Glutinous Snail

(*Myxas glutinosa*)

Conservation Action Plan 2026-2032

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Cover image: *Myxas glutinosa* housed in an aquarium © Ian Hughes

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Introduction

The Glutinous snail *Myxas glutinosa* is a top conservation priority in the British Isles, as it is restricted to a single lake in Wales, despite having once been widely distributed across England, where it persisted until the 1990's. It remains widespread in parts of mainland Europe. Its decline and related threats are poorly understood but are believed to be connected to water quality and eutrophication. This conservation action plan will collate the current knowledge on the species, as well work collaboratively with a broad range of stakeholders to identify goals and actions to secure its future recovery.

Taxonomy

- Kingdom – Animalia
  - Phylum – Mollusca
    - Class – Gastropoda
      - Order – Hygrophila
        - Family – Lymnaeidae
          - Genus – *Myxas*
            - Species - *glutinosa*

M. glutinosa (Müller, 1774) is a small, pulmonate freshwater snail from the Lymnaeidae family. The species measures approximately 15 mm in dorsal-ventral height and 12 mm in transverse width, although it is noted to occur at much smaller sizes in Llyn Tegid, Wales (Willing *et al.*, 2014), possibly due to low calcium levels and/or wave action. *M. glutinosa* is characterised by a very thin, rounded shell with a relatively short, blunt, inconspicuous spire (Figure 1) (Mouthon & Vimpère, 2014; Willing *et al.*, 2014). The shell aperture is large and elliptical and does not possess an operculum. The mantle extensively covers the shell, leaving only the uppermost part of the shell exposed (Freshwater Habitats Trust, 2022; Conchological Society, 2024; Hughes, pers. comm., 2026).

Figure 1. A dorsal and ventral view of the shell of *Myxas glutinosa*. Francisco Welter Schultes, no known copyright restrictions (Public Domain).

Distribution

British Isles

The distribution of extant *M. glutinosa* within the British Isles is now thought to be restricted to a single location, Llyn Tegid, Wales, within Snowdonia National Park, which is a Site of Special Scientific Interest (SSSI). The species was first recorded there prior to 1852 and was regarded as numerous in the early 1950s (Whitfield *et al*., 1998). It was not recorded from 1960 onwards but was re-discovered in 1998 along approximately 75% of the lake shoreline (Willing & Holyoak, 1998). The lake itself is owned by the National Park Authority, while the shoreline is under multiple ownership, primarily by farmers. Historically, however, the species was relatively widespread (Figure 2), occurring at around 35-40 sites in England (Howe 2020) with the last English record from Oxfordshire in 1993. It has only ever been recorded at a single site in Wales and has never been documented in Scotland (Table 1).

In terms of the species distribution in Llyn Tegid, *Myxas glutinosa* is currently present at low densities at a number of locations around the lake perimeter. Surveying conducted in 2016 recorded largest numbers then at sites in south-east and north-west of the lake (Willing & Hughes 2017).

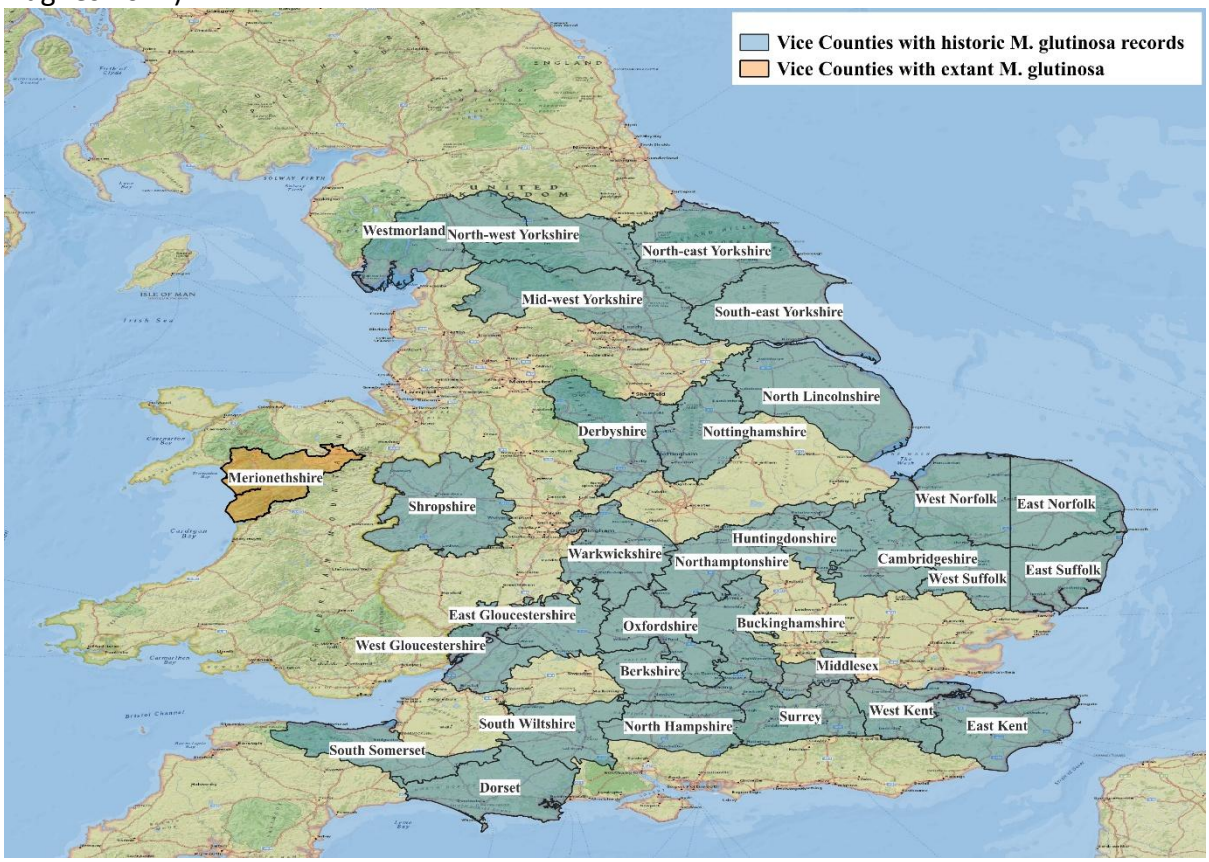

Figure 2. The historical county-based distribution of *Myxas glutinosa* throughout Britain previously occupied counties highlighted in blue, with the single extant population in Merionethshire highlighted in orange.

Table 1. A comprehensive overview of the historic distribution of *Myxas glutinosa* throughout Britain extracted from Whitfield *et al*. (1998).

County	Location	Date(s) of record
Somerset (VC5)	Dunster Castle	pre-1819
South Wiltshire (VC8)	Sailsbury	pre-1866
Dorset (VC9)	Chamberlaynes River	pre-1898
North Hampshire (VC12)	Basingstoke Canal	single shell 1969
East Kent (VC15)	Sittingbourne	pre-1885
	St Nicholas Marsh	1883
	Chislet Marshes	1930
	Deal	pre-1803 & 1910
	Sandwich	1874
	Minster	1883
	Minster Monkton	1915
Surrey (VC17)	Basingstoke Canal	1913
	Weybridge	1911
	Battersea Fields	pre-1836
Middlesex (VC21)	Stanmore	pre-1836
Berkshire (VC22)	Faringdon	pre-1885
	Reading	~1805,1885, & 1887
	South Hinksey	pre-1857
Oxfordshire (VC23)	Kennington Pit	1988
	Godstow	pre-1833
	Oxford	pre-1916
	Henley-on-thames	pre-1880
Buckinghamshire (VC24)	Eton	pre-1833
	Buckingham	pre-1885
	Taplow	pre-1885
East Suffolk (VC25)	Needham Market	1902
West Suffolk (VC26)	Mildenhall	Pre-1891
East Norfolk (VC27)	Cringleford	Pre-1858
	Colney	Pre-1889
	Heigham	Pre-1894
	Keswick	Pre-1872
	Norwich	1940
	Acle	1912
	Hellesdon	Pre-1894
West Norfolk (VC28)	Swaffham	Pre-1833
Cambridgeshire (VC29)	Whittlesey Mere	Pre-1833
Huntingdonshire (VC31)	Earith	1862
East/West Gloucestershire (VC33/VC34)	Chalford	1914
West Gloucestershire (VC34)	Stapleton	1875
Warwickshire (VC38)	Packington Park	1895
Merioneth (VC48)	Llyn Tegid	1852-present
North Lincolnshire (VC54)	Brigg	Pre-1913
	Saltfleetby	1894
	Tetney	1902, 1903, & 1907
Nottinghamshire (VC56)	Beeston Ryelands	Pre-1853
	Beeston Lock	Pre-1862
Derbyshire (VC57)	Sinfin Brook	Pre-1889
South-east Yorkshire (VC61)	Skidby	1889
North-east Yorkshire (VC62)	Scarborough	Pre-1866
Westmorland (VC69)	Windermere	Pre-1819, 1935, & 1957

	Rydal Water	Pre-1910	

Europe

M. glutinosa is a European species and is widespread (Figure 3) but rather local in northern Europe between the Alps and the Arctic Circle (Kerney, 1999). European populations have seen varying degrees of decline and owing to the rarity of the species throughout much of this range, the current known distribution throughout Europe is difficult to accurately ascertain. Table 2 highlights the known historic range of the species across mainland Europe and provides some reference to the dates in which surveys were conducted.

