Survey of Vertigo Snails in the Killala Bay/Moy Estuary SAC 000458

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Table of contents

1. Introduction

The Killala Bay/Moy Estuary Special Area of Conservation (SAC) and Special Protection Area (SPA) in Counties Mayo and Sligo supports several habitats of European interest including well- developed fixed dune systems, associated salt marsh, as well as extensive mudflats and sandflats that are exposed at low tide.

In September and October of 2022 Allen and Mellon Environmental Ltd was commissioned to complete a survey for whorl snails at potentially suitable habitats within the Killala Bay/Moy Estuary SAC, with a focus on Narrow-mouthed whorl snail (*Vertigo angustior*), Geyer's whorl snail (*V. geyeri*) and where possible, for other Red Listed non-marine mollusca such as the mud snail (*Hydrobia acuta neglecta*).

Initially the project was to include monitoring and condition assessment of the existing *V. angustior* population at Killanley Glebe. However, this was part of a wider SAC monitoring project for the species (NPWS, 2012) and so the project focused on surveying other potentially suitable sites within and adjacent to the SAC.

The surveyors who carried out the work were Anna Hart Consultant Ecologist for Allen and Mellon Environmental and Dr. Roy Anderson. Anna was formerly the Northern Ireland Conservation Officer for Buglife - the Invertebrate Trust. Roy is an expert entomologist and an acknowledged expert in mollusca who has published many papers on Vertigo snails and other invertebrate taxa.

2. Target Species

The Narrow-mouthed Whorl Snail (Vertigo angustior) has a shell with mid-brown colouration, a striate surface of fine raised lines and 5-6 teeth in the mouth. It has been assessed as being Vulnerable VU (A2c) in the Irish Red List with the Irish population being of global importance (Byrne, Moorkens, Anderson, Killeen and Regan, 2009). It is listed in the EU Habitats and Species Directive and is considered threatened in most countries (Anderson, 2006-18). This species is usually found in areas of dune grassland, dune slacks and undisturbed marshes (Byrne, Moorkens, Anderson, Killeen and Regan, 2009; National Museums Northern Ireland (NMNI) Dr Roy Anderson, 2006-18; Anderson, 2016a).

Vertigo angustior prefers habitats with unshaded conditions with vegetation that is quickly warmed by the sun, flowing groundwater and high, stable humidity. Optimal habitat is also not exposed to periodic desiccation or prolonged flooding. Given the specific microhabitat requirements of this species, it is often found in a narrow zone around wetlands, restricted to suitable habitat that is only a few metres wide (JNCC, 2022). There is currently only one known site for the species within the SAC (Killanley Glebe) and this was last monitored in 2009 as part of a wider condition assessment for Annex II Vertigo species in Ireland (Moorkens and Killeen, 2011). This is one of the few remaining “marsh phase” sites for the species, with most Irish populations occurring within dune systems.

Figure 1. Narrow-mouthed whorl snail (*Vertigo angustior*) © Dr Roy Anderson

Another target species for this project was Geyer's Whorl Snail (*Vertigo geyeri*). This snail has a glossy shell with pale red-brown colouration and four teeth, with the animal itself being dark. It has been assessed as being Vulnerable VU (A2c) in the Irish Red List, with the Irish population being of global importance (Byrne et al, 2009). It is associated with relict base-rich flushes where it requires an alkaline pH, short mossy vegetation with sun penetration and no excessive trampling or disturbance to thrive (Anderson, 2016b).

The spire snail (*Hydrobia acuta neglecta*) (family Hydrobiidae) was identified as a potential target species. This snail has a spired shell with dull yellow-brown coloration and the animal is dark with pale tentacles that have black marks near the tip. It has been assessed as being Endangered VU (B2ab (iii, iv)) in the Irish Red List (Byrne et al, 2009), being extremely rare and declining. It is associated with non-tidal coastal lagoons that are diluted by a freshwater input and have a stable water table. All of the above species are threatened by habitat loss, fragmentation and degradation (Anderson, 2016b; Byrne et al, 2009).

3. Materials and methods

The methodology for this work was based on several recent monitoring surveys of different vertigo species; Monitoring of Narrow-mouthed Whorl Snail (Vertigo angustior) on the North Coast (Anderson and Hart, 2022), surveys for Demoulin's Whorl Snail (V. moulinsiana) carried out in 2019 at Corbally Fen (Allen and Mellon Environmental Ltd), Annex ll snail surveys carried out in 2017 (Anderson et al.) and Long & Brophy (2013). Although Narrow-mouthed Whorl Snail surveys can be carried out throughout the year in appropriate habitat, the optimal time is now recognised to be between August and October (Anderson and Hart, 2022). Survey work was therefore completed during the months of September and October to maximise the chance of finding target species.

Four main areas were surveyed as part of this project:

- Petrifying streams near Ballina and Belleek Woods
- Enniscrone dunes
- Bartra Island dunes
- Ross dunes

Aerial imagery was used to identify other areas of potential habitat, which were also surveyed. The petrifying springs habitats identified as a key target for survey work were guided by the data provided by Denyer (2021). The 32 petrifying springs/ streams/ seepages highlighted in the 2021 survey can be found in Table 1. Efforts were made to visit as many of these locations as possible to determine their suitability for Vertigo monitoring. In the field it was determined that many of the identified springs/ streams/ seepages were not suitable for the target Vertigo species for a variety of reasons. For example, many of these locations were too shaded either by scrub or trees and some of the sites along the estuary were influenced by salt water, making conditions unsuitable for the target Vertigo species.

Figure 2. Searching through vegetation for target snail species.

A few of the springs/ streams/ seepages visited in 2022 were deemed to have some potential for target Vertigo species and were searched accordingly. These locations include Castleconner (M01), Quay House (M04), Pump House (M08), Pump House (M09), Pump House (M10), Estuary bank (M11), Knockroe (M12), Warren Walk (M14), Warren Walk (M15), Warren Walk (M16), Scurmore (M19), Belleek Woods south (M20), Belleek Woods (north) (M26), Belleek Woods (south) (M27), Lecarrow (M29), Lecarrow (M30) and Belleek Woods (north). Sampling points were either at or near to these locations. At each site information was also noted on habitats and ecology, with any site management concerns being highlighted and recommendations for future site management being made.

A total of 28 sampling points were surveyed in 2022 (see Table 2). Approximately 20 minutes was taken at each site with the two surveyors working in tandem for the prescribed period. At all the locations survey effort consisted of searching through the vegetation and leaf litter by beating over a large white tray laid on or near the ground. The trays were then examined minutely using a hand lens, with all whorl snails being collected to then be identified at the end of the time period.

Figure 3. Sorting collected snails into species.

Although the focus of this work was the Narrow-mouthed whorl snail (*Vertigo angustior*) and Geyer's whorl snail (*V. geyeri*) all snail species were recorded as bycatch along with a range of other invertebrates present at the sites including, millipedes (Diplopoda); centipedes (Chilopoda); woodlice (Isopoda); beetles (Coleoptera) etc. Many of these were removed from the site for identification because of the technical difficulty associated with that. Information on the snail species recorded, species of interest and other invertebrates can be found on the following pages.

Despite extensive searches the target species were not found. Other endangered vulnerable and threatened species were recorded during the surveys and are included in Tables 3 and 4.

Name	Grid ref
Castleconner (M01)	G 26129 24265
Castleconner (M02)	G 26051 23738
Castleconner (M03)	G 25712 21900
Quay House (M04)	G 25733 21569
Cregg's Road (M05)	G 26782 20600
Belleek Woods (north) (M06)	G 25258 21965
Quignamanger (M07)	G 25775 21169
Pump House (M08)	G 25761 21482
Pump House (M09)	G 25753 21522
Pump House (M10)	G 25737 21550
Estuary bank (M11)	G 26583 27216
Knockroe (M12)	G 26138 25348
Castleconner (M13)	G 26309 24904
Warren Walk (M14)	G 26717 26387
Warren Walk (M15)	G 26670 26461
Warren Walk (M16)	G 26596 26617
Iceford Stables (M17)	G 26637 23072
Belleek Woods (north) (M18)	G 25271 21941
Scurmore (M19)	G 26534 26797
Belleek Woods south (M20)	G 25383 21924
Belleek Woods (north) (M21)	G 25285 21955
Belleek Woods (north) (M22)	G 25117 21898
Belleek Woods (north) (M23)	G 25043 21994
Belleek Woods (north) (M24)	G 25141 22004
Belleek Woods (north) (M25)	G 25117 22143
Belleek Woods (north) (M26)	G 25177 22126
Belleek Woods (south) (M27)	G 25182 20721
Belleek Woods (north) (M28)	G 25166 22098
Lecarrow (M29)	G 25228 25996
Lecarrow (M30)	G 25287 26159
Belleek Woods (north) (M31)	G 25161 22106
Belleek Woods (north) (M32)	G 2520332969

Table 1. 32 petrifying springs/ streams/ seepages highlighted in the 2021 survey (Denyer, 2021).

SITE	SAMPLING POINT	GRID REF
Belleek Woods	1	G25182072
	2	G25162211
	3	G25372195
Quay House	4	G25782158
	5	G25742158
Bartragh Island	6	G25262862
	7	G25262893
	8	G25442896
	9	G25542879
Castle Magee Dunes	10	G21383363
	11	G21613367
Ross Point	12	G21423138
	13	G21893189
Lecarrow	14	G25292611
Enniscrone Beach	15	G28392978
	16	G27882961
Enniscrone Dunes	17	G27552876
	18	G27492872
	19	G27442856
	20	G27402859
	21	G27052867
	22	G27252939
Warren Walk	23	G2657327219
	24	G2661526604
	25	G2661726548
	26	G2669226413
Northern Killanley	27	G2609124273
Rathmurphy	28	G2608125207

Table 2. Sampling points

Figure 4. Belleek Woods sampling point 2.

4. Site Summaries

4.1 Belleek Woods

Belleek woods were visited on 19th September with conditions being cool and cloudy. This area is a mixed plantation woodland by the estuary, with three main sites being surveyed in 2022. The first, at G25182072 (sampling point 1), was under dead wood and stones by a small, petrified tufa stream. This location was found to be very shaded and damp, with patches of very deep mud. The second sampling site consisted of moss on the banks of a drainage ditch at G25162211 (Belleek Woods sampling point 2). As with the first site, conditions were shaded and damp. The third and final site was near boulders and rocks above the high tide mark with a stream at G25372195 (Belleek Woods sampling point 3). Although this location was more open than the previous two it was still found to be rather shaded. The two surveyors walked through the woodland looking for other locations to survey however all appeared to be too shaded for the target species.

Figure 5. Belleek Woods sampling point 1.

Six species of mollusca were recorded from the first sampling point: Inishowen slug *Arion owenii* (family Arionidae), Silky snail *Ashfordia granulata* (family Hygromiidae), Grey field slug *Deroceras reticulatum* (family Agriolimacidae), Tree slug *Lehmannia marginata* (family Limacidae), Draparnaud *Oxychilus draparnaudi* (family Oxychilidae). The ground beetle *Agabus biguttatus* (family Carabidae), the rove beetles *Lesteva sicula ssp. Heeri*, *Myllaena brevicornis* (both family Staphylinidae) and the millepede *Ophyiulus pilosus* (family Oxychilidae) were also recorded here. The freshwater shrimp *Gammarus duebeni* (family Gammaridae) and the water cricket *Velia caprai* (family Veliidae) were both recorded from the small, petrified stream.

Figure 6. Belleek Woods pool of water near sampling point 1.

At the second sampling point three species of snail were recorded: *Euconulus fulvus fulvus* (family Euconulidae), *Oxychilus alliarius* and *Oxychilus draparnaudi* (both family Oxychilidae). The water scavenger beetle *Anacaena globulus* (family Hydrophilidae), the rove beetles *Lesteva sicula ssp. Heeri*, *Olophrum piceum* (both family Staphylinidae) and the landhopper *Arcitalitrus dorrieni* (family Talitridae) were also recorded at this location. New Zealand mud snail *Potamopyrgus antipodarum* (family Tateidae) was recorded in the petrifying stream/drain and Yellow-barred peat hoverfly Sericomyia silentis (family Syrphidae) was recorded resting on bramble leaves nearby. The rove beetle *Omalium italicum* (family Staphylinidae) was also recorded from a crevice in an oak branch at G25182213.

Figure 7. Stream and ditch at Belleek Woods sampling point 3.

Two species of snail were recorded from the final site in tidal drift by the small stream: Mud bithynia *Bithynia tentaculata* (family Bithyniidae) and the New Zealand mud snail *Potamopyrgus antipodarum* (family Tateidae). The rove beetles *Lesteva punctata*, *Lesteva sicula ssp. Heeri*, *Lithocharis nigriceps*, *Stenus canaliculatus*, *Stenus juno* (family Staphylinidae) and the millipede *Leptoiulus belgicus* (family Julidae) were also recorded here. At the third site the ground beetle *Bembidion mannerheimii* (family Carabidae), the rove beetles *Gyrohypnus angustatus* and *Nehemitropia lividipennis* (both family Staphylinidae) were all beaten off vegetation along the small stream. Strawberry snail *Trochulus striolatus* (family Hygromiidae) was recorded on Pendulous Sedge *Carex pendula* growing in the ditch. Spire snail *Ecrobia ventrosa* (family Hydrobiidae) was recorded from the upper rocky shore of the estuary and the centipede *Strigamia maritima* (Linotaeniidae) was recorded under rocks at the upper shore.

Figure 8. Near Belleek Woods sampling point 3

Conditions at Belleek Woods were found to be unsuitable for the target snail species, as it was too shaded. Most of the invertebrate species recorded are common and widespread, found in a variety of scrubby and woodland habitats. The third sampling point was found to be the most diverse in terms of species recorded, which may be due to the more openness of the habitat.

The water in and around Belleek Woods sampling point 1 flows into the nearby duck pond at G 25403 20724. Water quality depends on a variety of factors that weren't surveyed. As the water that enters the duck pond is flowing from an area of intensively farmed grassland, any runoff from this will likely influence the quality of water. The only way to know for certain would be to measure water quality at various points along the stream. The area could perhaps benefit from some scrub clearance though care should be taken not to damage the tufa spring in the process.

Figure 9. Quay House sampling point 5.

