.

Further analysis of the topography, geology, substrate, adjacent/upstream land use, chemistry and water flow rate at the sites which produced the most individual specimens may give a greater indication of the preferred habitat for these freshwater mollusc species. An analysis of the other species present at each location might give further insight into inter-species competition within these habitats.

Appendix 1. Spheridae presence from 2018-19 data taken from water quality monitoring data provided by DEFA.

Site Code	River	Site Name	Spring 2018	Summer 2018	Autumn 2018	Spring 2019	Summer 2019	Autumn 2019
2001	Middle River	u/s River Douglas			Y	Y	Y	Y
2002	Middle River	Richmond Hill		Y	Y	Y	Y	Y
2003	River Douglas	d/s Pulrose		Y	Y		Y	
2007	Middle River	Middle Farm	Y	Y	Y	Y	Y	Y
2011	River Dhoo	d/s Greeba confluence		Y	Y		Y	Y
2026	River Dhoo	u/s Glen Vine Bridge		Y				Y
2101	Groudle River	Port Groudle	Y					
2711	River Neb	d/s weir & Raggatt	Y					Y
2714	Foxdale Stream	u/s River Neb	Y	Y		Y		
3004	Colby River	Colby Glen	Y	Y		Y	Y	
3031	Polyvaaish Stream	u/s beach	Y					
3101	Silverburn	u/s Castletown			Y			
3111	Glashen Stream	Derbyheaven			Y		Y	Y
3201	Santonburn	Ballawoods					Y	
3231	Crogga River	Port Soderick	Y	Y		Y	Y	
3233	Crogga River	d/s Bushey's Brewery			Y		Y	Y
3235	Crogga River	u/s Mount Murray					Y	Y

Appendix II. 2021 *Spheridae* sampling locations within the Ballaugh Curragh Ramsar site.

Site	OS Grid Ref.	Latitude	Longitude	Notes	Mussels
1	SC294457	54.321129	-4.516672	Stagnant water; lots of hog lice.	P
2	SC363570	54.323670	-4.517814	River, slow flowing; Fools' Watercress present	P
3	SC363940	54.322694	-4.517212	River, faster flowing than site 2	P
4	SC3606394964	54.323777	-4.522363	On bend by bridges; slow flow; lots of shrimp = less mussels?	P
5	SC3647594695	54.321256	-4.515788	River adjacent to path & bridge, just up from bench - slow flow	P
6	SC3645294880	54.323215	-4.5162348	Stagnant water; right of ditch and path, dense sediment	not P
7	SC3628894807	54.322507	-4.5187137	Open area of wide channel, still areas of flow	not P
8	SC3645094669	54.321320	-4.5161498	Kilane Trench, no vegetation in ditch, flowing channel, muddy	P
9	SC3640294637	54.321018	-4.5168695	Slow flow	P

References

Spheridae distribution, NBN Atlas, (2017).

Voshell, J.R. (2002). *A guide to common freshwater invertebrates of North America.* Blacksburg, VA: McDonald and Woodward.

Cuttelod, A., Seddon, M. & Neubert, E. (2011). *European Red List of Non-marine Molluscs.* IUCN Red List, pp. 9-14.

BRIG (2007). *Report on the Species and Habitat Review (Report by the Biodiversity Reporting and Information Group (BRIG) to the UK Standing Committee)*. Peterborough, UK: JNCC.

Holopainen, I.J. & Jónasson, P.M. (1983). *Long-term population dynamics and production of* Pisidium *(Bivalva) in the profundal of Lake Esrom, Denmark.* Oikos, 41(*1*), pp. 99-117.

Joyner-Matos, J., Richardson, H., Sammeli, T. & Chapman, L.J. (2011). *A fingernail clam (Sphaerium sp.) shows higher reproductive success in hypoxic waters.* Canadian Journal of Zoology, 89(*3*), pp. 161-168.

Holopainen, I.J. & Hanski, I. (1986). *Life history variation in* Pisidium *(Bivalvia: Pisidiidae).* Ecography, 9(*2*), pp. 85-98.

Thorp, J.H. & Rogers, D.C. (2011). *Field Guide to Freshwater Invertebrates of North America*. Kansas, KY: Academic Press.

Anderson, K.B. & Sparks, R.E. (1978). *Rapid Assessment of Water Quality, Using the Fingernail Clam,* Musculium transversum*.* Urbana, IL: University of Illinois.

Zischke, J.A. & Arthur, J.W. (1987). *Effects of elevated ammonia levels on the fingernail clam,* Musculium transversum*, in outdoor experimental streams.* Archives of Environmental Contamination and Toxicology, 16, pp. 225-231.

Schultheiß (2007). *Systematics and character evolution of* Pisidium *(Bivalvia) in the ancient lakes Ohrid and Prespa.* The Malacologist, 49.

National Museums Northern Ireland (2018). *Northern Ireland Priority Species* – Musculium lacustre – *lake (or capped) orb mussel.*

Kilgour, B.W. & Mackie, G.L. (1991). *Relationships between Demographic Features of a Pill Clam (*Pisidium casertanum*) and Environmental Variables.* Journal of the North American Benthological Society, 10(*1*), pp. 68-80.

Dussart, G. (1979). Sphaerium corneum *(L.) and* Pisidium *spp. Pfeiffer – The Ecology of Freshwater Bivalve Molluscs in Relation to Water Chemistry.* Journal of Molluscan Studies, 45(*1*), pp. 19-34.