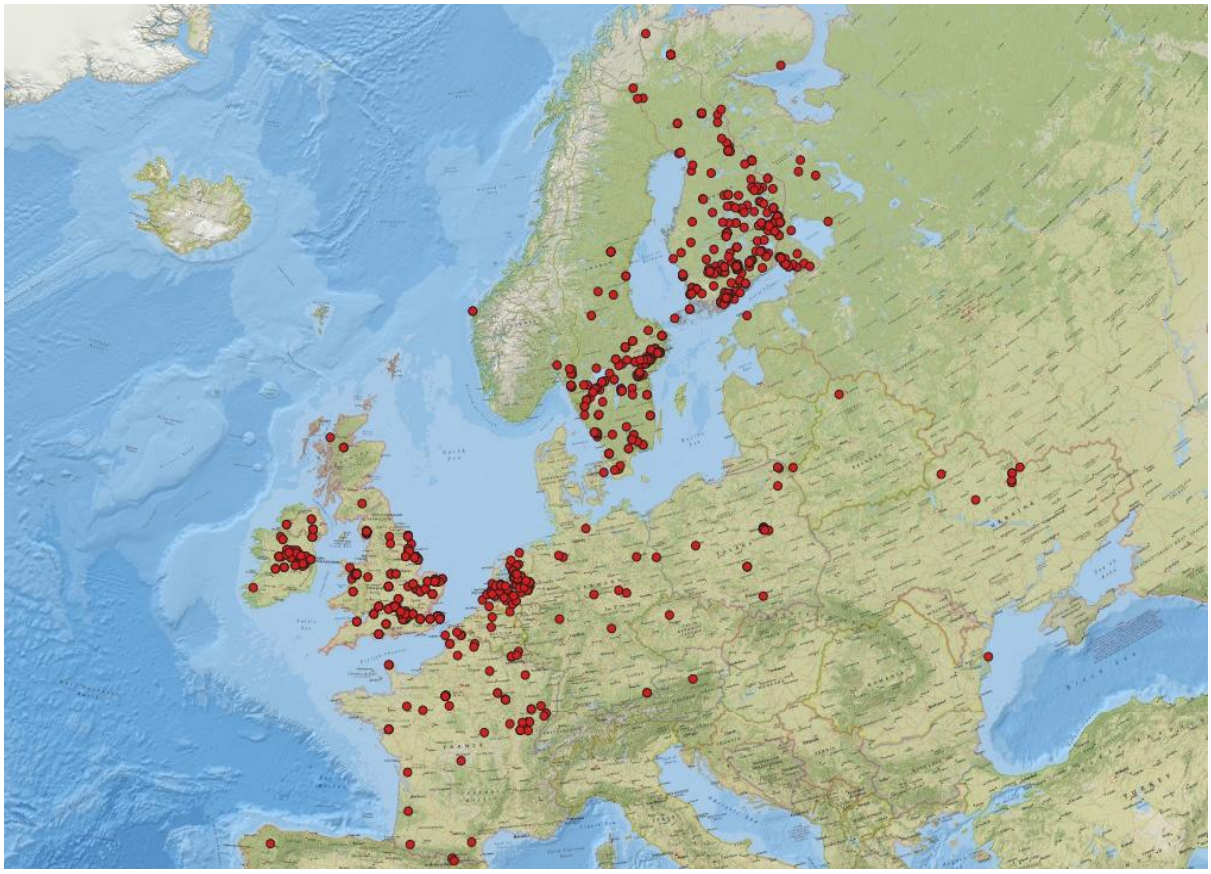

Figure 3. The European distribution of *Myxas glutinosa.* The information presented in this map uses GBIF records and includes several unsubstantiated reports of the species from several other locations in Wales, Northern Ireland, and Scotland.

Table 2. A comprehensive overview of the historic distribution of *Myxas glutinosa* throughout mainland Europe.

Country	Location	Date(s) of record (if stated).	Source
Austria	Tyrol		Wells & Chatfield (1992); Whitfield *et al*. (1998)
Belgium	Moyenne	1860-1977	Wells & Chatfield (1992); Whitfield *et al*. (1998)
	Basse-Belgique		Wells & Chatfield (1992); Whitfield *et al*. (1998)

	Haute-Belgique		Wells & Chatfield (1992); Whitfield *et al*. (1998)
	Flanders		Wells & Chatfield (1992); Whitfield *et al*. (1998)
	Namur		Wells & Chatfield (1992); Whitfield *et al*. (1998)
Denmark	Mid-Jutland		Wells & Chatfield (1992); Whitfield *et al*. (1998)
	Zeeland		Wells & Chatfield (1992); Whitfield *et al*. (1998)
	Falster		Wells & Chatfield (1992); Whitfield *et al*. (1998)
France	River Aube	1979,1987, 2022	Mouthon & Vimpère (2014); Bichain & Ryelandt (2023)
	River Eure	2015	Mouthon & Vimpère (2014); Cucherat & Philippe (2015)
	Côtes-d'armor	1971	Mouthon & Vimpère (2014)
	Finistère	1956, 1971	Mouthon & Vimpère (2014)
	Loire-Atlantique	1967	Mouthon & Vimpère (2014)
	Vendée	1988, 1990-1992	Mouthon & Vimpère (2014)
	Charente-Maritime	2001	Mouthon & Vimpère (2014)
	Haut-Pont Marsh	2022	Cucherat (2023)
	Condette Marsh	1838	Cucherat (2023)
	Bray River	1892	Cucherat (2023)
	Doigt River	1892	Cucherat (2023)
	Maye Canal	1892	Cucherat (2023)
	Canal de la Somme	1892	Cucherat (2023)
	Bray Marsh	1892	Cucherat (2023)
	Érondelle Marsh	1892	Cucherat (2023)
	Pont-Rémy Marsh	1892	Cucherat (2023)
	Avre	1883	Cucherat (2023)
	Longueau	1883	Cucherat (2023)
	Cagny	1883	Cucherat (2023)
	Boves	1883	Cucherat (2023)
	La Bartèque	1872	Cucherat (2023)
	Valenciennes	1872	Cucherat (2023)
	Douai	1872	Cucherat (2023)
	Landrecies	1872	Cucherat (2023)
	Lys River	1858-1932	Cucherat (2023)
	Sensée River	1858-1932	Cucherat (2023)
	Scheldt River	1858-1932	Cucherat (2023)
	Marne River	1869	Cucherat (2023)
Finland	Aland Islands	1996	Wells & Chatfield (1992); Whitfield *et al*. (1998); Carlsson (2000)
Germany	Schleswig-Holstein		Wells & Chatfield (1992); Whitfield *et al*. (1998)
	Bavaria	1947	Wells & Chatfield (1992)
	Baden-Wurttembergs		Wells & Chatfield (1992)
	Nordhein-Westfalen		Wells & Chatfield (1992)
	Eschefeld		Wells & Chatfield (1992)
Republic of Ireland	Grand Canal, Dublin.	1985, 2003, 2004	Wells & Chatfield (1992); Whitfield *et al*. (1998); Moorkens & Killeen (2005)

	Royal Canal, Dublin	2003, 2004	Wells & Chatfield (1992); Whitfield *et al*. (1998); Moorkens & Killeen (2005)
	Lough Sheelin, County Cavan	2003, 2004	Holyoak (2004, 2005)
	Lough Mask, County Mayo	2003, 2004	Holyoak (2004, 2005)
	Lough Cullin, County Mayo	2003, 2004	Holyoak (2004, 2005)
	Lough Mask, County Galway	2003, 2004	Holyoak (2004, 2005)
	Lough Corrib, County Galway	2004	Holyoak (2005)
	Lough Ree, County Roscommon	2004	Holyoak (2005)
	Newry Canal, County Down	1871	Pond Action (1992)
	Brusna, Kings Coutny	1871	Pond Action (1992)
	Bann River, County Armagh	1899, 1901	Pond Action (1992)
			Pond Action (1992)
Netherlands	Zwolle	1996	Wells & Chatfield (1992)
Norway	Three lakes found in the south-east (no further information given)		Wells & Chatfield (1992)
Poland	Niepolomice Forest	Pre-1970	Wells & Chatfield (1992); Whitfield *et al*. (1998);
	Modla		Wells & Chatfield (1992); Whitfield *et al*. (1998);
Russia	Kungur Town	1906-1963	Vinarski *et al*. (2013)
	Pechora River Basin	1905-1970	Vinarski *et al*. (2013)
	Tomsk City		Vinarski *et al*. (2013)
	Ob Basin	1971	Vinarski *et al*. (2013)
	Irtysh Basin	1955-1961	Vinarski *et al*. (2013)
	Novosibirsk Reservoir	1956-1961	Vinarski *et al*. (2013)
	Yenisei Basin		Vinarski *et al*. (2013)
	Kurejka River		Vinarski *et al*. (2013)
	Ulkendamy River	2002	Vinarski *et al*. (2013)
	Mochishche Lake	2006	Vinarski *et al*. (2013)
	Kulanutpes River	2012	Vinarski *et al*. (2013)
	Miass River	2009	Vinarski *et al*. (2013)
Sweden	Lake Ravarpen, Dalsland	1992	Wells & Chatfield, (1992); Whitfield *et al*. (1998)

Ecology

Habitat

In terms of the British Isles its sole remaining site is in Llyn Tegid (Figure 4), Wales's largest natural lake, which is an oligotrophic to mesotrophic glacial lake that sits at an altitude of 160 m and has a length of around 9 km, a width of around 2 km, and a depth of up to 42 m (Monteith *et al.*, 1997; Willing *et al.*, 2014). The lake is used by boats, anglers, and tourists, and there is a car park close to the shoreline. It has an extensive catchment which is predominantly agricultural, plus some natural forests. It is geologically varied, comprising of seasonally waterlogged non-alluvial soils to the south and west, peaty soils which are loamy and permeable along the south-eastern upland areas of the lake, and fine, well-drained, loamy soils along the lower-lying edges of the northern and southern shores (Monteith *et al.*,

1997). There are numerous sources that feed the lake, with the two key inflows being the Afon Twrch from the south and the Afon Lliw from the west. Llyn Tegid flows into the River Dee at the northern end of the lake (Monteith *et al.*, 1997). The Snowdonia National Park Rangers have responsibility for site management in relation to the lake itself, with private landowners controlling the shoreline.