4.2 Quay House

Quay House was visited on 20th September with conditions being cool and cloudy. This is a built-up area, with rural gardens near the estuary. Two main sites were surveyed; the first at G25782158 (Quay House sampling point 4) which consisted of a petrified stream flowing out of a lawn, alongside a hedgerow down towards the estuary and the second location at G25742158 (Quay House sampling point 5) which consisted of mossy ground by the petrifying stream as it enters the estuary.

Figure 10. Quay House sampling point 4 in garden.

Six species of mollusca were recorded from the first sampling point; Hedgehog slug (*Arion intermedius*), Large red slug (*Arion ater rufus*) (both family Arionidae), Silky snail (*Ashfordia granulata*) (family Hygromiidae), Grey field slug (*Deroceras reticulatum*) (family Agriolimacidae), Irish yellow slug (*Limacus*

maculatus) (family Limacidae), Spanish slug (*Ambigolimax valentianus*) (family Lymnaeidae), English chrysalis snail (*Leiostyla anglica*) (family Lauriidae) and Draparnaud snail (*Oxychilus draparnaudi*) (family Oxychilidae). The ground beetles *Leistus fulvibarbis*, *Nebria brevicollis* and the rove beetle *Lesteva sicula ssp. Heeri*, (family Staphylinidae) were found by searching under branches on the lawn by the stream. Several other species of invertebrate were recorded under branches in this area; the Spotted snake millipede (*Blaniulus guttulatus*) (family Blaniulidae), Flat-backed millipedes *Brachydesmus superus*, *Polydesmus inconstans* (both family Polydesmidae), the millipedes *Cylindroiulus britannicus*, *Cylindroiulus londinensis*, *Ophyiulus pilosus* (family Julidae), *Nemasoma varicorne* (family Nemasomatidae), the pill millipede *Glomeris marginata* (family Glomeridae), the landhopper *Arcitalitrus dorrieni* (family *Talitridae)*, Common pygmy woodlouse (*Trichoniscus pusillus agg.*) (family Trichoniscidae), Common shiny woodlouse (*Oniscus asellus*) (family Oniscidae), and Common rough woodlouse (*Porcellio scaber*) (family Porcellionidae). The pygmy woodlouse *Haplophthalmus mengii* (family Trichoniscidae) was also recorded under dumped stones by the stream. Two- spotted water hog-louse (*Asellus aquaticus*) (family Asellidae) and the water cricket *Velia caprai* (family Veliidae) were recorded from the petrifying stream in the garden.

Figure 11. Strandline debris reaching the trees.

At the second sampling point four species of mollusca were recorded. The Silky snail (*Ashfordia granulata*) (family Hygromiidae) and Draparnaud snail (*Oxychilus draparnaudi*) (family Oxychilidae) were both found in moss by the petrifying stream. Pfeiffer's amber snail (*Oxyloma elegans*) (family Succineidae) was also recorded from this stream. The Spire snail (*Ecrobia ventrosa*) (family Hydrobiidae) was found by searching under small stones in the upper shore of estuary. The ground beetle *Bembidion maritimum* (family Carabidae) and the Common shorebug (*Saldula saltatoria*) (family Saldidae) were also recorded by searching under stones and branches in this area. The freshwater shrimp *Gammarus duebeni* (family Gammaridae) was found the small petrifying stream.

Figure 12. Estuary.

Conditions at Quay House were found to be unsuitable for the target snail species, being disturbed, too shaded and influenced by salt water from the estuary. Land management changes have undoubtedly influenced the invertebrate communities in and around the petrified stream. Trees and scrub dominate most of the bank and much of the main tufa mound is covered. Removal of scrub and trees in this area could have a positive effect in opening the habitat up however it should be noted that as the target snail species are not found here, they will not benefit.

Focus should instead be on other invertebrate species that are associated with this particular habitat, for example Scarce Blue-tailed Damselfly (*Ischnura pumilio*) (family Coenagrionidae). Care must be taken to ensure any habitat management does not damage the stream or surrounding tufa. Also, it is important not to remove any strandline branches, detritus, rocks etc. as this is itself a vital habitat for rare species such as the ground beetle *Bembidion maritimum* (family Carabidae).

Figure 13. Bartragh Island.

4.3 Bartragh Island

Bartragh Island was visited on 20th September with conditions being cool and cloudy. This area consists mainly of lowland marshy grassland and sand dunes with four sites being visited. The first at G25262862 (Bartragh Island sampling point 6) consisted of marshy lowland grassland with surveying targeted at the roots of Iris in abandoned pasture. This location was found to be open and damp, with some shade coming from a small patch of trees and scrub. The second sampling site involved searching through the roots of vegetation at the saltmarsh/dune interface at G25262893 (Bartragh Island sampling point 7). As with the first site, conditions were open and damp. The third sampling point at G25442896 (Bartragh Island sampling point 8) consisted of marshy lowland grassland with surveying taking place at the roots of Iris in abandoned pasture. The fourth and final site at G25542879 (Bartragh Island sampling point 9) consisted of coastal yellow dunes in a dune hollow.

Figure 14. Bartragh Island sampling point 6.

At the first sampling point nine species of mollusca were recorded; Clear glass snail (*Aegopinella pura*) (family Gastrodontidae), Common door snail (*Clausilia bidentata*) (Clausiliidae), Moss snail (*Cochlicopa lubrica*), Lesser moss snail (*Cochlicopa lubricella*) (both family Cochlicopidae), Toothless chrysalis snail *(Columella edentula*) (family Truncatellinidae), Common chrysalis snail (*Lauria cylindracea*), English chrysalis snail (*Leiostyla anglica*) (both family Lauriidae), Marsh whorl snail (*Vertigo antivertigo*) and Striated whorl snail (*Vertigo substriata*) (both family Vertiginidae). Six species of beetle were recorded at this location: Iris flea beetle (*Aphthona nonstriata*) (family Chrysomelidae), A water scavenger beetle (*Helophorus obscurus*) (family Helophoridae), the rove beetles *Heterothops binotatus*, *Quedius schatzmayri*, *Sepedophilus nigripennis*, *Stenus ossium* and *Tachyporus dispar* (all family Staphylinidae).

Figure 15. Bartragh Island sampling point 7.

At the second sampling point ten species of mollusca were recorded; Clear glass snail (Aegopinella pura) (family Gastrodontidae), Common door snail (Clausilia bidentata) (Clausiliidae), Lesser moss snail (*Cochlicopa lubricella*) (family Cochlicopidae), Toothless chrysalis snail (*Columella edentula*) (family Truncatellinidae), Common chrysalis snail (*Lauria cylindracea*), English chrysalis snail (*Leiostyla anglica*) (both family Lauriidae), Rock snail (*Pyramidula umbilicata*) (family Pyramidulidae), Marsh whorl snail (*Vertigo antivertigo*), Common whorl snail (*Vertigo pygmaea*) and Striated whorl snail (*Vertigo substriata*) (all family Vertiginidae). The ground beetle *Carabus granulatus* (family Carabidae) was recorded nearby on an old stone wall.

Figure 16. The ground beetle *Carabus granulatus* (family Carabidae).

At the third sampling point three species of mollusca were recorded: Moss snail (*Cochlicopa lubrica*) (family Cochlicopidae), Common whorl snail (*Vertigo pygmaea*) and Striated whorl snail (*Vertigo substriata*) (both family Vertiginidae). The ground beetle *Trichocellus placidus* (family Carabidae), the rove beetles *Stenus brunnipes* and *Stenus clavicornis* (both family Staphylinidae) were also recorded from this location.

Figure 17. Flower rich grassland on Bartragh Island.

At the fourth sampling point six species of mollusca were recorded: Clear glass snail (*Aegopinella pura*) (family Gastrodontidae), Brown-lipped snail (*Cepaea nemoralis*) (family Helicidae), Heath snail (*Helicella itala*) (family Geomitridae), Rayed glass snail (*Nesovitrea hammonis*) (family Gastrodontidae), Hairy snail (*Trochulus hispidus*) (family Hygromiidae) and Milky crystal snail (*Vitrea contracta*) (family Pristilomatidae). Five species of beetle were recorded at this location: the ground beetle *Calathus cinctus* (family Carabidae), the rove beetles *Gyrohypnus angustatus*, *Nehemitropia lividipennis*, *Quedius semiobscurus* and *Tachyporus chrysomelinus* (all family Staphylinidae). Other species recorded include the millipede *Ophyiulus pilosus* (family Julidae) the earwig *Forficula auricularia* (family Forficulidae) Porcellio scaber *Myrmica ruginodi* and the seed bug *Cymus glandicolor* (family Lygaeidae). Ruby tiger moth (*Phragmatobia fuliginosa*) (family Erebidae) and the Drinker moth (*Euthrix potatoria*) (family Lasiocampidae) were both found resting on Marram grass.

Figure 18. Bartragh Island sampling point 9.

Figure 19. Taking the boat to and from Bartragh Island.

Although the target snail species were not recorded, conditions at Bartragh Island appeared to be suitable for Narrow-mouthed whorl snail. It is noted that the time available for survey was restricted by boat access at high tide, which meant that only a small section of the island was covered during the 2022 survey. If the marshy grassland with patches of flushing is present in other parts of the island, there is a chance the snail could be found there.

Overall Bartragh Island sampling point 7 was found to be the most diverse in terms of snail species recorded, followed by Bartragh Island sampling point 6. The other two sampling points with drier conditions were found to support fewer snail species. There are significant areas of flower-rich grassland and in particular Devil's-bit scabious (*Succisa pratensis*) on the Island. Bartragh Island could be an important site for other invertebrates such as bees and butterflies including the marsh fritillary *Euphydryas aurinia* although surveys at a more appropriate time of year would be needed to confirm this.

Figure 20. Dune lake at Castle Magee Dunes.

4.4 Castle Magee Dunes

Castle Magee Dunes were visited on 21st September, with conditions being cool and cloudy. This area consists mainly of yellow dunes, dune slacks and open water in the form of a dune marl lake with a high density of charophytes growing. Two main sites were surveyed here during this project - the first in yellow dunes and dune hollows at G 21383363 (Castle Magee Dunes sampling point 10) and the second in dune slacks by the lake at G 21613367 (Castle Magee Dunes sampling point 11).

Figure 21. Castle Magee Dunes sampling point 10.

At the first sampling point five species of snail were recorded; Lesser moss snail (*Cochlicopa lubricella*) (family Cochlicopidae), Toothless chrysalis snail (*Columella edentula*) (family Truncatellinidae), Garlic snail (Oxychilus alliarius) (family Oxychilidae), Common whorl snail (*Vertigo pygmaea*), Striated whorl snail (*Vertigo substriata*) (both family Vertiginidae), Wrinkled snail (Candidula intersecta), Brown-lipped snail (*Cepaea nemoralis*), Garden Snail (*Cornu aspersum*) (both family Helicidae) and Heath snail (*Helicella itala*) (family Geomitridae). The Brown chafer (*Serica brunnea*) (family Scarabaeidae) was also found at this location.

Figure 22. Bright-line brown-eye (*Lacanobia oleracea*) (family Noctuidae).

Five species of mollusca were recorded at the second sampling point under fence poles: the Hedgehog slug (*Arion intermedius*) (family Arionidae), Lesser moss snail (*Cochlicopa lubricella*) (family Cochlicopidae), Grey field slug (*Deroceras reticulatum*) (family Agriolimacidae), Rayed glass snail (*Nesovitrea hammonis*) and Pfeiffer's amber snail (*Oxyloma elegans*). The flatworm *Microplana terrestris* (family Geoplanidae), the ground beetle (*Pterostichus nigrita*) (family Carabidae), Common shiny woodlouse (*Oniscus asellus*) (family Oniscidae), Common rough woodlouse (Porcellio scaber) (family Porcellionidae) and Common striped woodlouse (*Philoscia muscorum*) (family Philosciidae) were also found at this location.

Figure 23. Fen vegetation behind sand dunes.

At the second sampling point eleven species of beetle were recorded by searching through moss at the dune lake; the ground beetle *Bembidion mannerheimii* (family Carabidae), the pill beetle *Cytilus sericeus* (family Byrrhidae), the weevil *Sitona lineellus,* Strawberry root weevil (*Otiorhynchus ovatus*), White clover seed weevil (*Protapion fulvipes*) (family Curculionidae), the rove beetles *Gyrohypnus angustatus*, *Rugilus erichsoni*, *Stenus fulvicornis*, *Stenus tarsalis*, *Tachyporus atriceps* and *Xantholinus linearis* (all family Staphylinidae). The moth Bright-line brown-eye (*Lacanobia oleracea*) (family Noctuidae) was also recorded by searching through the months. The ground beetles *Amara aenea*, *Curtonotus aulicus* (family Carabidae), the dung beetles *Aphodius depressus*, *Aphodius rufipes* (family Scarabaeidae), the rove beetles *Philonthus albipes* and *Platystethus arenarius* (both family Staphylinidae), were all recorded under cow dung.

Figure 24. Dune slack near Castle Magee sampling point 11.

Twisted ramshorn (*Bathyomphalus contortus*) (family Planorbidae), the freshwater shrimp *Gammarus duebeni* (family Gammaridae) and the water boatman *Corixa affinis* (family Corixidae) were found in the shallow lake water at G21613365. Wandering pond snail (*Ampullaceana balthica*) (family Lymnaeidae) was washed up on the lake margins at G21773364 and Blue-tailed damselfly (*Ischnura elegans*) (family Coenagrionidae) was recorded when the surveyors searched the shallow water.

Figure 25. Castle Magee Dunes sampling point 11.

While walking along the beach between sampling sites, the rove beetle *Othius punctulatus* (family Staphylinidae), Black Marram Weevil (Otiorhynchus atroapterus) (family Curculionidae) and the leaf beetle *Psylliodes marcida* (Chrysomelidae) were all recorded under sea rocket in the strandline at G21143368.

Although the target snail species were not recorded from Castle Magee Dunes, conditions appeared to be suitable for Narrow-mouthed whorl snail. When planning the visit to this site the dune lake was highlighted as being potentially suitable for the mud snail (*Hydrobia acuta neglecta*), however when surveyors arrived it became apparent that conditions weren't suitable for this species.

Figure 26. Ross Point.

4.5 Ross Point

Ross Point was visited on 21st September when conditions were cool and cloudy, with scattered rain showers later in the day. Two main areas were surveyed: the first in overgrown damp dune hollows at the lower end of the site at G21423138 (Ross Point sampling point 12) and the second in the grazed grassy dunes to the north at G21893189 (Ross point sampling point 13).