A majority of the lake's shoreline is surrounded by marginal flora, of which *Phalaris arundinacea* and *Oenanthe crocata* are noted to be the dominant species (Monteith *et al*, 1997). The rocky littoral substrates are predominantly boulders, which, alongside wave action, aid in the prevention of sediments settling and subsequent plant growth (Monteith *et al*, 1997; Willing *et al*, 2014). Southern areas which are more sheltered, allowing for the deposition of silty substrata, support greater floral diversity, however, there are no records of *M. glutinosa* from this area of the lake (Monteith *et al*, 1997; Willing *et al*, 2014).

Within Llyn Tegid, *M. glutinosa* is known to inhabit a wide, shallow shelf around the margins of the littoral zone, living predominantly amongst stoney silt-free substrates, however, Ian Hughes (pers. comm., 2026) found Pentrepiod, which is relatively silty, to be one of the best spots for *M. glutinosa* surveys (Willing *et al.*, 2014; Natural Resources Wales, 2024). The Pentrepiod site has also been found to be the only location around the lake in which wood deposits and sinks naturally to create refugia for *M. glutinosa* (Hughes, pers. comm., 2026). *M. glutinosa* in Llyn Tegid has been found to show a preference for shallow water depths that range from 0.1 m – 2.7 m, with the majority of records occurring around 0.1 m – 0.5 m

Figure 4. Llyn Tegid, Wales, where the UK's last remaining population of *Myxas glutinosa* inhabits (Hughes, 2024).

(Hughes, pers. comm., 2025). Surveys carried out by divers in 1999 recorded *Myxas* at a maximum depth of 3.5m, equating to 1.95m below 'lake sill level' (Willing et al 2014). The depth in which the snails are found is also noted to vary with the fluctuations in the lake's water level (Willing *et al*, 2014). Records indicate that *M. glutinosa* is found to reside almost exclusively underneath areas of refuge, such as cobbles (displaying a preference for cobbles of around 20 cm (Hughes, pers. comm., 2025)), boulders, intentionally created refugia, and occasional debris that wash up along the strandline such as drift wood, old footwear, and car tyres (Willing *et al*, 2014).

Available records from the rest of the British Isles and Europe indicate that the species occupies a much broader range of habitats (Figures 5-7), with ditches, canals and ponds being the habitats where most records have been taken from. Surprisingly these records show less preference for clear, silt-free environments and occurring in areas with abundant vegetation and even in slightly polluted or slightly saline (<3ppt) conditions (Carlsson, 2000; Whitfield *et al.*, 1998; Vinarski *et al.*, 2013; Willing *et al.*, 2014). The literature also suggests a degree of association between *M. glutinosa* and the floating Waterlily (*Nuphar lutea*), as it has been observed at multiple locations across the UK, Europe, and Siberia, inhabiting the undersides of leaves within meadows that are dominated by water plants (Pond Action, 1992; Carlsson, 2000; Vinarski *et al.*, 2013; Cucherat & Philippe, 2015; Cucherat, 2023). These findings suggest that the species can display some degree of habitat flexibility under suitable low-disturbance conditions (Bichain & Ryelandt, 2023).

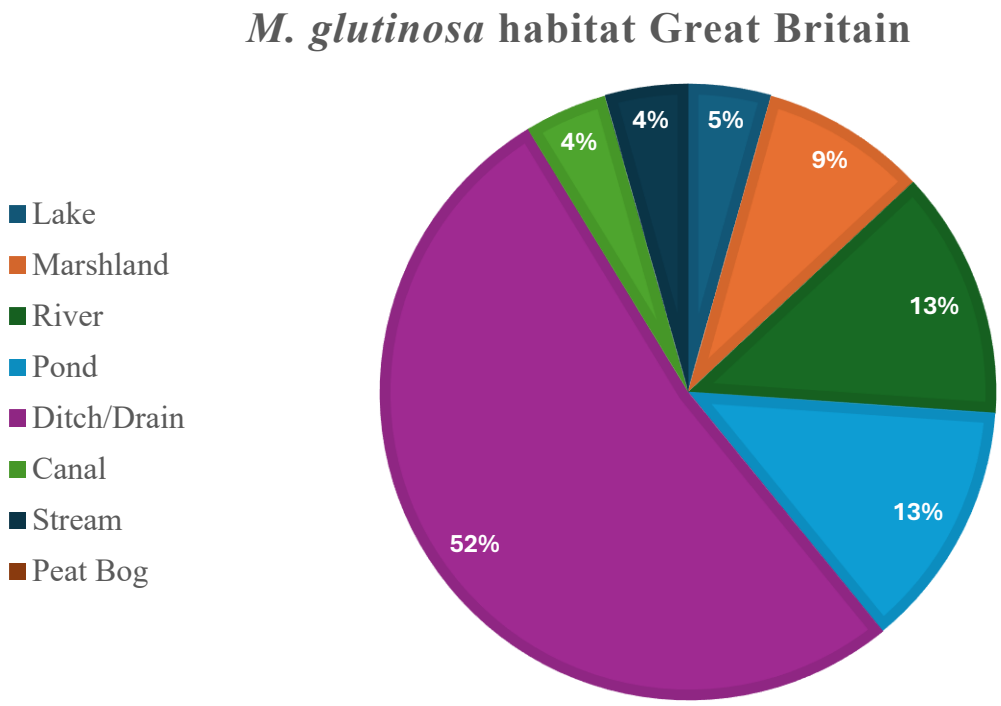

Figure 5. An overview of the habitat preference (in percentage) of *Myxas glutinosa* throughout all the historical records within Great Britain (Pond Action, 1992; Whitfield *et al*,1998).

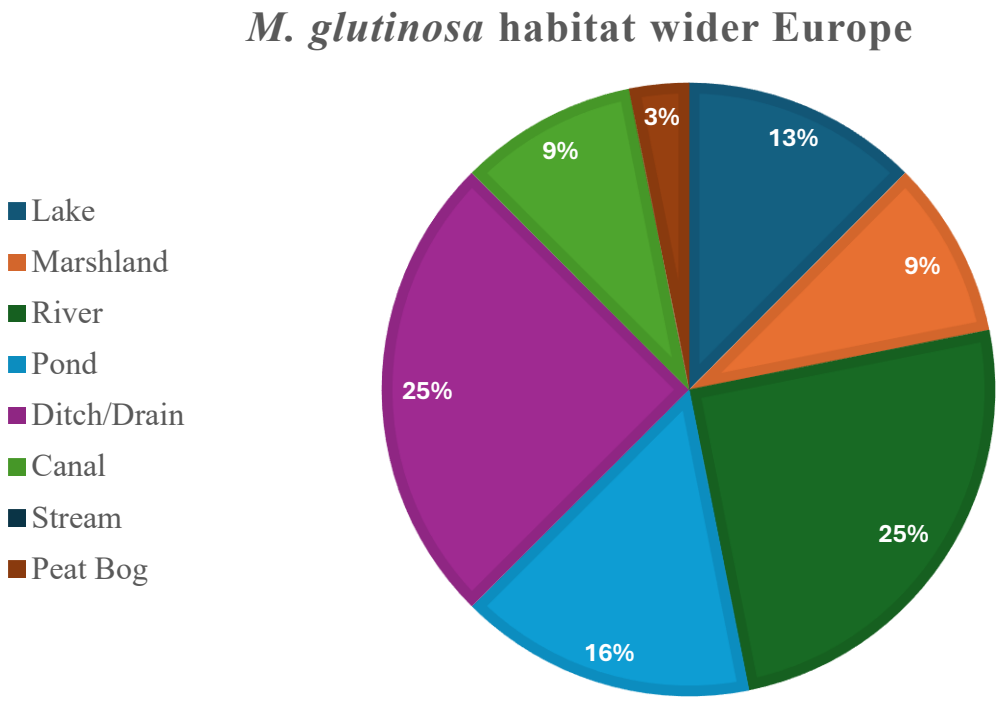

Figure 6. An overview of the habitat preference (in percentage) of *Myxas glutinosa* across its historical and extant range, excluding UK (Whitfield *et al*, 1998; Carlsson, 2000; Vinarksi *et al*, 2013; Cucherat & Philippe, 2015; Bichain & Ryelandt, 2023; Cucherat, 2023).

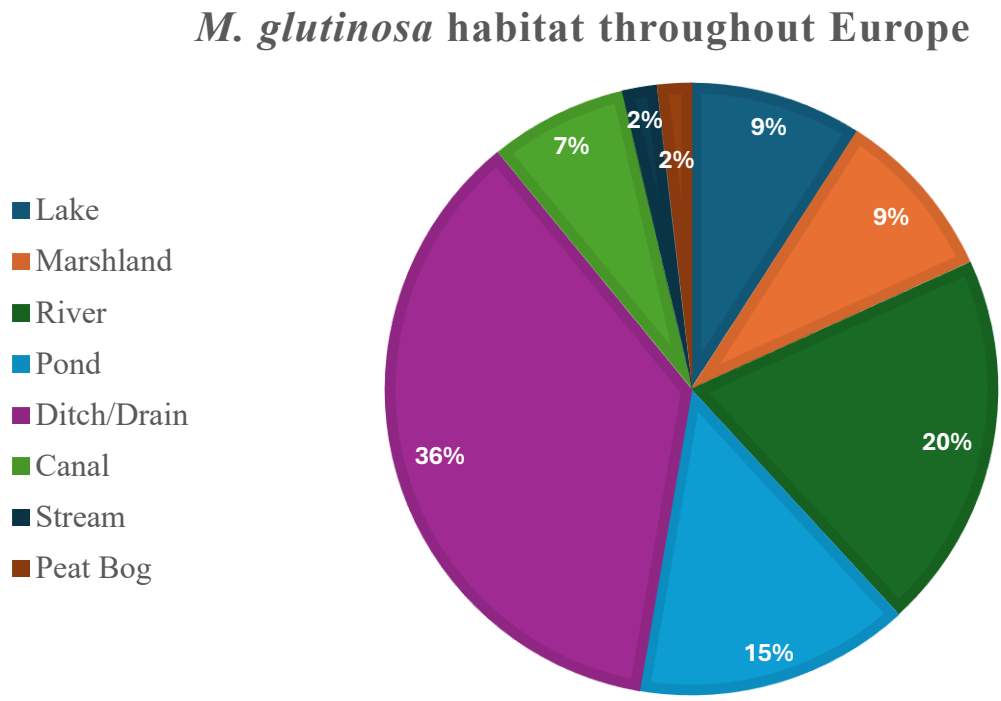

Figure 7. An overview of the habitat preference (in percentage) of *Myxas glutinosa* throughout its entire historical and extant range in Europe (Pond Action 1992; Whitfield *et al*, 1998; Carlsson, 2000; Vinarksi *et al*, 2013; Cucherat & Philippe, 2015; Bichain & Ryelandt, 2023; Cucherat, 2023).