At the first location seven species of snail were recorded: Brown-lipped snail (*Cepaea nemoralis*), Garden Snail (*Cornu aspersum*) (both family Helicidae), Lesser moss snail (*Cochlicopa lubricella*) (family Cochlicopidae), Heath snail (*Helicella itala*) (family Geomitridae), Common whorl snail (*Vertigo pygmaea*) and Striated whorl snail (*Vertigo substriata*) (both family Vertiginidae). The ground beetle *Amara aenea* (family Carabidae) and the Watercress beetle (*Phaedon cochleariae*) (family Chrysomelidae), Common shiny woodlouse (*Oniscus asellus*) (family Oniscidae), the woodlouse *Philoscia affinis* (family Philosciidae) and the ant *Myrmica ruginodis* (Formicidae) were also recorded at this location. Vertigo snails can often be present on the underside of wood, bits of rubbish etc. A large polystyrene container was overturned and several *V. pygmaea* and *V. substriata* were found on the surface.

Lesser moss snail (*Cochlicopa lubricella*) (family Cochlicopidae) was the only species of snail recorded from the second survey area. Nine species of beetle were recorded from this location: the weevils *Hypera punctata*, *Protapion fulvipes*, *Sitona hispidulus*, *Sitona sulcifrons* (all family Curculionidae), the rove beetles Ocypus olens, *Stenus clavicornis*, *Tachyporus atriceps*, *Tachyporus chrysomelinus*, and *Xantholinus linearis* (all family Staphylinidae).

The ground beetles *Broscus cephalotes* and *Nebria salina* (both family Carabidae) were also recorded under stones on the beach at G21483137, while walking to the survey areas. New Zealand mud snail (*Potamopyrgus antipodarum*) (family Tateidae) was also found at G223327.

Figure 27. Ross point sampling point 12.

Figure 28. Searching for Vertigo on polystyrene container.

Figure 29. Fixed dunes at the northern end of Ross Point.

Figure 30. Ross sampling point 13.

The target snail species were not recorded, and conditions at Ross Point appeared to be sub optimal for Narrow-mouthed whorl snail (*Vertigo angustior*) particularly at the Southern end of the site. Ross point is split into three subsections with an area of improved agricultural grassland in the middle. At the first location surveyed it was noted that much of the vegetation was overgrown and would benefit from light cattle grazing e.g. a maximum of two cows. The second location surveyed was found in fixed dunes that were well-grazed, with evidence of enrichment. This area would benefit from the removal of cattle and efforts put in place to reduce enrichment.

Figure 31. Section of improved agricultural grassland at Ross Point.

Figure 32. tufa on bank beside farm track at Lecarrow.

4.6 Lecarrow

Lecarrow was visited on 22nd September with conditions being warm and slightly cloudy. This area consists of boulders and rocks above the high tide mark with an adjacent farm track. Two seepages occur from the estuary bank with cascading tufa on mainly vertical slopes (Denyer, 2021). Searching was focused under stones on estuarine gravelly mud at G25292611 (Lecarrow sampling point 14).

Only two species of snail were recorded at this site, the Estuarine mouse-eared snail (*Myosotella myosotis*) (family Ellobiidae) and Laver spire shell (*Peringia ulvae*) (family Hydrobiidae). Five species of beetle were recorded here: the ground beetles *Aepus marinus*, *Dicheirotrichus gustavii*, *Pterostichus madidus* (all family Carabidae), the rove beetles *Falagria thoracica* and *Tasgius ater* (both family Staphylinidae). The centipede *Strigamia maritima*, Spotted snake millipede (*Blaniulus guttulatus*) (family Blaniulidae) and Common rough woodlouse (*Porcellio scaber*) (family Porcellionidae) were also found at this location.

Figure 33. Lecarrow sampling point 14.

Figure 34. Rocks showing high tide mark.

Conditions at Lecarrow were found to be unsuitable for the target snail species, being too shaded by scrub and trees on the landward side and influenced by salt water on the estuary side. The vertical nature of the tufa also limits the period it is exposed to warming from the sun.

Figure 35. Enniscrone beach.

4.7 Enniscrone Beach

Enniscrone beach was visited on 19th October with conditions being cool and cloudy. This area consists mainly of beach along with embryonic/ marram sand dunes. Two main areas were searched during the survey: the first in the fore dunes at G28392978 (Sampling point Enniscrone 15) and the second an area of yellow dunes with marram grass at G27882961 (Sampling point Enniscrone 16).

Two species of snail were recorded from the first location by searching through vegetation in the foredunes and under stones: Brown-lipped snail (*Cepaea nemoralis*) and Garden snail (*Cornu aspersum*) (both family Helicidae). Three species of beetle were recorded from this location: the ground beetles *Calathus mollis*, *Paradromius linearis* (both family Carabidae) and the water scavenger beetle *Cercyon littoralis* (family hydrophilidae). The centipede *Lithobius borealis* (family Lithobiidae), the millipede *Ophyiulus pilosus* (family Julidae), Common striped woodlouse (*Philoscia muscorum*) (family Philosciidae), Common rough woodlouse (*Porcellio scaber*) (family Porcellionidae) and Common earwig (*Forficula auricularia*) (family Forficulidae) were also recorded from this sampling point.

Figure 36. Searching under stones at Enniscrone beach.

Four species of snail were recorded by searching through moss on yellow dunes at the second location: Brown-lipped snail (*Cepaea nemoralis*), Garden snail (*Cornu aspersum* (both family Helicidae), Striped snail (*Cernuella virgata*) and Heath snail (*Helicella itala*) (both family Geomitridae). Seven species of beetle were also recorded here; the rove beetles *Metopsia retusa*, *Quedius fuliginosus*, *Sepedophilus nigripennis* (all family Staphylinidae), Red patched Nephus (*Nephi's redtenbacheri*) (family Coccinellidae), the weevil *Sitona griseus* (family Curculionidae), the water scavenger beetles *Cercyon littoralis* (family Hydrophilidae) and *Helophorus minutus* (family Helophoridae). Several other species were recorded from this location including White-legged snake millipede (*Tachypodoiulus niger*) (family Julidae), Common pygmy woodlouse (*Trichoniscus pusillus agg.*) (family Trichoniscidae) and the pill bug *Armadillidium vulgare* (family Armadillidiidae).

The leaf beetle Psylliodes marcida (family Chrysomelidae) was beaten off sea rocket in the fore dunes at G28332970.

Figure 37. Enniscrone Beach sampling point 16.

Overall conditions at Enniscrone beach were found to be unsuitable for the target snail species, being too dry, although conditions became damper further inland. Disturbance is also relatively high at both sampling points as the area is open to the public.

Figure 38. Enniscrone Dunes and golf course.

4.8 Enniscrone Dunes

This site was visited on 20th October with conditions being mostly cool and clear, becoming cloudy as the day progressed. Six areas were searched during this survey. The first was in an area with mainly saltmarsh plant species at G27552876 (Enniscrone Dunes sampling point 17). The second sampling point was located in the saltmarsh/dune interface at G27492872 (Enniscrone Dunes sampling points 18). The third sampling point was also in the saltmarsh/dune interface at G27442856 (Enniscrone Dunes sampling point 19). The fourth area searched was in coastal grassland at G27402859 (Enniscrone Dunes sampling point 20) specifically at the roots of Iris. The fifth sampling point was in a dune slack at G27052867 (Enniscrone Dunes sampling point 21). The sixth and final area searched was in the grey dunes of the golf course at G27252939 (Enniscrone Dunes sampling point 22).

Figure 39. Enniscrone Dunes sampling point 17.

Initially an area was searched at G27592879 with only one species of snail being recorded, Common door snail (*Clausilia bidentata*) (family Clausiliidae). Two other species of invertebrate were recorded from deep saltmarsh pools at this location, the freshwater shrimp (*Gammarus duebeni*) (family Gammaridae)

and the Common ditch shrimp (*Palaemon varians*) (family Palaemonidae). As the habitat was clearly influenced by seawater and unsuitable for the target snail species, surveyors quickly moved on to a more promising area.

Enniscrone Dunes sampling point 17 had vegetation dominated by species such as Cordgrasses (Spartina). Only five species of invertebrate were recorded at this location by searching under a driftwood log: Estuarine mouse-eared snail (*Myosotella myosotis*) (family Ellobiidae) and Rayed glass snail (*Nesovitrea hammonis*) (family Gastrodontidae), the rove beetles *Quedius semiaeneus* and *Stenus brunnipes* (both family Staphylinidae) and the Common rough woodlouse (*Porcellio scaber*) (family Porcellionidae).

Figure 40. Enniscrone Dunes sampling point 18.

At the second sampling point, in the saltmarsh/dune interface, only one species of snail was recorded, the snail Brown-lipped snail (Cepaea nemoralis) (family Helicidae). Twenty species of beetle were recorded at this location. The ground beetles *Philorhizus melanocephalus*, *Philorhizus notatus*, *Trichocellus placidus* (family Carabidae), the rove beetles *Aleochara punctatella*, *Cordalia obscura*, *Gabrius osseticus*, *Mocyta orbata*, *Ochthephilum fracticorne*, *Philonthus cognatus*, *Rugilus erichsoni*, *Rugilus rufipes*, *Stenus brunnipes*, *Stenus clavicornis*, *Stenus fulvicornis*, *Tachyporus chrysomelinus* (all family Staphylinidae), the Red marsh ladybird (*Coccidula rufa*), Red patched Nephus (*Nephus redtenbacheri*) (both family Coccinellidae), the water scavenger beetle *Megasternum obscurum* (family hydrophilidae), the leaf beetle *Chrysolina banksi* (family Chrysomelidae) and the weevil *Ischnopterapion modestum* (family Curculionidae). The woodlice *Philoscia affinis* and Common striped woodlouse (*Philoscia muscorum*) (both family Philosciidae) were also recorded from this location.

Nearby at G27512873, the Common whorl snail (*Vertigo pygmaea*) (family Vertiginidae) was the only snail species recorded. Six species of rove beetle were found at this location: *Boreophilia eremita*, *Mocyta orbata*, *Quedius fuliginosus*, *Quedius semiobscurus*, *Stenus clavicornis*, *Tachyporus nitidulus* (all family Staphylinidae). The woodlouse *Philoscia affinis* (family Philosciidae) and the millipedes *Cylindroiulus latestriatus* and *Ophyiulus pilosus* (family Julidae) were also recorded here.

Figure 41. Enniscrone Dunes sampling point 19.

Figure 42. Enniscrone Dunes sampling point 20.

The third main sampling point was in coastal grassland at G27442856, in particular searching through grass and moss growing over a dead tree. The Hedgehog slug (*Arion intermedius*) (family Arionidae), the Common door snail (*Clausilia bidentata*) (family Clausiliidae), Heath snail (*Helicella itala*) (family Geomitridae) and Common whorl snail (*Vertigo pygmaea*) (family Vertiginidae) were all recorded here. Seven species of beetle were found at this location: the ground beetles *Bembidion mannerheimii*, *Calathus mollis*, *Philorhizus melanocephalus*, *Philorhizus notatus*, *Pterostichus strenuus* (all family Carabidae), the rove beetle *Stenus brunnipes* (family Staphylinidae) and the click beetle *Agriotes lineatus* (family Elateridae). The woodlouse *Philoscia affinis* (family Philosciidae) was also recorded.

Figure 43. Enniscrone Dunes sampling point 21.

The fourth sampling area was to the northwest at the roots of an Iris plant at G27402859. Four species of snail were recorded: Brown-lipped snail (*Cepaea nemoralis*) (family Helicidae), Toothless chrysalis snail (*Columella edentula*) (family Truncatellinidae), *Euconulus alderi* (family Euconulidae) and Hairy snail *Trochulus hispidus* (family Hygromiidae). Five species of beetle were also found at this location: the rove beetles *Othius subuliformis*, *Sepedophilus nigripennis*, *Stenus fulvicornis*, *Tachyporus chrysomelinus* (all family Staphylinidae) and the minute brown scavenger beetle *Corticaria impressa* (family Latridiidae).

Figure 44. Enniscrone Dunes sampling point 22.

The fifth sampling point consisted of moss and wet vegetation in a dune slack at G27052867. Six species of snail were recorded at this location: Brown-lipped snail (*Cepaea nemoralis*), Garden snail (*Cornu aspersum*) (both family Helicidae), Heath snail (*Helicella itala*) (family Geomitridae), Rayed glass snail (*Nesovitrea hammonis*) (family Gastrodontidae), Dwarf snail (*Punctum pygmaeum*) (family Punctidae), Common whorl snail (*Vertigo pygmaea*) (family Vertiginidae). Two species of millipede were also recorded at this location: *Cylindroiulus latestriatus* and *Ophyiulus pilosus* (both family Julidae).

Figure 45. Area of beach.

The sixth and final area searched was in the grey dunes of the golf course at G27252939 where vegetation was primarily mossy grassland. Three species of snail were recorded in this area: *Aegopinella pura* (family Gastrodontidae), *Cochlicopa lubrica* (family Cochlicopidae) and *Vertigo pygmaea* (family Vertiginidae). The Feather-winged beetle *Ptenidium fuscicorne* (family Ptiliidae) was also recorded here.

The dune scarab beetle *Aegialia arenaria* (family Scarabaeidae) was recorded at G26722871 by searching under driftwood and stones on the tide line. Several Silver-Y moths (*Autographa gamma*) (family Noctuidae) were also observed flying in this zone (Figure 45).

Although the target snail species were not recorded, conditions at several of the Enniscrone Dunes sampling points appeared to be suitable for Narrow-mouthed whorl snail (*Vertigo angustior*). This site was well structured in terms of vegetation and ground conditions were damp. The first sampling point was not suitable due to the saltwater influence, as evident by salt marsh plant species. In terms of habitat management light grazing should only be considered if vegetation becomes rank or scrub encroachment becomes an issue.

Figure 46.Warren Way.

4.9 Warren Way

This site was visited on 21st October with conditions being cloudy and cool. This area consisted mainly of rocky shoreline, saltmarsh and scrubby woodland. Four main areas were searched during the survey. The first included shingle, rock and boulders above the high tide mark and strandline at G26572722 (Warren Way sampling point 23). The second area searched was in strandline vegetation at G26572756 (Warren Way sampling point 24) by a shallow tidal pool. The third sampling point was in saltmarsh at G26622660 (Warren Way sampling point 25). The fourth and final sampling point was found in an area of scattered scrub at G26692641 (Warren Way sampling point 26).

Figure 47. Warren Way sampling point 23.

At the first location the main technique involved searching under stones and litter on the upper rocky shore. There was a small tufa spring discharging from the estuary bank (Denyer, 2021). Three species of Mollusca were recorded - Large black slug (*Arion ater ater*), Hedgehog slug (*Arion intermedius*) and Laver spire shell (*Peringia ulvae*) (family Hydrobiidae). The woodlouse *Philoscia affinis* (family Philosciidae) and Common pygmy woodlouse (*Trichoniscus pusillus agg.*) (family Trichoniscidae) were also found at this location.

Figure 48. Warren Way sampling point 24.

The second area searched was in strandline vegetation at G26572756 and surveying consisted of searching under stones by a shallow tidal pool. This pool had been identified from aerial imagery as potential habitat for the mud snail (*Hydrobia acuta neglecta*). The ground beetle *Dicheirotrichus gustavii* (family Carabidae), the rove beetle *Quedius fuliginosus* (family Staphylinidae), the centipede *Strigamia maritima* (family Linotaeniidae) and the woodlouse *Ligia oceanica* (family Ligiidae) were all recorded here.

Figure 49. Warren Way sampling point 25.

The third area searched was in litter, grass and saltmarsh banks at G26622660, with evidence of a seepage (Denyer, 2021). Two snail species were recorded *Peringia ulvae* (family Hydrobiidae) and *Succinea putris* (Succineidae). The leaf beetle *Chrysolina banks*i (family Chrysomelidae), the water scavenger beetles *Helophorus aequalis*, *Helophorus brevipalpis* and *Helophorus grandis* (all family Helophoridae), the predaceous diving beetle *Hydroporus erythrocephalus (*family Dytiscidae), the rove beetles *Stenus juno* and *Thinobaena vestita* (both family Staphylinidae).

Figure 50. Warren Way sampling point 26.

The final site searched consisted mainly of moss and wet litter underneath a willow tree with a small river nearby. There was evidence of the cascade tufa formation in the wet woodland (Denyer, 2021). Seven species of Mollusca were recorded from this location: Southern garden slug (*Arion hortensis*), Inishowen slug (*Arion owenii*) (both family Arionidae), Silky snail (*Ashfordia granulata*) (family Hygromiidae), Red-crusted pea mussel (*Euglesa personata*) (family Sphaeriidae), Rayed glass snail (*Nesovitrea hammonis*), Cellar snail (*Oxychilus cellarius*) (family Oxychilidae) and New Zealand mud snail (*Potamopyrgus antipodarum*) (family Tateidae).

Fifteen species of beetle were recorded at this site; the leaf beetle *Chrysolina banksi* (family Chrysomelidae), the ground beetles *Agonum thoreyi*, *Leistus rufomarginatus* (both family Carabidae), the predaceous diving beetle *Ilybius fuliginosus* (family Dytiscidae), the water scavenger beetles *Anacaena globulus*, *Cercyon melanocephalus* (both family Hydrophilidae), the rove beetles *Bryaxis bulbifer*, *Dianous coerulescens*, *Lesteva sicula ssp. Heeri*, *Omalium rugatum*, *Stenus bimaculatus*, *Stenus brunnipes*, *Stenus nanus*, *Stenus nitidiusculus* and *Stenus similis* (all family Staphylinidae). The pill millipede *Glomeris marginata* (family Glomeridae), the millipedes *Cylindroiulus britannicus*, *Ophyiulus germanicus*, *Ophyiulus pilosus* (all family Julidae), Two-spotted water hog-louse (*Asellus aquaticus*) (family Asellidae), the freshwater shrimp *Gammarus duebeni* (family Gammaridae), Common shiny woodlouse (*Oniscus asellus*) (family Oniscidae), Common pygmy woodlouse (*Trichoniscus pusillus* agg.) (family Trichoniscidae) and Large yellow underwing (*Noctua pronuba*) caterpillar (family Noctuidae) were also found at this location by searching through moss and other wet vegetation. The Gossamer hoverfly (*Baccha elongata*) (family Syrphidae) was recorded flying in a woodland clearing.

Figure 51. Warren Way sampling point 26.

Although the target snail species were not recorded, conditions at Warren Way sampling point 24 appeared to be suitable for the mud snail (*Hydrobia acuta neglecta*). There is an opening in the estuary bank that allows an influx of salt water into the pool. Care should be taken to ensure that this situation isn't changed. If the mud snail is found nearby this site could be used to increase distribution. Although this sampling point is at risk from run off and nutrient enrichment with improved agricultural grassland nearby, this does not appear to be an issue at present.

Figure 52. Area searched at Northern Killanley.

4.10 Northern Killanley

Northern Killanley was visited on 21st October with conditions being cloudy and cool. The area consists of marshy lowland grassland and a small pool by the estuary. One sampling point was surveyed at G26082521 (Northern Killanley sampling point 27), made up of a marshy meadow with Iris litter. Most of the species were recorded by searching through the Iris litter grass and moss in this area. Six species of Mollusca were found in this way: Herald snail (*Carychium minimum*) (family Ellobiidae), Common door snail (*Clausilia bidentata*) (family Clausiliidae), Moss snail (*Cochlicopa lubrica*) (family Cochlicopidae), Rayed glass snail (*Nesovitrea hammonis*) (family Gastrodontidae), Dwarf snail (*Punctum pygmaeum*) (family Punctidae) and Common whorl snail (*Vertigo pygmaea*) (family Vertiginidae). The ground beetles *Pterostichus strenuus*, *Pterostichus vernalis* (both family Caribidae), rove beetles *Cordalia obscura, Reichenbachia juncorum*, *Myllaena brevicornis*, *Mocyta amplicollis*, *Lesteva sicula ssp. Heeri*, *Sepedophilus nigripennis*, *Tachyporus dispar* (all family Staphylinidae), the water scavenger beetles *Helophorus brevipalpis* and *Helophorus obscurus* (both family Helophoridae) were all recorded in the same way.

Figure 53. Sampling point Northern Killanley 27.

Several species were also recorded underneath a log in the pasture: Durham slug (*Arion flagellus*) (family Arionidae), Grey field slug (*Deroceras reticulatum*) (family Agriolimacidae), the ground beetles *Agonum fuliginosum*, *Bembidion lampros*, *Paradromius linearis* (all family Carabidae) and Common rough woodlouse (*Porcellio scaber*) (family Porcellionidae).

Figure 54. Improved agricultural grassland above survey area.

Although the target snail species was not recorded, conditions at Northern Killanley appeared to be suitable for Narrow-mouthed whorl snail (*Vertigo angustior*). This site is surrounded by improved agricultural grassland, making it particularly at risk from runoff and nutrient enrichment. Vegetation appeared to be well-structured at the time of surveying, however overgrazing and trampling from cattle was evident in patches.

Figure 55. Marshy Iris grassland

4.11 Rathmurphy

Rathmurphy was visited on 22nd October with conditions being cloudy, cool and wet. The area surveyed consisted of iris beds and marshy grassland near the estuary at G26112426 (sampling point Rathmurphy 28). Four species of snail were recorded from this site - Common door snail (*Clausilia bidentata*) (family Clausiliidae), Rayed glass snail (*Nesovitrea hammonis*) (family Gastrodontidae), Large amber snail (*Succinea putris*) (family Succineidae) and Strawberry snail (*Trochulus striolatus*) (family Hygromiidae).

Figure 56. Area searched at Rathmurphy.

Eleven species of beetle were recorded from this site: the ground beetles *Agonum fuliginosum*, *A. nigrum*, *Bembidion mannerheimii* (all family Carabidae), the rove beetles *Anthobium unicolor*, *Quedius semiobscurus*, *Stenus impressus*, *S. nanus*, *S. nitidiusculus* (all family Staphylinidae), Iris flea beetle (*Aphthona nonstriata*)

(family Chrysomelidae), Red marsh ladybird (*Coccidula rufa*) (family Coccinellidae) and White clover seed weevil (*Protapion fulvipes*) (family Curculionidae). Two species of millipede were also found here: *Cylindroiulus latestriatus* and *Ophyiulus germanicus* (both family Julidae).

Although the target snail species was not recorded, conditions at Rathmurphy appeared to be suitable for Narrow-mouthed whorl snail (*Vertigo angustior*). At the time of surveying the strandline was relatively close to the stone wall making the zone of suitable habitat narrow. The site at Rathmurphy is beside an area of improved agricultural grassland which makes this site vulnerable to run off and enrichment. Some vegetation was rank and overgrown, and the grassland could benefit from some light grazing. However, given the small size of the Rathmurphy site it may be difficult to establish the appropriate grazing levels. Of particular interest is *Agonum nigrum*, a species provisionally classified as Endangered (EN) in the Irish Red Data list that is in preparation.

5. Results

Despite significant time searching in the field, none of the three target species were recorded in 2022 - Narrow-mouthed whorl snail (*Vertigo angustior*), Geyer's whorl snail (*V. geyeri*) and the mud snail (*Hydrobia acuta neglecta*). Most of the sites surveyed were found to be unsuitable for these species. Although the presence of tufa in the form of petrifying streams can be an indication of good quality freshwater and base rich habitats, it is not a guarantee of habitat suitable for the Vertigo target species. Both of these snails prefer unshaded conditions and several of the 2022 survey sampling points were covered either fully or partially by scrub and trees. Geyer's whorl snail (*V. geyeri*) is usually associated with mossy vegetation in relict base-rich flushes, with no excessive trampling or disturbance (Anderson, 2016b). Most of the sampling points during this survey had some level of disturbance, for example through land use changes such as housing development, garden encroachment and agricultural intensification, as well as through trampling from walkers, cattle and sheep grazing. Narrow-mouthed whorl snail (*V. angustior*) is associated with vegetation that has flowing groundwater and high, stable humidity (Anderson, 2016a). Several of the sites appeared to have suitable habitat for Narrow-mouthed whorl snail (*V. angustior*) though this varied in quality and extent.

Bartragh Island and Castle Magee Dunes were found to be the most diverse in terms of snail species recorded. Of the three Vertigo species that were recorded in 2022, Common whorl snail (*V. pygmaea*) was found to be the most widely distributed while Marsh whorl snail (*V. antivertigo*) was found to be the most restricted.

Spire snail (*Ecrobia ventrosa*) (family Hydrobiidae) was recorded from Belleek woods and Quay House. Silky snail (*Ashfordia granulata*) (family Hygromiidae) was recorded from Belleek Woods, Quay House and Warren walk. Heath snail (*Helicella itala*) (family Geomitridae) was recorded from Ross Point, Enniscrone Beach and Enniscrone Dunes. English chrysalis snail (*Leiostyla anglica*) was recorded from Bartragh Island and Quay House.

In terms of beetle species recorded, rove beetles (family Staphylinidae) were found to be the most diverse followed by ground beetles (family Carabidae), and then weevils (family Curculionidae). Results from the 2022 surveys can be found in the following pages in Table 3, Table 4, Chart 1, Chart 2 and Chart 3. Photographs from the surveys can be found in Appendix 1, a full species list can be found in Appendix 2 and maps with species distributions can be found in Appendix 3.

	Snails and slugs (Mollusca)										
	SITE										
SPECIES	BI	BW	CMD	EB	ED	L	NK	QH	R	RP	WW
Aegopinella pura											
Arion ater ater											
Arion ater rufus											
Arion flagellus											
Arion intermedius											
Arion owenii											
Arion subfuscus											
Ambigolimax valentianus											
Ampullaceana balthica											
Ashfordia granulata											
Bathyomphalus contortus											
Bithynia tentaculata											
Candidula intersecta											
Carychium minimum											
Cepaea nemoralis											
Cernuella virgata											
Clausilia bidentata											
Cochlicopa lubrica											
Cochlicopa lubricella											
Columella edentula											
Cornu aspersum											
Deroceras reticulatum											
Ecrobia ventrosa											
Euconulus alderi											
Euconulus fulvus fulvus											
Helicella itala											
Lauria cylindracea											
Lehmannia marginata											
Leiostyla anglica											

	Snails and slugs (Mollusca)										
	SITE										
SPECIES	BI	BW	CMD	EB	ED	L	NK	QH	R	RP	WW
Limacus maculatus											
Myosotella myosotis											
Nesovitrea hammonis											
Oxychilus alliarius											
Oxychilus cellarius											
Oxychilus draparnaudi											
Oxyloma elegans											
Peringia ulvae											
Potamopyrgus antipodarum											
Punctum pygmaeum											
Pyramidula umbilicata											
Succinea putris											
Trochulus hispidus											
Trochulus striolatus											
Vertigo antivertigo											
Vertigo pygmaea											
Vertigo substriata											
Vitrea contracta											

Table 3. Mollusca collected during the survey, by site. Sections with darker shading indicate endangered, vulnerable or near threatened species.