Water quality

The tolerance in environmental parameters of the species is something that appears to be somewhat regional, with some researchers finding that the species does not tolerate conditions in one location that directly contradicts the findings of another location. For example, whilst some authors state the species intolerance of eutrophic conditions (Whitfield *et al*, 1998; Donohue *et al*, 2009) others have found that the species inhabits eutrophic conditions (Carlsson, 2000) or is able to tolerate occasional periods of eutrophication (Hughes, 2025, per. comm. December 2025). The species also appears to tolerate a pH of around 6.3 – 8.5 across its range.

In Llyn Tegid, the water quality is slightly acidic and has low alkalinity (Monteith *et at* , 1997; Willing *et al.*, 2014). Nitrate levels are reasonably high, and levels of dissolved organic carbon are stated to be consistently high. The lake has a strong thermal stratification with a well-developed thermocline at around 10 m (Monteith *et al*, 1997). Diffuse nutrient inputs from agricultural, forestry, and tourist developments and activities across the wider Llyn Tegid catchment have led to raised concentrations of nitrate and phosphorus in the water, causing intermittent short periods of eutrophication, promoting algal blooms and cyanobacterial growth (Monteith *et al*, 1997; Willing *et al*., 2014). Table 3 highlights the results of various water quality analyses that have been undertaken at Llyn Tegid, along with some of the other European locations in which *M. glutinosa* is found. However, with no consistency in recording of water quality parameters it is difficult to compare sites and so understand the needs of the species.

Table 3. Water quality analysis data from several locations in which *Myxas glutinosa* are extant.

Location	Water quality analysis	Source
Llyn Tegid, Wales	Mean values (n=5) pH: 7.1 Alkalinity: 75 µeq L^{-1} Conductivity: 57 µS cm^{-1} Sodium: 224 µeq L^{-1} Potassium 17 µeq L^{-1} Magnesium: 92 µeq L^{-1} Calcium: 191 µeq L^{-1} Chloride: 254 µeq L^{-1} Carbon (total organic): 4.2 mg L^{-1} Phosphorus (total) 13 µg P L^{-1} Phosphorus (total soluble) 8 µg P L^{-1} Phosphorus (soluble reactive) 5 µg P L^{-1} Nitrate: 453 µeq N L^{-1} Copper: 0 µg L^{-1} Iron: 63 µg L^{-1} Lead: 0 µg L^{-1}	Monteith *et al.*, 1997; Willing *et al*, 2014
River Aube, France	Temp: 18.95 °C pH: 8.11 Dissolved Oxygen O: 7.81 mg/L Redox: 87.6 mV	Bichain & Ryelandt, 2023
Hauts-De-France, France	Mean values (n=4)	Cucherat, 2023

	Conductivity: 314.25 µs/cm Biological Oxygen Demand: 2.88 mg/L Ammonium (NH_4^+): 1.55 mg/L Nitrate (NO_3^-): 1.02 mg/L pH: 6.52	
Lake Bolstaholm, Finland	Total Hardness: 6.2 °dH Conductivity: 230 µS/cm Alkalinity: 1.51 meq/L pH: 8 Water colour: 45 mg Pt/L Total Phosphate: 85 µg/L Total Nitrogen: 880 µg/L Salinity: 1.3 ppt	Whitfield *et al*., 1998; Carlsson, 2000
Lake Höckböle, Finland	Total Hardness: 9.6 °dH Conductivity: 260 µS/cm Alkalinity: 2 meq/L pH: 8 Water colour: 60 mg Pt/L Total Phosphate: 100 µg/L Total Nitrogen: 1600 µg/L Salinity: 1.7 ppt	Whitfield *et al*., 1998; Carlsson, 2000
Lake Medalen, Finland	Total Hardness: 5.5 °dH Conductivity: 210 µS/cm Alkalinity: 1.09 meq/L pH: 7.3 Water colour: 50 mg Pt/L Total Phosphate: ? Total Nitrogen: ? Salinity: ?	Whitfield *et al*., 1998; Carlsson, 2000
Lake Lángträsk, Finland	Total Hardness: 8.4 °dH Conductivity: 345 µS/cm Alkalinity: 1.4 meq/L pH: 7.7 Water colour: 65 mg Pt/L Total Phosphate: ? Total Nitrogen: ? Salinity: ?	Whitfield *et al*., 1998; Carlsson, 2000

Feeding

Feeding observations in the wild are relatively limited, but existing evidence suggests this snail grazes on periphyton algal mats and biofilms that build up on hard surfaces, as well as being reported to consume decaying vegetation (Carlson, 2000; Mouthon & Vimpère, 2014; Willing *et al*., 2014; Willing & Hughes, 2014).

Life cycle and population dynamics

At Llyn Tegid, egg laying typically begins in late winter to spring, shortly after adults reach reproductive maturity (Willing et al 2014). (However, eggs have been found during summer months on occasion (Hughes, pers. comm., 2026)) and ex situ breeding efforts have shown that in some cases a second egg mass can be produced within the same year (see Ex Situ Breeding section). Multiple egg masses are deposited on submerged stones or on vegetation over several weeks (Hughes, pers. comm., 2026). This timing is inferred from the appearance of very small juveniles in early spring and the death of adults soon after reproduction.

Llyn Tegid juveniles grow through spring–autumn, remaining under stones or in sheltered microhabitats (Willing et al. 2014). Shells remain thin and transparent; the mantle extends over the shell. Adults are easier to find from August once they reach a larger size. They reach full size and reproductive maturity (typically <10 mm in Llyn Tegid) in late winter or early spring. Adults reproduce once (semelparous tendency) and then die shortly afterwards in spring/early summer, indicating a life span of around 18 months (Boycott, 1936; Hughes, pers. comm., 2026). See Figure 8 below of Ian Hughes illustration of the life cycle.

This species growth is slow compared to other lymnaeids in Llyn Tegid, likely due to the oligotrophic water.

Irish canal populations may exhibit different patterns, as adults have been recorded at various times of year, indicating a less synchronised life cycle compared to that observed at Llyn Tegid. This difference may be related to the oligotrophic nature of the site and the effects of wave action (Willing et al. 2014). Additionally, patterns in mainland Europe also differ; for example, in Finland, variation in shell size suggests staggered breeding (Carlsson 2001). Research in Sweden indicates that Myxas glutinosa may reproduce multiple times between April and November. Individuals from early egg clutches die after reproducing in late summer or autumn and therefore live for only around half a year, whereas the overwintering population has a somewhat longer lifespan (von Proschwitz, T. (2025). It appears that life cycle length may vary slightly with climate and habitat. Ex-situ studies could also help to improve understanding of this variation.

Figure 8. An illustration of the life cycle of *Myxas glutinosa* (Hughes, 2017).

Population Sizes

To understand the size of Glutinous snail populations, the species has been monitored on and off in Llyn Tegid since the early 1950s. Since being regarded as numerous in the lake in the 1950s, surveys from 1998 to 2015 have since shown that the snail occurs at low density, with a 60-minute search rarely producing more than 30 specimens (Hughes, 2015; Willing, 2004, 2006, 2010; Willing & Holyoak, 1998; Willing & Hughes, 2017). Typical densities at times of maximum abundance are less than 1 snail per m^2 and less than 1/10 of this at times or places with low densities, compared to densities of more than 15 snails per m^2 in some Irish lakes (Willing et al., 2014). Maximum counts during sampling at Llyn Tegid have included 107 snails in 1998, 157 snails in 1999, 156 snails in 2000 and 138 snails in 2002 (Howe, 2020). Research in Sweden noted that the size of the populations of this species fluctuates considerably over time, it has a pronounced meta-population structure, and the distribution is fragmented. This makes the species hard to find relative to monitoring effort (von Proschwitz, T. 2025).

Species Status

The species is currently listed as Critically Endangered in the British Isles (Seddon *et al.* 2014) and has full protection on Schedule 5 of the Wildlife and Countryside Act. It is listed under the Ramsar features for Llyn Tegid which is a SSSI (and is therefore subject to statutory monitoring, having last been monitored in 2014). On the European Red List, it is currently assessed Least Concern (LC) (Cuttelod *et al*. 2011). In Ireland, it is listed as Endangered (Bryne et al. 2009), in Germany as Critically Endangered (Jungbluth *et al*. 2011) and it is classified as LC in the latest national Red List of Sweden (von Proschwitz, T. pers. comm. 2025). Indicating that the species is threatened in some parts of Europe but not all. It is not covered by Berne Convention or European Directives (Annex species), or where these are transposed into UK 2017 Habitat Regulations The species has not been assessed globally on the IUCN red list since 1996, when it was assessed as Data Deficient (DD) (Mollusc Specialist Group, 1996).