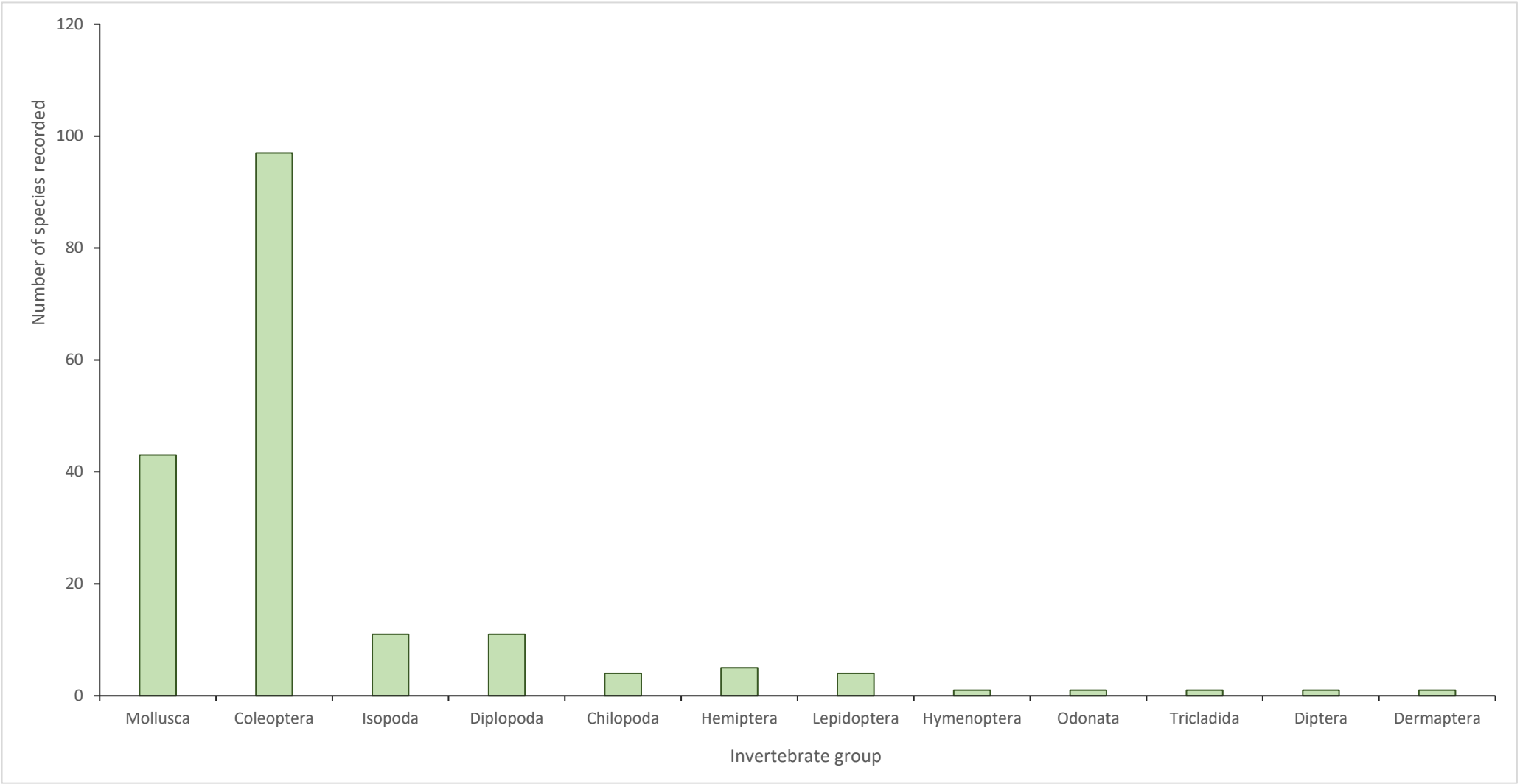

Chart 1. The number of species recorded per invertebrate group. Snails and slugs (Order Mollusca), Beetles (Order Coleoptera), Bugs (Order Hemiptera), Millepedes (Order Diplopoda), Woodlice and shrimps (Order Isopoda, Amphipoda), Centipedes (Order Chilopoda), Earwigs (Order Dermaptera), Flies (Order Diptera), Bees, wasps and ants (Order Hymenoptera), Dragonflies and damselflies (Order Odonata) and Flatworms (Order Tricladida).

			SPECIES						
SITE	SAMPLING POINT	GRID REF	Vertigo antivertigo	Vertigo pygmaea	Vertigo substriata	Leiostyla anglica	Ecrobia ventrosa	Ashfordia granulata	Helicella itala
BW	1	G25182072						SEVERAL	
	2	G25162211							
	3	G25372195					SEVERAL		
QH	4	G25782158				OCCASIONAL		SEVERAL	
	5	G25742158					FREQUENT	SEVERAL	
BI	6	G25262862	OCCASIONAL		FREQUENT	SEVERAL			
	7	G25262893	FREQUENT	SEVERAL	FREQUENT	SEVERAL			
	8	G25442896		SEVERAL	OCCASIONAL				
CMD	9	G21383363		OCCASIONAL	SEVERAL				
	10	G21613367							
	11	G21773364							
RP	12	G21423138		OCCASIONAL	FREQUENT				OCCASIONAL
	13	G21893189							
L	14	G25292611							
EB	15	G28392978							
	16	G27882961							FREQUENT
ED	17	G27552876							
	18	G27492872		OCCASIONAL					
	19	G27442856		SEVERAL					OCCASIONAL
	20	G27402859							
	21	G27052867		FREQUENT					OCCASIONAL
	22	G27252939		OCCASIONAL					
WW	23	G2657327219							
	24	G2661526604							
	25	G2661726548							
	26	G2669226413						OCCASIONAL	
NK	27	G2609124273		SEVERAL					
R	28	G2608125207							

Table 4. Endangered, vulnerable or near threatened species of Snails and slugs (Mollusca) collected during the survey, by sampling site. *Vertigo pygmaea* was found at the most sites and Bartragh Island was found to have the greatest variety of species.

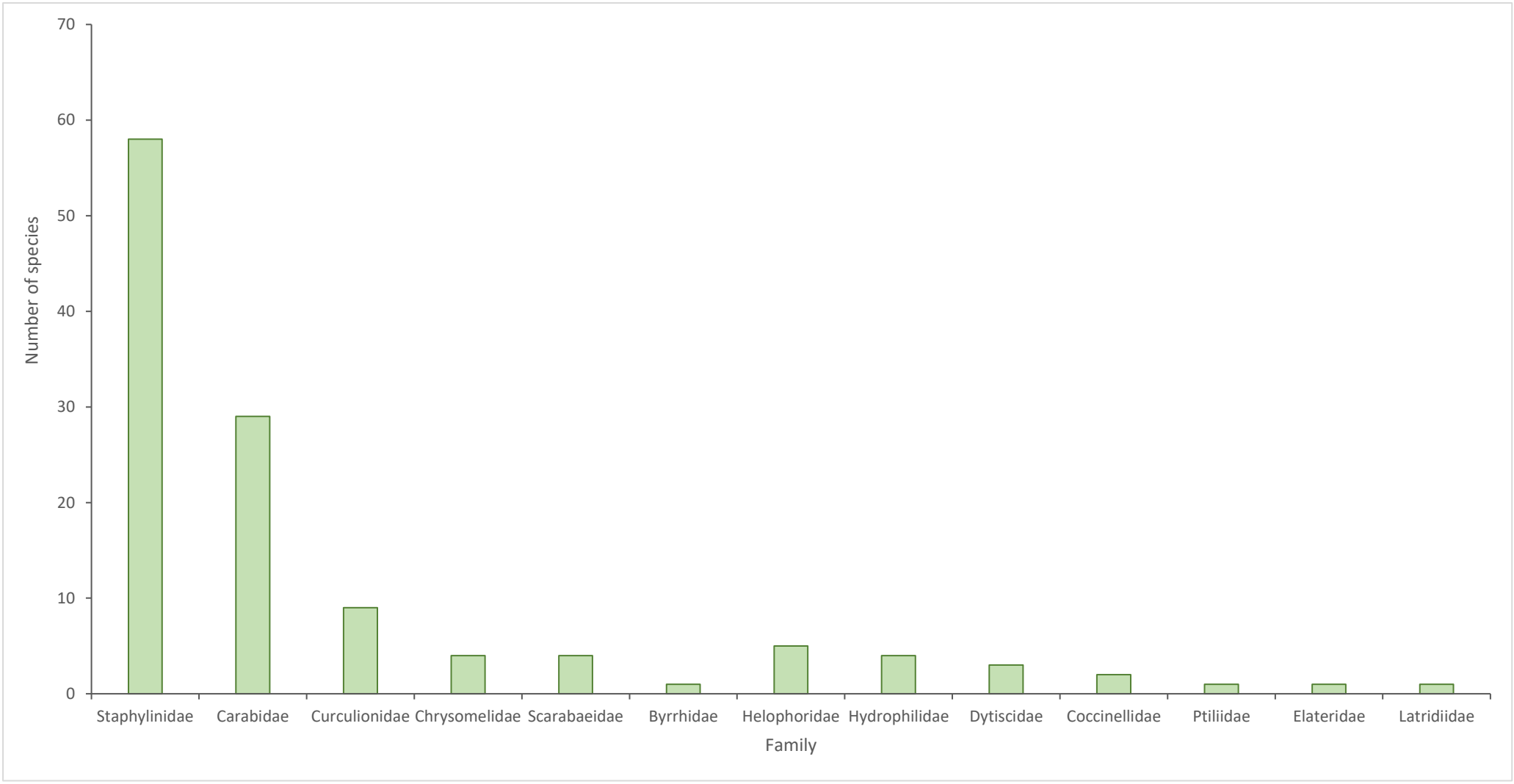

Chart 2. The number of Beetle species (Coleoptera) recorded per family group. Ground beetles (family Carabidae), Rove beetles (family Staphylinidae), Ladybirds (family Coccinellidae), Weevils (family Curculionidae), Leaf beetles (family Chrysomelidae), Dung beetles (family Scarabaeidae), Click beetles (family Elateridae), Predaceous diving beetles (family Dytiscidae), Pill beetles (family Byrrhidae), Water scavenger beetles (Helophoridae) and Minute scavenger beetles (family Latridiidae).

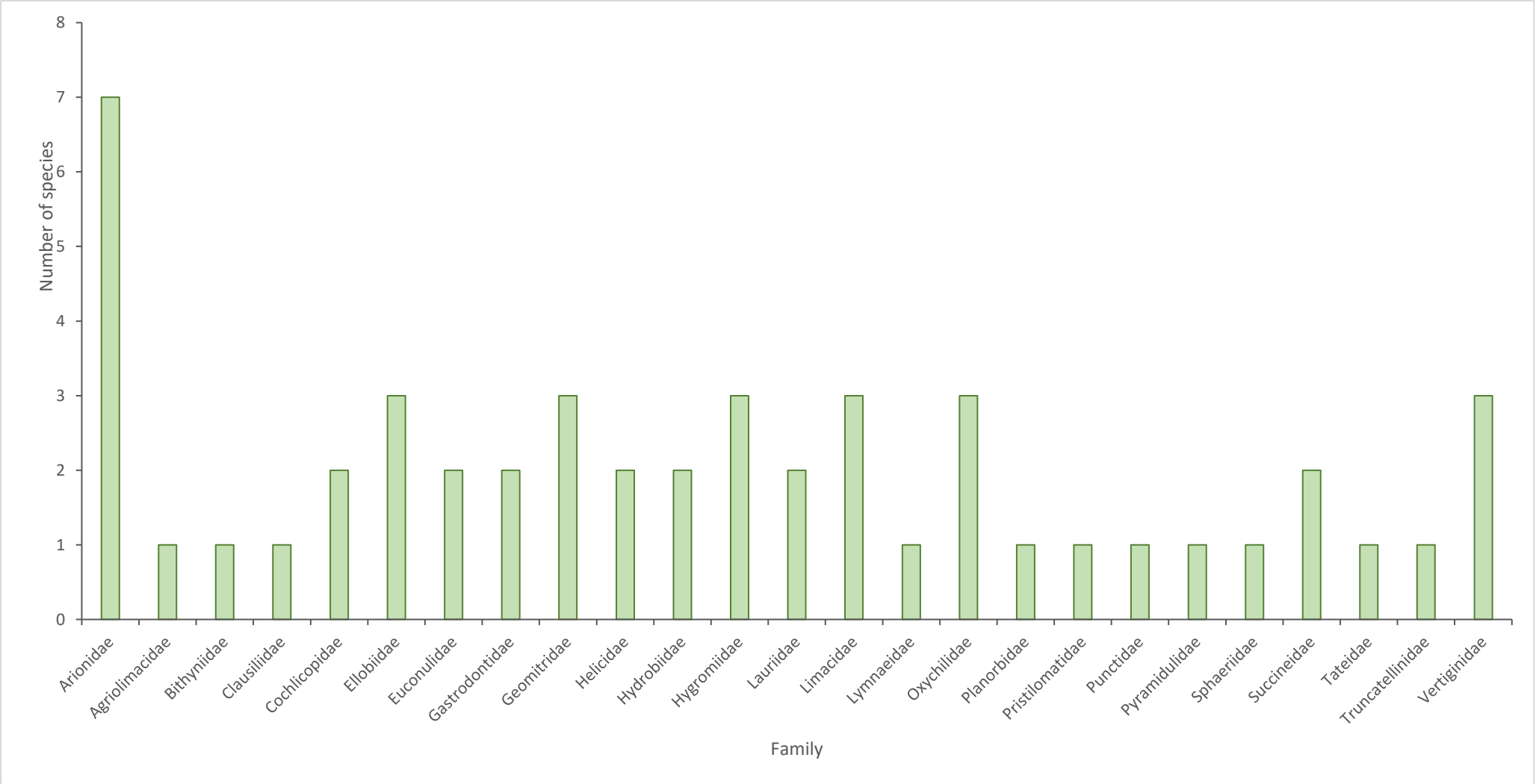

Chart 3. The number of Beetle species (Coleoptera) recorded per family group. Ground beetles (family Carabidae), Rove beetles (family Staphylinidae), Ladybirds (family Coccinellidae), Weevils (family Curculionidae), Leaf beetles (family Chrysomelidae), Dung beetles (family Scarabaeidae), Click beetles (family Elateridae), Predaceous diving beetles (family Dytiscidae), Pill beetles (family Byrrhidae), Water scavenger beetles (Helophoridae) and Minute scavenger beetles (family Latridiidae).

6. Other Species of Interest

The ground beetle *Trechus fulvus* (family Carabidae) was recorded from Enniscrone Dunes on 20th October by searching under driftwood and stones on the tide line at G26562876. This is a rare coastal species that is Red-listed as endangered (EN). It is mainly associated with shingle beaches but also can be found in dunes (Anderson and McFerran, 2001).

The ground beetle *Agonum nigrum* (family Carabidae) was recorded from Rathmurphy on 22nd October in marshy grassland near the estuary. This species is provisionally classified as Endangered (EN) in the Irish red data file in preparation G26112426. The ground beetle *Bembidion maritimum* (family Carabidae) was recorded under stones and rocks above the high tide mark of the estuary at G25742158 near Quay House on 20th September. This is a very local and uncommon estuarine beetle that is Red-listed as vulnerable (VU) (family Carabidae).

The rove beetle *Gabrius osseticus* (family Staphylinidae) was recorded in Enniscrone Dunes on 20th October from the saltmarsh/dune interface in a grass pile in mossy wet dunes at G27492872. This is a northern rove beetle, of local occurrence. The ground beetle *Leistus rufomarginatus* was recorded from Warren Way on 21st October in moss and wet litter underneath a willow tree. This species has been spreading across Europe and this is the first record for western Ireland. One *Omalium rugatum* a local and uncommon staphylinid beetle was recorded at Warren Way on 21st October in moss and wet litter under willow. The rove beetle *Dianous coerulescen* was also recorded from Warren Way at the same location. This is a northern species that is usually associated with waterfall moss.

Figure 57. Small white (*Pieris rapae*) (family Pieridae)

The woodlouse *Philoscia affinis* (family Philosciidae) was recorded from Enniscrone Dunes, Ross Point and Warren Way. This species is a recent addition to Irish fauna being discovered in Ireland in 2018. It is very local in Britain, through in Ireland appears to be more widespread in moderately damp places. The flatworm *Microplana terrestris* (family Geoplanidae) was recorded from Castle Magee Dunes on 21st September under fence poles by a dune lake at G21613367. This is a species of native terrestrial flatworm though it is unusual to be recorded from sand dunes.

The flea beetle *Psylliodes marcida* (family Chrysomelidae, Order Coleoptera) is a coastal species which feeds on sea rocket on strandlines. It was recorded from Castle Magee Dunes at G21143368 on 21st September and Enniscrone at G28332970 on 19th October. This species was found by beating Sea rocket (*Cakile maritima*) (family Brassicaceae) in the strandline. The landhopper *Arcitalitrus dorrieni* (family Talitridae, Order Amphipoda) was recorded from Belleek Woods and Quay House during the September survey period. In Belleek woods it was found in moss on the banks of a drainage ditch. At Quay House it was found under partly decorticate branch on lawn by stream. This is an invasive species from New Zealand, and this is the first record for Northwest Sligo.

Figure 58. Leaving Bartragh Island.

7. Habitat Management Issues & Recommendations

The transition zone between the marshy grassland and saltmarsh should be protected and excessive scrub encroachment should be prevented in this zone. The extent of this management issue appears to vary by site. For example, at Enniscrone Beach footfall from members of the public means that scrub encroachment is not a problem while at Ross Point vegetation has become rank in places. The latter could benefit from some light grazing.

One of the factors influencing the quality of the Narrow-mouthed whorl snail (*Vertigo angustior*) habitat at sites in Northern Ireland is the quality of freshwater flowing from seepages at the nearby cliffs. The ecological interest of these seepages depends on cold, unpolluted, and well-oxygenated water (Buglife, 2022b). Petrified tufa streams and seepages are vulnerable and threatened by land use practices and/or intensive farming. For example, fertiliser, slurry and herbicide application, physical modification of the seepage through damaging land management activities such as the installation of artificial drains, or lack of land management such as grazing (Buglife, 2022b). Managing grassland in the zone around the sampling points should be considered as a buffer reducing diffuse pollution from adjacent land.

There are large areas of flower-rich grassland in particular Devil's-bit scabious (*Succisa pratensis*) on Bartragh Island. This site could be important for other rare species such as Great Yellow bumblebee (*Bombus distinguendus*) (family Apidae), Northern colletes (Colletes floralis) (family Colletidae), Marsh fritillary (*Euphydryas aurinia*) (family Nymphalidae) etc. **It is recommended that targeted surveys take place at Bartragh Island on a wider range of invertebrate taxa including bees, wasps, butterflies and moths.**

Figure 59. Coastal cliff at Bartragh Island.

8. Conclusions

- Narrow-mouthed whorl snail (*Vertigo angustior*), Geyer's whorl snail (*V. geyeri*) and the mud snail (*Hydrobia acuta neglecta*) were not recorded in any of the 11 areas surveyed.
- Killanley Glebe remains the only known site for Narrow-mouthed whorl snail (V. angustior) within the SAC.
- Three of the more common species of Vertigo were recorded; Marsh whorl snail (*V. antivertigo*), Common whorl snail (*V. pygmaea*) and Striated whorl snail (*V. substriata*) (all family Vertiginidae).
- The best areas for these species are Bartragh Island, Ross Point and Castle Magee Dunes.
- Sampling points with damp ground conditions tended to have a greater chance of finding Vertigo snails.
- At drier sampling points conditions appeared to be sub-optimal and Vertigo species occur at lower densities.
- Enniscrone dunes had the greatest variety of invertebrate species recorded, followed by Bartragh Island and then Warren Way.
- Management should be site specific within the SAC.
- Where grazing is introduced, this should remain light at all times.

- The rare ground beetles *Trechus fulvus*, *Agonum nigrum* and *Bembidion maritimum* (all family Carabidae) were all recorded during the 2022 surveys.
- Site managers should prioritise the sensitive management of the tide line and upper shore.
- Consider targeted scrub removal at Belleek Woods, Quay House and Warren Way.
- Consider using Aerial imagery to monitor scrub encroachment in survey areas.
- Consider targeted surveys of Bartragh Island for a wider range of invertebrates.
- Consider using Aerial imagery to monitor scrub encroachment in survey areas.
- Consider targeted surveys of Bartragh Island.

Figure 60. Bartragh Island from Enniscrone Beach.

References

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Appendix 1: Photos

Figure 61. Deep mud in Belleek Wood.

Figure 62. Dry petrified stream.

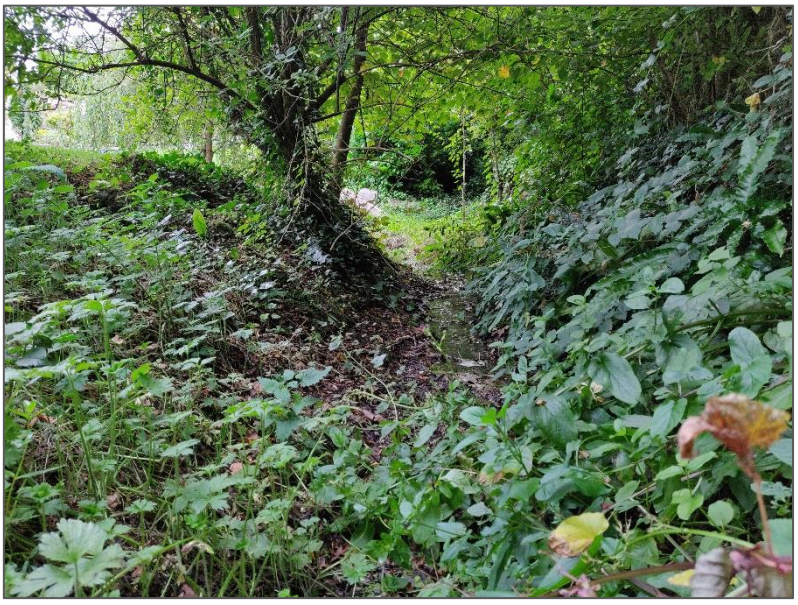


Figure 63. Belleek Wood sampling point 2.

Figure 64. Patches of shorter and taller vegetation at Enniscrone Dunes.

Figure 65. Mud bank at Enniscrone Dunes.

Figure 66. Warren Way sampling point 23.

Figure 67. Opening in estuary bank to tidal pool.

Figure 68. Surveying a shallow tidal pool.

Figure 69. Boulder on shore of estuary.

Figure 70. Iris and tall vegetation at Warren Way.

Figure 71. Warren Way sampling point 26.

Figure 72. Wet woodland at Warren Way.

Figure 73. A dune lake at Castle Magee Dunes.

Figure 74. Bartragh Island from Enniscrone Dunes.

Figure 75. Three vertigo species.

Appendix 2: Species list

Common name	Species	Family
Large black slug	*Arion ater ater*	Arionidae
Large red slug	*Arion ater rufus*	Arionidae
Durham slug	*Arion flagellus*	Arionidae
Southern garden slug	*Arion hortensis*	Arionidae
Hedgehog slug	*Arion intermedius*	Arionidae
Inishowen slug	*Arion owenii*	Arionidae
Dusky Slug	*Arion subfuscus*	Arionidae
Grey field slug	*Deroceras reticulatum*	Agriolimacidae
Common Bithynia	*Bithynia tentaculata*	Bithyniidae
Common door snail	*Clausilia bidentata*	Clausiliidae
Moss snail	*Cochlicopa lubrica*	Cochlicopidae
Lesser moss snail	*Cochlicopa lubricella*	Cochlicopidae
Herald snail	*Carychium minimum*	Ellobiidae
Estuarine mouse-eared snail	*Myosotella myosotis*	Ellobiidae
A snail	*Euconulus alderi*	Euconulidae
A snail	*Euconulus fulvus fulvus*	Euconulidae
Clear glass snail	*Aegopinella pura*	Gastrodontidae
Rayed glass snail	*Nesovitrea hammonis*	Gastrodontidae
Wrinkled snail	*Candidula intersecta*	Geomitridae
Striped snail	*Cernuella virgata*	Geomitridae
Heath snail	*Helicella itala*	Geomitridae
Brown-lipped snail	*Cepaea nemoralis*	Helicidae
Garden snail	*Cornu aspersum*	Helicidae
Spire snail	*Ecrobia ventrosa*	Hydrobiidae
Laver spire shell	*Peringia ulvae*	Hydrobiidae
Silky snail	*Ashfordia granulata*	Hygromiidae
Hairy snail	*Trochulus hispidus*	Hygromiidae
Strawberry snail	*Trochulus striolatus*	Hygromiidae
Common chrysalis snail	*Lauria cylindracea*	Lauriidae
English chrysalis snail	*Leiostyla anglica*	Lauriidae
Spanish slug	*Ambigolimax valentianus*	Limacidae
Tree slug	*Lehmannia marginata*	Limacidae
Irish yellow slug	*Limacus maculatus*	Limacidae
Wandering pond snail	*Ampullaceana balthica*	Lymnaeidae
Garlic snail	*Oxychilus alliarius*	Oxychilidae
Cellar snail	*Oxychilus cellarius*	Oxychilidae
Draparnaud	*Oxychilus draparnaudi*	Oxychilidae
Twisted ramshorn	*Bathyomphalus contortus*	Planorbidae
Milky crystal snail	*Vitrea contracta*	Pristilomatidae
Dwarf snail	*Punctum pygmaeum*	Punctidae
Rock snail	*Pyramidula umbilicata*	Pyramidulidae
Red-crusted pea mussel	*Euglesa personata*	Sphaeriidae
Pfeiffer's amber snail	*Oxyloma elegans*	Succineidae
Large amber snail	*Succinea putris*	Succineidae
New Zealand mud snail	*Potamopyrgus antipodarum*	Tateidae
Toothless chrysalis snail	*Columella edentula*	Truncatellinidae
Marsh whorl snail	*Vertigo antivertigo*	Vertiginidae
Common whorl snail	*Vertigo pygmaea*	Vertiginidae
Striated whorl snail	*Vertigo substriata*	Vertiginidae

Common name	Species	Family
A ground beetle	*Aepus marinus*	Carabidae
A ground beetle	*Agonum fuliginosum*	Carabidae
A ground beetle	*Agonum nigrum*	Carabidae
A ground beetle	*Agonum thoreyi*	Carabidae
A ground beetle	*Amara aenea*	Carabidae
A ground beetle	*Anchomenus dorsalis*	Carabidae
A ground beetle	*Bembidion bruxellense*	Carabidae
A ground beetle	*Bembidion lampros*	Carabidae
A ground beetle	*Bembidion mannerheimii*	Carabidae
A ground beetle	*Bembidion maritimum*	Carabidae
A ground beetle	*Broscus cephalotes*	Carabidae
A ground beetle	*Calathus cinctus*	Carabidae
A ground beetle	*Calathus mollis*	Carabidae
A ground beetle	*Carabus granulatus*	Carabidae
A ground beetle	*Curtonotus aulicus*	Carabidae
A ground beetle	*Dicheirotrichus gustavii*	Carabidae
A ground beetle	*Leistus fulvibarbis*	Carabidae
A ground beetle	*Leistus rufomarginatus*	Carabidae
A ground beetle	*Nebria brevicollis*	Carabidae
A ground beetle	*Nebria salina*	Carabidae
A ground beetle	*Paradromius linearis*	Carabidae
A ground beetle	*Philorhizus melanocephalus*	Carabidae
A ground beetle	*Philorhizus notatus*	Carabidae
A ground beetle	*Pterostichus madidus*	Carabidae
A ground beetle	*Pterostichus nigrita*	Carabidae
A ground beetle	*Pterostichus strenuus*	Carabidae
A ground beetle	*Pterostichus vernalis*	Carabidae
A ground beetle	*Trechus fulvus*	Carabidae
A ground beetle	*Trichocellus placidus*	Carabidae
A rove beetle	*Aleochara punctatella*	Staphylinidae
A rove beetle	*Anthobium unicolor*	Staphylinidae
A rove beetle	*Atheta castanoptera*	Staphylinidae
A rove beetle	*Boreophilia eremita*	Staphylinidae
A rove beetle	*Bryaxis bulbifer*	Staphylinidae
A rove beetle	*Cafius xantholoma*	Staphylinidae
A rove beetle	*Cordalia obscura*	Staphylinidae
A rove beetle	*Dianous coerulescens*	Staphylinidae
A rove beetle	*Falagria thoracica*	Staphylinidae
A rove beetle	*Gabrius osseticus*	Staphylinidae
A rove beetle	*Gyrohypnus angustatus*	Staphylinidae
A rove beetle	*Heterothops binotatus*	Staphylinidae
A rove beetle	*Lesteva punctata*	Staphylinidae
A rove beetle	*Lesteva sicula ssp. heeri*	Staphylinidae
A rove beetle	*Lithocharis nigriceps*	Staphylinidae
A rove beetle	*Metopsia retusa*	Staphylinidae
A rove beetle	*Mocyta amplicollis*	Staphylinidae
A rove beetle	*Mocyta orbata*	Staphylinidae
A rove beetle	*Myllaena brevicornis*	Staphylinidae
A rove beetle	*Nehemitropia lividipennis*	Staphylinidae
A rove beetle	*Ochthephilum fracticorne*	Staphylinidae
A rove beetle	*Ocypus olens*	Staphylinidae
A rove beetle	*Olophrum piceum*	Staphylinidae