Threats

Llyn Tegid, Wales

Although the current state of the last known remaining *M. glutinosa* population and its habitat in the British Isles has been described as favourable (as documented in the last NRW 'Common Standards Monitoring' undertaken in 2014 [Willing & Hughes 2017]), there are potential threats that could, if rapid changes were to occur, lead to mortalities. These include manipulating water levels and inundation during the installation and operation of a sluice gate at Llyn Tegid, which can significantly modify shoreline habitats by exposing or inundating them, periodically leaving shallow littoral zones desiccated or completely submerged beyond the snails' range. Such large-scale changes in water level could also lead to significant mortality, particularly if changes are rapid and so the snails are unable to migrate to a suitable habitat quickly enough (Willing & Hughes, 2014; Hughes, 2017). However, the current water level management has not demonstrated an effect. Although the lake sees recurring short episodes of cyanobacterial growth and nutrient enrichment, which are tolerated by the snails, long-term nutrient loading in the lake has the potential to significantly impact habitat quality. Additionally, the diminishing the extent of silt-free habitat through siltation may impact the population, as the snails favour silt-free areas via run off and algal decomposition from eutrophication (Willing *et al.*, 2014; Willing & Hughes, 2014; Hughes, 2017). Collectively, these pressures are consistent with the recognised sensitivity of the species to water quality, substrate condition, and hydrological stability elsewhere. The siltation and the eutrophication are driven by the agriculture surrounding the lake, as well as run off from hard surfaces, such as the roads, car parks and campsites. Alongside these threats, it has been inferred that there may be some interest in gathering more data in relation to the threats that the species faces from predation from non-native fish and competition from non-native snail species within the lake, and how this relates to aspects such as exposure through the fluctuations in water level

and siltation (Willing *et al*., 2014; Hughes, 2017). Also, the impact of recreation on water quality and disturbance, for example boat oil in the lake, as well as sewage leaks from recreation facilities.

Historic populations within the wider United Kingdom

The principal drivers of the widespread decline of *M. glutinosa* across England are believed to have been eutrophication and general pollution of the waterbodies in which they inhabited, with likely additional pressures from habitat loss due to sedimentation and physical disturbance (Pond Action, 1992; Whitfield *et al*., 1998; Donohue *et al*., 2009). Furthermore, the loss of habitat through drainage of fens and similar habitats, alongside the ditches and streams that would have connected them being converted into underground pipelines would have had significant impacts on populations (Hughes, pers. comm., 2026). Although the loss of the species in England is generally very poorly understood.

Mainland Europe

Marked reductions have been documented across Europe, leading to extreme rarity and complete loss in some populations. The drivers behind such declines are multifaceted and primarily result from the convergence of several factors (possibly synergistically), which, in combination, have caused fragmentation and the eventual loss of populations over time.

Decreasing numbers throughout the Central European regions have been attributed to the species being sensitive to declines in water quality alongside the resulting eutrophication of water bodies; these have been further bolstered by sedimentation and the disruption of suitable habitat through river engineering (Beran, 2002; Glöer & Mier-Brook, 2003; Horsák *et al*., 2010; Welter-Schultes, 2012). Western European populations have also seen a marked reduction in the number of sites where they are found, with losses attributed to nutrient-rich inputs from agricultural runoff and associated eutrophication. Aside from declines from nutrient enrichment, population decline is being further driven by the regulation of rivers and the construction of dams, which in turn, pose a risk to populations which may have some level of tolerance to substandard water quality (de Brunye & van der Velde, 1998; Bichain *et al.*, 2003; Bouchet, 2007).

Northern populations have experienced marked declines due to hydrological changes, including water-level regulation, drainage, and shoreline modifications (Valovirta, 1998; von Prochwitz, 2006). Similarly, large-scale hydrological modifications have driven declines within Eastern European populations, which have experienced long-term habitat degradation and fragmentation due to river regulation and dam construction. These impacts have been further exacerbated by industrial pollution, which has led to the near disappearance of populations in Latvia (Zettler *et al.*, 2006; Rudzīte *et al.*, 2010; Vinarski *et al*., 2013). Southern European populations are thought to be regionally extinct due to pressures similar to those observed elsewhere in Europe, with the primary drivers being eutrophication and the engineering of water bodies (Bodon *et al*., 1995; Welter-Schultes, 2012). A potential factor that may increase

the susceptibility of *M. glutinosa* to such pressures is their apparent inability to survive for extended periods of time out of water, with observations showing that mortalities occur after only 20 minutes of exposure (Hughes, pers. comm., 2026). Alongside this, it has been proposed that *M. glutinosa* is also incapable of regulating its buoyancy in the way that other snails are able, which means it is unable to utilise buoyancy to move with the changes in water level as they occur (Hughes, pers. comm., 2026).

Although pollution and eutrophication are both stated to pose a significant threat to the species throughout its range, it is crucial to note that there are currently two known locations where *M. glutinosa* inhabits waters that are polluted or eutrophic. The first is Lake Bolstaholm on the Åland Islands, Finland, which has been subjected to decades of untreated runoff from cattle farms and is recognised as being a eutrophic lake (Carlsson, 2000). The second is the Miass River, which runs through Chelyabinsk City in the Southern Urals, Russia. This river is exposed to high levels of pollution from multiple anthropogenic sources, with the most prominent being an industrial plant in the vicinity of the snail habitat (Vinarski *et al.*, 2013). It is feasible that surface pollutants may pose more of a threat than all other pollutants, as these would be the most likely to wash towards the margins and become concentrated, before contacting the snails (Hughes, pers. comm., 2026).

Threat summary

Table 4 highlights the range of threats that are faced by *M. glutinosa* throughout its entire European range and indicates which countries these threats are observed. When summarised, the literature consistently suggests that the decline of *M. glutinosa* across its European range is largely driven by water pollution, most specifically eutrophication. However, the species appears to tolerate some eutrophication and water pollution; when combined with hydrological manipulation and habitat degradation particularly the loss of hard surfaces, it is rapidly lost. Those populations that have been found to tolerate some poor water quality; the extent of their tolerance and adaptability to such conditions has not been assessed and should be subject to further study (Carlsson, 2000; Vinarski *et al*., 2013). The main drivers of loss and decline are believed to be agriculture both in terms of water pollution, eutrophication and loss of hard surfaces, as well as adjacent urban developments and recreational use of larger lakes.

Table 4. An overview of the range of threats faced by *Myxas glutinosa* throughout its European range.

Prioritised threats (ordered by frequency of occurrence)	Regions affected	Reference
Habitat loss and Fragmentation	United Kingdom; Ireland; Northern Europe; Eastern Europe; Central Europe; Western Europe	Whitfield *et al*. (1998); Holyoak (2004, 2005); Carlsson (2000); Vinarski *et al*. (2013); Mouthon & Vimpère (2014)
Water pollution	Llyn Tegid; United Kingdom; Ireland; Eastern Europe; Central Europe; Western Europe	Willing & Holyoak (1998); Whitfield *et al*. (1998); Carlsson (2000); Vinarski *et al*. (2013); Mouthon & Vimpère (2014)

Eutrophication	Llyn Tegid; United Kingdom; Ireland; Central Europe; Western Europe	Willing & Holyoak (1998); Whitfield *et al*. (1998); Carlsson (2000); de Bruyne *et al*. (2008); Donohue *et al*., 2009; Mouthon & Vimpère (2014)
Siltation	Llyn Tegid, Wales; Ireland; Central Europe; Western Europe	Willing & Holyoak (1998); Holyoak (2004); Feliksiak (1939); Mouthon & Vimpère (2014); de Bruyne *et al*. (2008)
Artificial fluctuations in water levels	Llyn Tegid, Wales	Willing & Holyoak (1998); Willing (2004, 2006, 2010)
Drainage and canalisation	United Kingdom; Ireland	Pond Action (1992, 1993); Whitfield *et al*. (1998); Holyoak (2004, 2005)
Loss of suitable hard substrates	United Kingdom	Williams *et al*. (1991); Whitfield *et al*. (1998
Potential predation by fish	Llyn Tegid	Willing & Holyoak (1998); Willing *et al*. (2014)

Ex situ Populations

In order to better understand the species, and to ensure that the species has a safety net of captive populations, Ian Hughes has been working with *ex situ* populations of the species since 2014. Since 2024, there have also been several *ex situ* populations established across British and Irish Association of Zoos and Aquaria (BIAZA) collections (Askham Bryan College, Chester Zoo, Dudley Zoo and Castle, Longleat Safari Park, and Wingham Wildlife Park).

Ex-situ environments

Captive snails are currently maintained in unheated glass aquaria (Figure 9) or ponds (Figure 10), which, when kept indoors, have 7-9 hours of artificial plant growth lighting to stimulate algal growth. The captive environments are furnished with rocks and stones, as well as the use of the aquatic plant *Elodea* spp. to allow the snails to seek refuge, as they would in the wild. The aquaria and ponds are filled using tap water, which has been found to be the most successful option, above pond water and rainwater (Hughes, 2024).

Figure 9. an aquarium set up to house an *ex situ* population of *Myxas glutinosa* (Hughes, 2024).

The environments are filtered using shop bought aeration driven sponge filters or under gravel filtration, as these are found to be the least environmentally impactful options for the snails as far as water flow and vibration is concerned (Hughes, 2024). Water changes and maintenance should be undertaken weekly unless any issues arise that require this to occur more frequently. The snails that are kept in ponds outdoors have no additional filtration or equipment, as their biological demand on the pond is outweighed by the natural filtration capability and sheer volume of the pond. Water quality monitoring should occur on a weekly basis and parameters should ideally be; ammonia (NH_3) 0 mg/L, nitrite (NO_2^-) 0 mg/L, nitrate (NO_3^-) ideally as low as possible but no more than 20 mg/L, pH around 7 – 7.5.

The ponds and aquaria are maintained at temperatures of around 0^{o}C to 6 ^{o}C over winter, and up to 22 ^{o}C in the summer months. Any aquaria which are held indoors year-round can be lowered to the winter temperatures by partially submerging the aquaria in a bath which has a chiller and pump set up into it. This would allow for seasonal variation in instances where keeping outdoors is not possible.