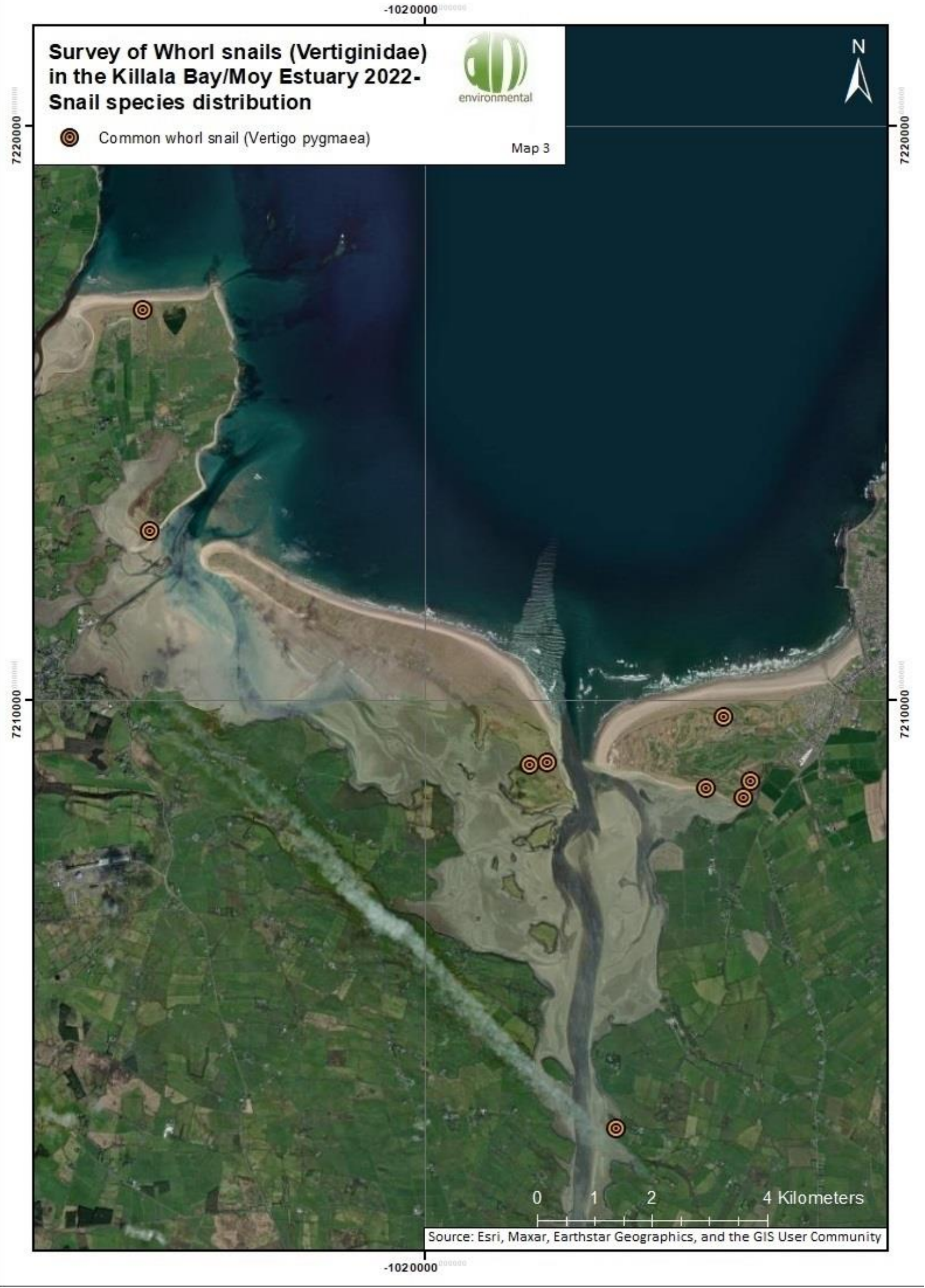
Common name	Species	Family
A rove beetle	*Omalium italicum*	Staphylinidae
A rove beetle	*Omalium laeviusculum*	Staphylinidae
A rove beetle	*Omalium rugatum*	Staphylinidae
A rove beetle	*Othius punctulatus*	Staphylinidae
A rove beetle	*Othius subuliformis*	Staphylinidae
A rove beetle	*Philonthus albipes*	Staphylinidae
A rove beetle	*Philonthus cognatus*	Staphylinidae
A rove beetle	*Platystethus arenarius*	Staphylinidae
A rove beetle	*Quedius fuliginosus*	Staphylinidae
A rove beetle	*Quedius schatzmayri*	Staphylinidae
A rove beetle	*Quedius semiaeneus*	Staphylinidae
A rove beetle	*Quedius semiobscurus*	Staphylinidae
A rove beetle	*Reichenbachia juncorum*	Staphylinidae
A rove beetle	*Rugilus erichsoni*	Staphylinidae
A rove beetle	*Rugilus rufipes*	Staphylinidae
A rove beetle	*Sepedophilus nigripennis*	Staphylinidae
A rove beetle	*Stenus bimaculatus*	Staphylinidae
A rove beetle	*Stenus brunnipes*	Staphylinidae
A rove beetle	*Stenus canaliculatus*	Staphylinidae
A rove beetle	*Stenus clavicornis*	Staphylinidae
A rove beetle	*Stenus fulvicornis*	Staphylinidae
A rove beetle	*Stenus impressus*	Staphylinidae
A rove beetle	*Stenus juno*	Staphylinidae
A rove beetle	*Stenus nanus*	Staphylinidae
A rove beetle	*Stenus nitidiusculus*	Staphylinidae
A rove beetle	*Stenus ossium*	Staphylinidae
A rove beetle	*Stenus similis*	Staphylinidae
A rove beetle	*Stenus tarsalis*	Staphylinidae
A rove beetle	*Tachyporus atriceps*	Staphylinidae
A rove beetle	*Tachyporus chrysomelinus*	Staphylinidae
A rove beetle	*Tachyporus dispar*	Staphylinidae
A rove beetle	*Tachyporus nitidulus*	Staphylinidae
A rove beetle	*Tasgius ater*	Staphylinidae
A rove beetle	*Thinobaena vestita*	Staphylinidae
A rove beetle	*Xantholinus linearis*	Staphylinidae
Clover leaf weevil	*Hypera punctata*	Curculionidae
A weevil	*Ischnopterapion modestum*	Curculionidae
Black Marram Weevil	*Otiorhynchus atroapterus*	Curculionidae
A weevil	*Otiorhynchus ovatus*	Curculionidae
White clover seed weevil	*Protapion fulvipes*	Curculionidae
Clover-root weevil	*Sitona hispidulus*	Curculionidae
A weevil	*Sitona griseus*	Curculionidae
A weevil	*Sitona lineellus*	Curculionidae
A weevil	*Sitona sulcifrons*	Curculionidae
Iris flea beetle	*Aphthona nonstriata*	Chrysomelidae
A leaf beetle	*Chrysolina banksi*	Chrysomelidae
Watercress beetle	*Phaedon cochleariae*	Chrysomelidae
A leaf beetle	*Psylliodes marcida*	Chrysomelidae
A dune scarab beetle	*Aegialia arenaria*	Scarabaeidae
A dung beetle	*Aphodius depressus*	Scarabaeidae
A dung beetle	*Aphodius rufipes*	Scarabaeidae
Brown chafer	*Serica brunnea*	Scarabaeidae

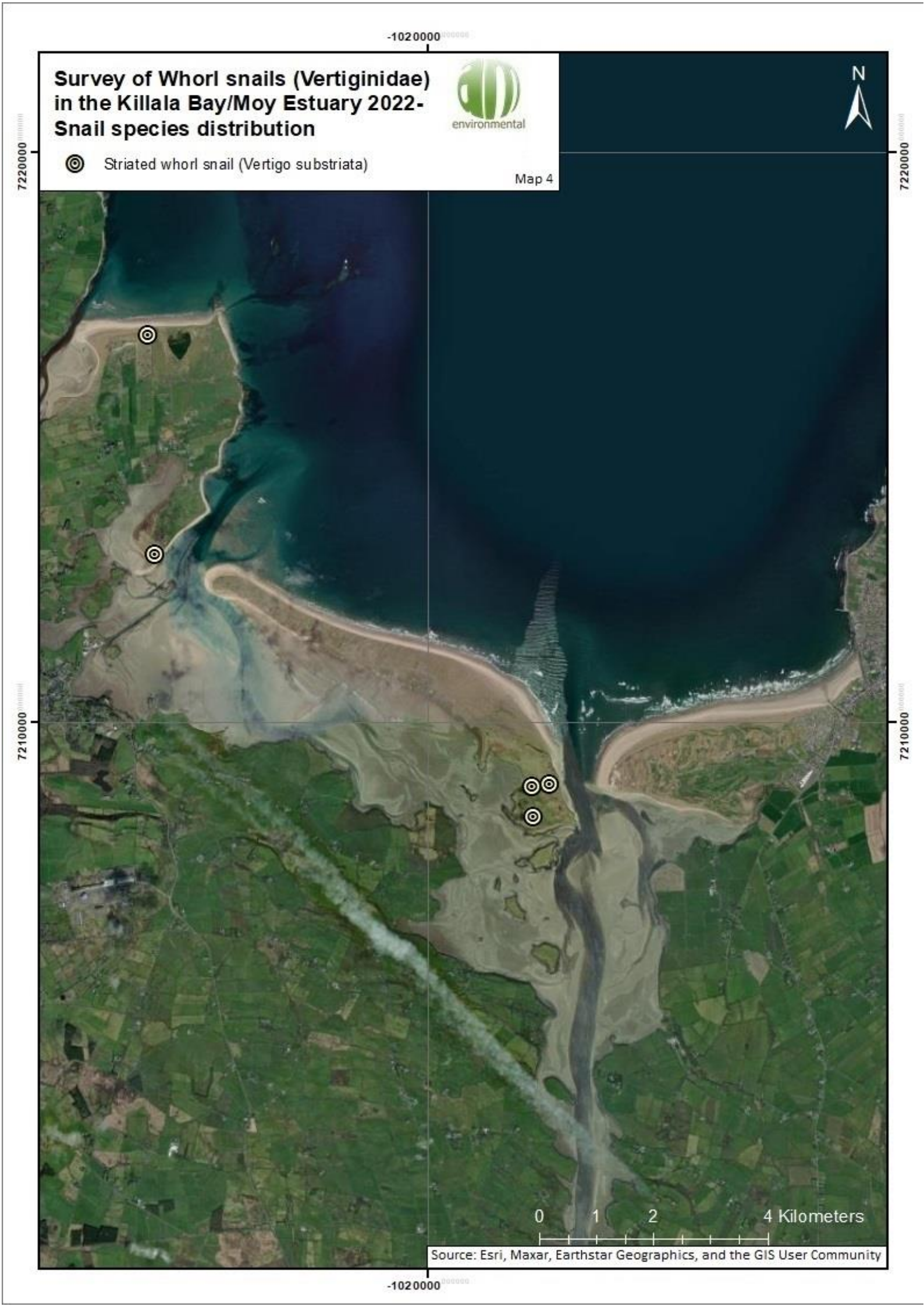
Common name	Species	Family
A pill beetle	*Cytilus sericeus*	Byrrhidae
A water scavenger beetle	*Helophorus aequalis*	Helophoridae
A water scavenger beetle	*Helophorus brevipalpis*	Helophoridae
A water scavenger beetle	*Helophorus grandis*	Helophoridae
A water scavenger beetle	*Helophorus minutus*	Helophoridae
A water scavenger beetle	*Helophorus obscurus*	Helophoridae
A water scavenger beetle	*Anacaena globulus*	Hydrophilidae
A water scavenger beetle	*Cercyon littoralis*	Hydrophilidae
A water scavenger beetle	*Cercyon melanocephalus*	Hydrophilidae
A water scavenger beetle	*Megasternum obscurum*	Hydrophilidae
Predaceous diving beetle	*Agabus biguttatus*	Dytiscidae
Predaceous diving beetle	*Hydroporus erythrocephalus*	Dytiscidae
Predaceous diving beetle	*Ilybius fuliginosus*	Dytiscidae
Red marsh ladybird	*Coccidula rufa*	Coccinellidae
Red patched Nephus	*Nephus redtenbacheri*	Coccinellidae
A feather-winged beetle	*Ptenidium fuscicorne*	Ptiliidae
A click beetle	*Agriotes lineatus*	Elateridae
A minute brown scavenger beetle	*Corticaria impressa*	Latridiidae
Common pill bug	*Armadillidium vulgare*	Armadillidiidae
Two-spotted water hog-louse	*Asellus aquaticus*	Asellidae
A freshwater shrimp	*Gammarus duebeni*	Gammaridae
A pill millipede	*Glomeris marginata*	Glomeridae
Spotted snake millipede	*Blaniulus guttulatus*	Blaniulidae
A millipede	*Cylindroiulus britannicus*	Julidae
A millipede	*Cylindroiulus latestriatus*	Julidae
A millipede	*Cylindroiulus londinensis*	Julidae
A millipede	*Leptoiulus belgicus*	Julidae
A millipede	*Ophyiulus germanicus*	Julidae
A millipede	*Ophyiulus pilosus*	Julidae
White-legged snake millipede	*Tachypodoiulus niger*	Julidae
A millipede	*Nemasoma varicorne*	Nemasomatidae
Flat millipede	*Brachydesmus superus*	Polydesmidae
A millipede	*Polydesmus inconstans*	Polydesmidae
A centipede	*Strigamia maritima*	Linotaeniidae
A centipede	*Lithobius borealis*	Lithobiidae
A centipede	*Lithobius flavus*	Lithobiidae
Brown centipede	*Lithobius forficatus*	Lithobiidae
Common sea slater	*Ligia oceanica*	Ligiidae
Common shiny woodlouse	*Oniscus asellus*	Oniscidae
Common ditch shrimp	*Palaemon varians*	Palaemonidae
A woodlouse	*Philoscia affinis*	Philosciidae
Common striped woodlouse	*Philoscia muscorum*	Philosciidae
Common rough woodlouse	*Porcellio scaber*	Porcellionidae
Common pygmy woodlouse	*Trichoniscus pusillus agg.*	Trichoniscidae
A pygmy woodlouse	*Haplophthalmus mengii*	Trichoniscidae
A landhopper	*Arcitalitrus dorrieni*	Talitridae
Common earwig	*Forficula auricularia*	Forficulidae
Yellow-barred peat hoverfly	*Sericomyia silentis*	Syphidae
Gossamer hoverfly	*Baccha elongata*	Syphidae
An ant	*Myrmica ruginodis*	Formicidae
A water boatman	*Corixa affinis*	Corixidae
A water boatman	*Cymatia bonsdorffi*	Corixidae

Common name	Species	Family
A seed bug	*Cymus glandicolor*	Lygaeidae
A water cricket	*Velia caprai*	Veliidae
Common shorebug	*Saldula saltatoria*	Saldidae
Bright-line brown-eye	*Lacanobia oleracea*	Noctuidae
Small white	*Pieris rapae*	Pieridae
Silver y	*Autographa gamma*	Noctuidae
Large yellow underwing	*Noctua pronuba*	Noctuidae
Blue-tailed damselfly	*Ischnura elegans*	Coenagrionidae
A flatworm	*Microplana terrestris*	Geoplanidae

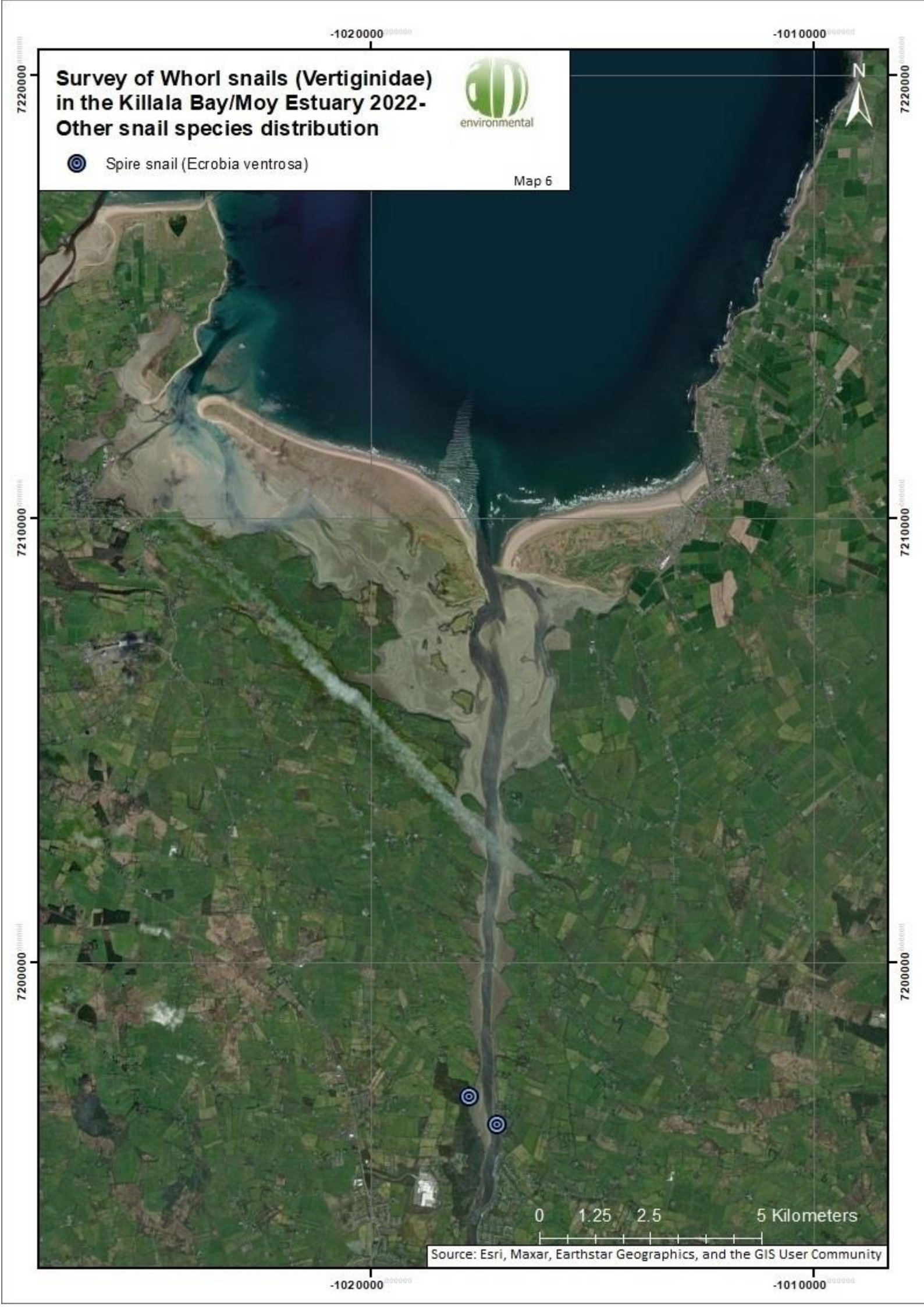
Appendix 3: Maps

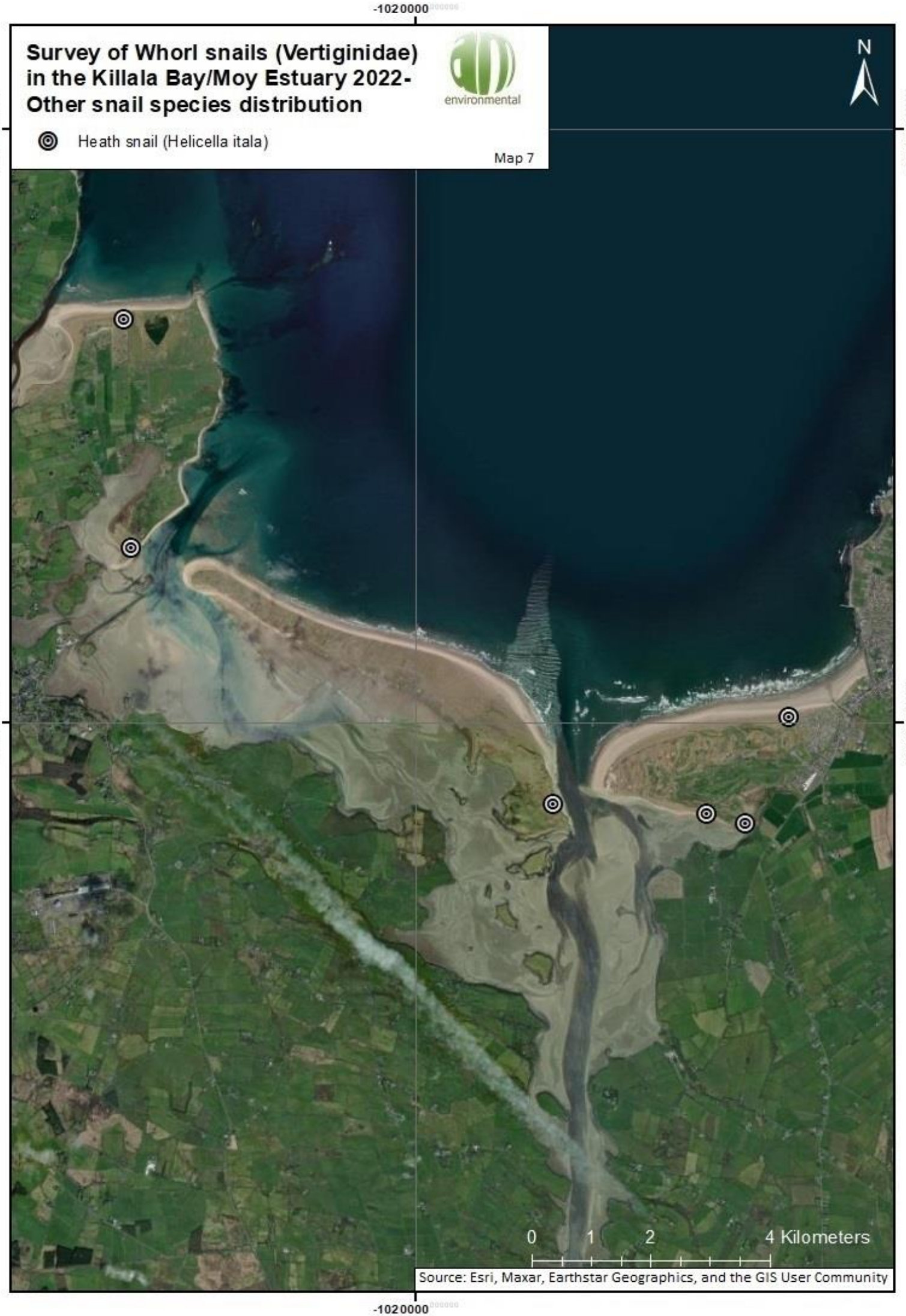

-1020000
7220000
7210000
Survey of Whorl snails (Vertiginidae) in the Killala Bay/Moy Estuary 2022- Snail species distribution
environmental
Marsh whorl snail (Vertigo antivertigo)
Map 2
N
0
1
2
4 Kilometers
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

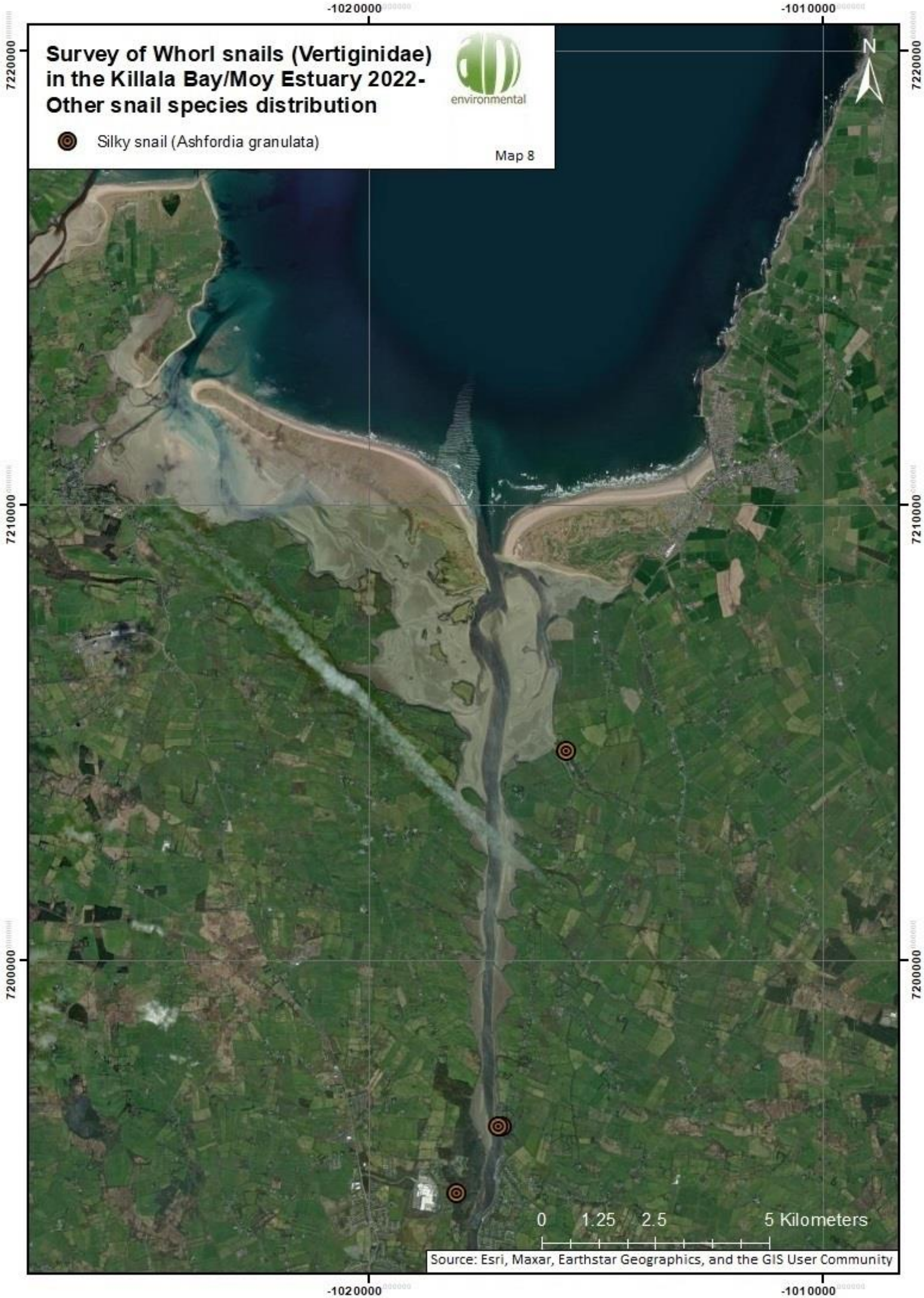

-1020000
Survey of Whorl snails (Vertiginidae) in the Killala Bay/Moy Estuary 2022- Snail species distribution
environmental
N
Common whorl snail (Vertigo pygmaea)
Map 3
7220000
7210000
0
1
2
4 Kilometers
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community


-1020000
Survey of Whorl snails (Vertiginidae) in the Killala Bay/Moy Estuary 2022- Snail species distribution
environmental
N
Striated whorl snail (Vertigo substriata)
Map 4
7220000
7210000
0
1
2
4 Kilometers
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community


Survey of Whorl snails (Vertiginidae) in the Killala Bay/Moy Estuary 2022- Snail species distribution
environmental
One species
Two species
Three species
Map 5
N
-1020000
7220000
7210000
0
1
2
4 Kilometers
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community


Survey of Whorl snails (Vertiginidae) in the Killala Bay/Moy Estuary 2022- Other snail species distribution
environmental
Spire snail (Ecrobia ventrosa)
Map 6
-1020000
-1010000
7220000
7210000
7200000
N
0 1.25 2.5 5 Kilometers
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community


Survey of Whorl snails (Vertiginidae) in the Killala Bay/Moy Estuary 2022- Other snail species distribution
environmental
Heath snail (Helicella itala)
Map 7
N
-1020000
7220000
7210000
0 1 2 4 Kilometers
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community


Survey of Whorl snails (Vertiginidae) in the Killala Bay/Moy Estuary 2022- Other snail species distribution
environmental
Silky snail (Ashfordia granulata)
Map 8
-1020000
-1010000
7220000
7210000
7200000
N
0 1.25 2.5 5 Kilometers
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community


Survey of Whorl snails (Vertiginidae) in the Killala Bay/Moy Estuary 2022- Other snail species distribution
environmental
English chrysalis snail (Leiostyla anglica)
Map 9
-1020000
-1010000
7220000
7210000
7200000
N
0 1.25 2.5 5 Kilometers
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community


Survey of Whorl snails (Vertiginidae) in the Killala Bay/Moy Estuary 2022- Distribution of other species
environmental
Ground beetle (Agonum nigrum)
Ground beetle (Bembidion maritimum)
Ground beetle (Trechus fulvus)
Map 10
N
-1020000
-1010000
7220000
7210000
7200000
0 1.25 2.5 5 Kilometers
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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