Figure 10. Makeshift ponds created from an old oil barrel to house an *ex situ* colony of *Myxas glutinosa* outdoors (Hughes, 2024).

Ex-situ feeding

The snails have been noted to favour algae grown on rocks over any other food source (Hughes, 2024), however they will consume other sources in the absence of algal mats. Snails have been observed feeding on other sources of algae such as filamentous algae, as well as the leaves of foods such as lettuce, cabbage, or beetroot which have been boiled for 10 seconds or so to soften them (Hughes, 2024). Commercially available extruded fish foods, such as flakes or pellets, have also been confirmed to be grazed upon by the snails, however, these are generally consumed in the absence of fresh green food such as algae or leaves and pose a higher risk of polluting the water.

A method to ensure a continuous food source can be through setting up an ‘algae farm’ in which floating plastic cups are stored outdoors in water basins that don’t have any livestock housed in them and have been placed somewhere in which they will receive a lot of direct light. The cups can then be cycled in and out of the snails' environment for them to graze whilst algae is cultivated on clean cups. Alongside the use of plastic cups, cuttlefish bones have also been utilised as a grazing station, however it is noted that the snails seem to prefer the cups for grazing over the cuttlefish (Hughes, pers. comm., 2026).

Ex-situ reproduction

Reproduction is noted to be environmentally triggered through the water temperature increasing, as well as the increasing abundance of food. It is noted that in captivity the species can alternate between univoltine (i.e. producing one generation per year) and bivoltine (producing two generations in a year) reproduction, depending on weather conditions, so there can be potential for a second cohort to appear as temperatures begin to decrease (Hughes, 2024).

Eggs can be deposited on any surface of the environment, and each snail can produce numerous egg masses. These masses tend to contain around 30 eggs each and can take around 30 days to hatch, depending on temperature (Hughes, 2024). Upon depositing egg masses, the adult snails can be moved into another aquarium to allow the next generation of snails to feed and grow without competition from adults.

In situations where population number become larger than the available space of a collection, and surplus snails cannot be passed to another facility, it is recommended that there should be a chosen number of aquaria that are kept in optimum ratios and conditions for the size and space of the aquaria or pond, and the rest of the colony should be kept in an over populated environment and allowed to fluctuate in numbers naturally (Hughes, 2024).

Conservation Actions

There have been no specific conservation actions applied to improve habitat for *M. glutinosa* in Llyn Tegid, due to difficulties in reliably implementing conservation actions for a species whose needs are still not completely understood (Hughes, pers. comm., 2026). However, there was a ditch that was funded by BMW and installed by the National Park Authority in 2021 to catch run-off into the lake as part of a mitigation scheme for the installation of electric car charging facilities (Hughes, pers. comm., 2026). Artificial refuges were created and installed in 2016, using a concaved base to form a permanent puddle and a domed lid, these refugia present a permanent sanctuary for snails to escape exposure when water levels begin to drop (Hughes, pers. comm., 2026). There has also been long-term monitoring of the species at the site, including condition assessments for the species, with Lake Wardens being added as accredited agents on Ian Hughes species license to increase monitoring outputs (Hughes, pers. comm., 2026). A monitoring protocol and Conservation Objective were established in 2000 which involved sampling at eight sites which supported the snail in 1998 and 1999 (Willing & Holyoak, 2000). This has been repeated at regular intervals, the last of which was in 2014, when *M. glutinosa* was found at all 7 sites where it had previously been recorded and at numbers that allowed the species to be judged as in Favourable Condition relative to Condition Assessment standards (Willing & Hughes 2014). It has been stated that the use of artificial refugia could be a much more informative means of surveying than the current survey method, with some protocol development and fine tuning (Hughes, pers. comm., 2026). Studies in the use of refugia could therefore usefully run parallel to continued current

monitoring techniques at the 8 monitoring stations chosen as a representative assessment of the entire lake perimeter.

Species Action Plan

Workshop

To create an action plan for the conservation of *M. glutinosa*, BIAZA held a Glutinous Snail Task Force (GSTF) planning workshop, which was facilitated by the Species Recovery Trust, where the visions, goals, and actions were formulated through discussions and group planning. The workshop was held at Chester Zoo on the 3rd and 4th of March 2026 and included delegates from various BIAZA institutions, Natural England, and the Species Recovery Trust (the workshop programme and full participant list are provided in Appendix 1). The agreed vision from the workshop is presented below, together with a section outlining proposed roles and responsibilities for delivery of the plan. The five goals, along with their associated objectives and actions, are also summarised in the table below.

At present, a goal and action table relating specifically to the management of the existing population at Llyn Tegid is not included. However, this will be addressed through engagement with Eryri National Park to initiate discussions, after which this section will be developed and incorporated into the plan.

Vision

By 2050 the Glutinous Snail has thriving, sustainable populations in healthy freshwater habitats across a natural range of sites, with its threats mitigated and extinction risk reduced. Knowledge of its threats, decline, and ecology are widely understood and communicated. People recognise it as an indicator for healthy freshwater habitats, and local communities are actively engaged. Outcomes will inform Glutinous Snail conservation in Europe.

Roles

The Taskforce will act as the core management group. Keeping it to a manageable number of people, each representing a key element of the plan. Its role will be to set priorities and establish a series of Focus Groups.

Each Focus Group will take responsibility for a defined set of goals, objectives, or actions, with a designated lead responsible for coordination. This structure enables a wider range of contributors including academics, students, conservation practitioners, geneticists, and European researchers to engage meaningfully with the plan, without expanding the Taskforce to an unmanageable size.

Funding

Initial funding provided by BIAZA and BIAZA member zoos and BIAZA corporate members, has already supported the running of the conservation planning workshop, as well as the collection and quarantining of a second cohort of snails by Ian Hughes and some initial genetic

analysis. Further funding has been secured through Natural England's Species Recovery Programme, to support the elements of the project which align with Natural England's identified Threatened Species Recovery Actions; namely feasibility for reintroduction; research on autecology; and trial reintroduction. Additional sources of funding will be required to capitalise on specific opportunities, particularly to support the research components of the plan.

It will be beneficial to broaden research partnerships and strengthen links with genetics teams and academic institutions—such as those listed on the BIAZA research directory, as well as contacts at Sheffield, Kent, Edinburgh, Nottingham, and Aberystwyth Universities. There is also scope to draw on Disease Risk Assessment (DRA) collaborations and European partners, including Dublin Zoo, and to work with specialist groups such as the EAZA Terrestrial Invertebrate Taxon Advisory Group to help reduce overall costs.

Research Goal 1: *By 2032 research on the glutinous snail will have established and documented a gold standard by which ex-situ insurance populations should be maintained, including a robust, reliable health screening protocol; additionally, optimal habitat conditions will have been defined, including species interactions and tolerance ranges to identified threats, and the species ecology will be better understood to inform the selection of suitable reintroduction sites. A Glutinous Snail Recovery Toolkit will be compiled and disseminated, to include housing and habitat preferences, biosecurity, health screening protocols and Disease Risk Analysis frameworks.*

- Objective 1.1 – Understand health profile of wild and captive populations, including genetic diversity
- Objective 1.2 – Determine key threats to the species exploring the impact of pollution, siltation, predation and competition
- Objective 1.3 – Conduct ex-situ experiments under a variety of controlled parameters informed by desk-based studies and evidence from European populations

Action wording	**Priority (1-urgent, 3 low)**	**Who is responsible (lead organisation in BOLD)**	**When**	**How**	**What resources needed**	**Output(s)**	**Indicator of success**
Objective 1.1: Understand health profile of wild and captive populations, including genetic analysis							
Action 1.1.1 Sample representative number (33) of captive and wild individuals for health screening to assess comparative health profile status. In addition, submit samples for biobanking	1	GS Veterinary advisors	As soon as we have a sufficient number of animals	Samples collected from all holders and wild	Snails / Vets/ lab / funding / ethical review	Results submitted	Results received

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When	How	What resources needed	Output(s)	Indicator of success
Action 1.1.2 Undertake collection of tissue samples to assess genetic diversity within the captive and wild population	1	GS Veterinary advisors	As soon as we have a sufficient number of animals	Samples collected from all holders and wild	Snails / Vets/ lab / funding / ethical review	Results submitted	Results received
Action 1.1.3 Disease risk assessment	2	To be identified	End 2026	The required due diligence processes	Funds and informed by health screening results	DRA produced	Adopted by holders
Objective 1.2: Determine key threats to the species exploring the impact of pollution, siltation, predation and competition							
Action 1.2.1 Conduct species distribution modelling/PHVA climate resilience impact	2	GSTF Academic partner	2027-2028	Student research (minimum MSc/MRes)	Student funding, data available,	Greater understanding of threats and site condition/viability, thesis	Thesis/scientific publication, model complete and informing conservation action
Action 1.2.2 Carry out research to increase understanding of species ecology and its resilience to threats including dispersal ability, predators, competitors, impact of environmental factors such as pollution and siltation.	1	GSTF, Academic partner, European lines	2026-2028	Student researchers (BSc, MSc) or relevant NGO	Funding, site access, staff time, network, current data	Thesis/scientific publication	Information available to inform conservation action plan
Objective 1.3: –Conduct ex-situ experiments with a variety of parameters guided by animal husbandry team requirements for applied research							

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When	How	What resources needed	Output(s)	Indicator of success
Action 1.3.1 Maintain consistent records across all holders to correlate population trends and densities with varying environmental, habitat and dietary parameters based on existing field data	1	All holders	On going	During routine husbandry	No additional resources required	Understanding impact of environmental changes on the population	Animals under human care are viable and sustainable
Action 1.3.2 Comparative study analysing a variety of management, housing and habitat preferences coordinated by GS task force research coordinators. Including coordination of ex-situ pond development to allow standardised studies.	3	All holders	Post above action	Through coordinated research proposal	To be determined	Project up and running with data collected	Published research updated BPG V2

Survey Goal 2: *By 2032 wild and ex situ population trends are understood, using a standardised, scalable and accessible survey protocol.*

- Objective 2.1 – Build an international network of experts to ground-truth the status of the European populations
- Objective 2.2 – Identify and trial different survey techniques
- Objective 2.3 – Carry out standardised habitat monitoring alongside snail surveys

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When	How	What resources needed	Output(s)	Indicator of success
Objective 2.1: Build international network of experts to ground-truth status of European population							
Action 2.1.1 Identify and connect with key experts and contacts across the historic and European range	?1	Glutinous Snail Task Force (GSTF) Ian Hughes Mary Seddon, IUCN SSC	2026 April	At GSTF meeting as an agenda item	Taskforce time	Contact list	List of people who have agreed involvement
Action 2.1.2 Gathering information from identified contacts on known population in Wales, including supporting Ian Hughes to collate and write up his ex-situ results	2	GSTF liaison	2026 Q3	Email comms	Contact list Taskforce time	Data and up to date information, gap identification	Data exists
Action 2.1.3 Gathering information/recent records from historic sites in England, asking ecologists through CIEEM and appealing to recorders and revisiting a selection of historic sites (in England) to confirm total loss of the snail. Examples include the extensive Basingstoke canal complex and possibly some of less	2	GSTF – liaison inc Martin Willing	2027	Email comms and in-person surveying	SRP funding	Data and up to date information	Data exists

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When	How	What resources needed	Output(s)	Indicator of success
polluted areas (in-flow sectors?) of Lake Windermere plus selected others (carefully chosen upper Thames tributaries?).							
Action 2.1.4 Ongoing monitoring of Llyn Tegid population, refine method and engage Eryri NP in monitoring	1	GSTF working with Snowdonia NP rangers	In progress	NRW working with Ian Hughes and rangers	NRW funding	Updated population density data and habitat/parameters	Data recorded and shared
Objective 2.2: Identify and trial different survey and monitoring techniques							
Action 2.2.1 Determine feasibility of eDNA methods for presence/absence	2	GSTF	2026 April	GSTF to identify contacts, links and costs as meeting agenda item	Funding, facilities/researchers/company (nature metrics?)	Report on feasibility and working plan	Report exists
Action 2.2.2 •Identify, test and agree a standardised survey and population estimation methodology (e.g.refugia, density, marking methods)	3	GSTF, holders, students/researchers	2026-2027 Q4	Practical development, experimental design, BPG, evidenced documentation survey techniques	Staff time, guidance document to clarify need, surplus stock	Evidence document	Survey methods identified

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When	How	What resources needed	Output(s)	Indicator of success
Action 2.2.3 – Compile monitoring protocol, based on outcomes of actions 2.2.1 and 2.2.2	1	GSTF	2026	Practical tests at ex situ holders	Survey equipment, time	Population monitoring data and standardised protocol	Standardised protocol in use at all holders
Objective 2.3: Carry out standardised habitat monitoring alongside snail surveys							
Action 2.3.1 Determine suite of habitat characteristics (vegetation structure, land use, water quality, temp, UV, salination etc)	2	GSTF, Natural England, Freshwater Habitat Trust, European partners	2026	Desk based study, supplemented with data from network	Staff time and communication with network	Spreadsheet of characteristics and how they are measured	Spreadsheet completed, survey methods identified
Action 2.3.2 Carry out site assessments using developed methods to determine optimum habitat characteristics, coupled with in situ preference testing to define key habitat, water quality and seasonal parameters influencing survival and reproduction.	1	GSTF, Natural England, Freshwater Habitat Trust, European partners	2027-2028	In person assessment	Staff time, funding	Optimum habitats identified and documented	Optimum habitat identified

Action wording	Priority (1- urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When	How	What resources needed	Output(s)	Indicator of success
Action 2.3.3 To engage with the Eryri National Park and identify opportunities for monitoring and management of GS with them	1	GSTF	2027	Meeting with Eryri National Park	Time from partners	Integration of habitat management action for Llyn Tegid into the Action Plan	Evidence of Eryri National Park collaborating with GSTF

Ex-Situ Goal 3: *By 2032, there will be a regional ex-situ network of at least 10 holders following and progressing best practise to include robust health screening.*

- Objective 3.1 - Recruit holders and continuation of BIAZA GSTF
- Objective 3.2 - Generate best practice guidance (BPG)using current informed best practise husbandry management, encompassing broad range of experience from all holders, to incorporate robust routine and pre- translocation health screening protocol by 2027

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When	How	What resources needed	Output(s)	Indicator of success
Objective 3.1: Recruit holders and continuation of BIAZA GS task force							
Action 3.1.1 Increase ex situ populations at BIAZA zoos to a number informed by the disease risk analysis zoos/aquariums. These ex situ populations will include both indoor exhibits and outdoor semi-natural ponds, via BIAZA campaign to boost awareness through socials / working groups / conferences / targeted dissemination of relevant material	1	BIAZA	2028	See action	Time and a computer, zoo/aquarium facilities	Up to 7 new ex situ populations	Recruitment of new holders
Action 3.1.2 Maintain existing GS taskforce meetings at least quarterly	1	BIAZA + Members	Quarterly	3 online and 1 in person	Time / computer / venue / funding	Meeting minutes and actions generated and disseminated	
Objective 3.2: Generate best practice guidance – Current informed best practise husbandry management, encompassing broad range of experience from all holders, to incorporate robust routine and pre- translocation health screening protocol by 2027							

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When	How	What resources needed	Output(s)	Indicator of success
Action 3.2.1 Immediately develop biosecurity practises amongst existing holders	1	All holders	ASAP	Meeting with vet advisors	Vets / time / computer	Robust bio-secure protocol in place	Disseminated to all holders
Action 3.2.2 Identify compromises to newly developed biosecurity protocols	2	All holders	ASAP	Cross reference to protocol	Vets / time / computer	List of actions identified to address	All holder working uniformly to protocol
Action 3.2.3 Establish Focus Group for BPG with at least 1 member of the existing holders representing	2	BIAZA	Mid 2026	Show of hands	Time / willingness / computer	Active steering group	First draft of BPG by mid 2027
Action 3.2.4 Produce the BPG	2	GS BPG steering group	First draft of BPG by mid 2027	Following EAZA BPG format	Time / willingness / computer	BPG published	Holders following BPG
Action 3.2.5 Establish a structured reporting and shared-learning protocol (via GSTF and digital platform) to document husbandry successes, failures and adaptive responses.	2	BIAZA and GSTF	Mid 2026	Online	Time / willingness / computer	Online forum and clear protocol shared and understood by holders	Regular reporting underway

Outreach Goal 4: *By 2032, all holders have standardised modern interpretation providing high quality public engagement.*

- Objective 4.1 - Produce educational guidelines for holders to develop engaging modern public interpretation to promote species conservation
- Objective 4.2 - Secure suitable stakeholder partners to enhance funding and engagement opportunities to support ex-situ and / or outreach activities

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When	How	What resources needed	Output(s)	Indicator of success
Objective 4.1: Produce educational guidelines for holders to develop engaging modern interpretation to promote species conservation							
Action 4.1.1 Establish Focus Group for education guidelines and incorporate Ian Hughes existing materials	2	Dudley with Ian Hughes	Mid 2026	Dudley to coordinate	Time / willingness / computer	Active steering group in place	First version mid 2027
Action 4.1.2 Produce the education strategy for display and zoo-based interpretation	2	SG	First version of BPG by mid 2027	Utilise existing strategies as template and divide tasks amongst SG	Time / willingness / computer	Strategy published	All holders engaged and adopting guidance
Action 4.1.3 V2 of education strategy incorporating community engagement and or potential income generation	3	SG	Before first translocation	Update to V1	Time / willingness / computer	Strategy published	All holders engaged and adopting guidance
Objective 4.2: Secure suitable stakeholder partners to enhance funding and engagement opportunities to support ex-situ and / or outreach activities							
Action 4.2.1 Establish Focus Group for partnerships and funding	2	GSTF	Once we hear back from SRP	N/A	Time / willingness	Functional group in place	1st meeting by Q1 2027
Action 4.2.2 Focus group to assess existing GS task force member's capacity to generate funds and potential engagement with supportive partners	2	Focus group	After the action above has a resolution	Survey	Time/ willingness	Spreadsheet with collated data	List of potential donors and partners
Action 4.2.3 Securing and maintain	2	Focus group	On going	Liaison with existing	Time	Money and	Project

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When	How	What resources needed	Output(s)	Indicator of success
funds and partnerships for required project goals				and potential new partners		support secured	activities fulfilled
Action 4.2.4 Explore EAZA EEP for the species	2	GSTF	By end of 2026	Contact TITAG chairs and vice chairs	Email	Clarity on hoops we need to jump through	Decision on next steps

Translocation Goal 5: *By 2032 - A minimum of two pilot translocations will be underway. These will be evidence-led and aligned with best practice guidelines.*

- Objective 5.1 - Habitat and ecosystem feasibility studies to inform selection of release sites.
- Objective 5.2 - Social and economic feasibility studies to inform selection of release sites.
- Objective 5.3 - Legal feasibility studies to inform selection of release sites.
- Objective 5.4 - Biological feasibility studies to inform selection of release sites.
- Objective 5.5 - Methodology established for release, including monitoring and evaluation and exit strategy, following best practice.

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When completed by	How	What resources needed	Output(s)	Indicator of success
Objective 5.1: Habitat and ecosystem feasibility studies to inform selection of release sites.							
Action 5.1.1 Global analysis of current wild and historical populations and characterisation of their habitats, optimal parameters and threats presence/absence, considering risk from climate change,	1	GSTF Research Focus Group	June 27	Student MSc/post grad project	Self-funded student plus travel expenses (e.g. £1k). Supervisory input from focus group	Published report including modelling	Report completed and shared and habitats understood

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When completed by	How	What resources needed	Output(s)	Indicator of success
habitat connectivity, informing habitat modelling for suitable sites in England (using data from the research surveys).					member		
Action 5.1.2 Define, quantify and rank threats at potential release sites, through site visits (pending landowner permissions – see action below) and surveying to ascertain e.g. other species present, food availability, invasive species etc.	1	GSTF with student support	Mar 28	Student MRes project	funded student plus travel expenses (e.g. £1k) Supervisory input from group	Published report with threats ranked for min 4 potential release sites	Min 4 potential release sites identified
Action 5.1.3 • Produce a feasibility report with clear recommendations on site suitability (ranked by probability of success), detailing constraints (e.g. threats, connectivity and long-term security) and readiness for potential trial release.	1	GSTF	July 28	Report review and online meeting	SRP funding and time of group members/ reviewers	Decisions documented Feasibility report	Min 2 release sites identified
Objective 5.2: Social and economic feasibility studies to inform selection of release sites.							
Action 5.2.1 Comms and awareness plan developed for relevant target audiences in local communities, e.g. recreational water users	3	GSTF Engagement Focus Group	Dec 28	Online	GSTF member time	Documented comms plan	Completed plan shared
Action 5.2.2 Stakeholder engagement plan including experts, regulators (e.g. EA), communities	2	GSTF Engagement Focus Group	Dec 28	Online	GSTF member and stakeholder	Documented comms plan	Completed plan shared

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When completed by	How	What resources needed	Output(s)	Indicator of success
and interested parties relevant to the risk					time		
Action 5.2.3 Action: Plans to mitigate potential conflict - Method statements around habitat management/activities that may impact the glutinous snail in the wild	2	GSTF Engagement Focus Group	Dec 28	Online	GSTF member time	Documented comms plan	Completed plan shared
Objective 5.3: Legal feasibility studies to inform selection of release sites.							
Action 5.3.1 Review of relevant licensing and legislative requirements, including protected sites	1	GSTF/Natural England	Dec 28	Online	GSTF member and Natural England time	Necessary applications identified	Any necessary applications made
Action 5.3.2 Landowner consents and agreements secured, including long term management	1	GSTF Engagement Focus Group	Dec 28	Online	GSTF member time	Necessary applications identified	Any necessary applications made
Action 5.3.3 Links made to local, national biodiversity objectives and catchment/water basin management	2	GSTF/Natural England	Dec 28	Online	GSTF member time	Necessary applications identified	Any necessary applications made
Objective 5.4: Biological feasibility studies to inform selection of release sites.							
Action 5.4.1 DRA carried out and outputs to inform captive sites and standardised health screening being carried out by all current and potential suitable future holders.	1	GSTF Veterinary Focus Group	Dec 26	Veterinary consultancy	£14K	DRA in place and health screening routinely carried out	DRA in place and health screening being carried out by all holders
Action 5.4.2 Genetic analysis of source population from Wales (and consideration of import of additional founders from Europe)	1	GSTF/Academic partners e.g. Aberystwyth Uni NE has some expertise (no lab)	Dec26	Analysis by Uni lab	Funding and appropriate academic partner	Genetic diversity of founder population understood, and genetic diversity required for successful	Genetic integrity identified

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When completed by	How	What resources needed	Output(s)	Indicator of success
						reintroductions.	
Action 5.4.3 Design quarantine and biosecurity protocol for captive breeding and releases.	1	GSTF Veterinary Focus Group	Dec 26	Online	GTSF Time	Quarantine and biosecurity protocol produced and shared	Quarantine and biosecurity protocol in use at all holders
Action 5.4.4 Identify common objectives with other species, cohabiting the same site (snowball effect of conservation/bigger picture ecosystem restoration). (linked with site surveys in habitat feasibility)	3	GSTF with student support	Mar 28	Student MRes project	funded student plus travel expenses (e.g. £1k)	Summary of benefits to other species/ecosystem	Summary of benefits to other species/ecosystem
Objective 5.5: Methodology established for release, including monitoring and evaluation and exit strategy, following best practice and incorporating limitations as identified within feasibility studies.							
Action 5.5.1 Assess conclusions of feasibility study.	2	GSTF	April 28	Online	Outputs of feasibility study	Clear decision on whether and where to proceed	Move to development stage
Action 5.5.2 Design release strategy – how many, where, when, who, stages/repetitions, welfare assessment etc	2	GSTF	Dec 28	Online and site visits	GTSF Time	Documented release protocol	Release protocol agreed by all
Action 5.5.3 Development of an exit strategy	3	GSTF	Dec 28	Online	GTSF Time	Documented exit strategy	Exit strategy agreed by all
Action 5.5.4 Design post-release monitoring survey (including dispersal rates, territory size, population dynamics), identifying indicators of success.	3	GSTF (Research Focus group)	Dec 28	Online	Surveyors identified	Documented post-release monitoring protocol, including indicators or success	Documented post-release monitoring protocol, including indicators or

Action wording	Priority (1-urgent, 3 low)	Who is responsible (lead organisation in BOLD)	When completed by	How	What resources needed	Output(s)	Indicator of success
							success
Action 5.5.5 Identify and communicate any necessary ongoing habitat management requirements.	3	GSTF plus landowner/ zoo holders	Dec 28	Online	Longer term source of funding/ resource identified	Clear plans in place for habitat management	Clear plans carried out for habitat management
Objective 5.6: Release the snails!							
Action 5.6.1 Methodology rolled out as above, with monitoring and documentation, and adaptive management	2	GSTF	June 29 (in Spring)	Site visits	Sufficient surplus snails	Snails in the wild	Successive surveys identify continuing presence of snails
Action 5.6.2 Monitor population numbers and key environmental variables over a three-year period	2	GSTF	June 29-June 32	Site visits	Time	Population record data	Population record data
Action 5.6.3 Communication and dissemination of outputs, site-specific management recommendations informed by trial outcomes	3	GSTF Engagement Focus Group	June 29	Joint comms plan	Interpretation resources (signage, flyers, foam)	Interpretation resources (signage, flyers, foam)	Increased awareness by relevant audiences

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Appendices

Glutinous Sail Task Force Action Planning Workshop Programme

Glutinous Snail Planning Workshop Agenda	
Location: Chester Zoo Mottershead Room **Duration:** 2 days	
Workshop Leads: Vicky Wilkins (SRT) and Phill Robinson (SRT)	
Facilitators: Phill Robinson (SRT), Leah Williams (Chester Zoo), James Andrewes (Chester Zoo)	
Scribers: Frankie Lawrence-Thompson (BIAZA), Nicky Needham (BIAZA), Iri Gill (Chester Zoo)	
Day 1 – Understanding the Species it threats and defining a Vision and Goals	
09:30-10:00	**Arrival**
10:00-10:30	**Welcome & Introductions**
	○ Introduction
	○ Workshop welcome, housekeeping and ground rules for workshop
	○ Ice breaker
	○ Aims and objectives of the next two days
10:30 – 11:20	**Species Overview**
	○ Review of existing survey and monitoring data – Lyn Tegid plus current distribution and status in Europe
	○ Ecology and habitat requirements
	○ Threats
	○ Conservation to date
11:20 - 11:40	**Coffee break**
11:40 – 12:30	**Visioning session**
	○ In an ideal world do we want the species to look like in 30 years' time, its distribution, abundance, threats, people engagement etc.
12:30 – 13:30	**Lunch**
13:30 – 14:45	**Threat Analysis Workshop**

	○ Group exercise: Prioritising threats by severity and reversibility – identifying drives for each
14:45 – 15:00	**Coffee break**
15:00 – 16:00	**Goal Session (split into groups)**
16:00-16:20	**Goal Feedback Session (presenter from each group)**
16:20 – 17:00	**Wrap-Up & Reflection** ○ Key insights from Day 1 and present Vision ○ Preview of Day 2
Day 2 – Planning for Action	
09:30 – 09:45	**Recap of Day 1** ○ Vision agreed ○ Summary of threats ○ Introduce Goals
09:45– 11:15	**Objectives session** ○ Identify objectives under each of the goals (consider relevant threats) ○ Groups present back
11:15 – 11:30	**Coffee break**
11:30 – 12:30	**Action Planning Session I** ○ Filling out the action plan table for the goals, embedded under each of the objectives
12:30-12:45	**Action Planning Session I** ○ Groups present back
12:45 – 13:45	**Lunch**
13:45 – 14:45	**Action Planning Session II** ○ Filling out the action plan table for the goals, embedded under each of the objectives
14:45 - 15:00	**Action Planning Session II** ○ Groups present back

15:00 – 15:15	**Coffee break**
15:15 – 16:00	**Delivery Framework** ○ Roles and responsibilities and identify plan leadership ○ Opportunities for collaboration
16:00 – 16:30	**Next Steps & Closing remarks** ○ Agree outputs and timeline for follow-up

Expected Outputs

- Clear **species recovery vision** for *Myxas glutinosa* in England & Wales
- Prioritised **threats**
- Draft **action plan** (survey, research, habitat management, policy)
- Defined **roles, responsibilities, and partnerships**
- Agreed **timeline for next steps**

Glutinous Sail Task Force Action Planning Workshop Attendees List

Vicky Wilkins; Species Recovery Trust
Phill Robinson; Species Recovery Trust
Nicky Needham; BIAZA
Frankie Lawrence-Thompson, BIAZA
Iri Gill, Chester Zoo
Gerardo Garcia, Chester Zoo
Heather Prince, Chester Zoo
Javier Lopez, Chester Zoo
Kieran Richardson, Chester Zoo
Tom Slocombe, Askham Bryan College
Jack Williams, Dudley Zoo
Thomas Lewis, Longleat
Paul Pearce-Kelly, ZSL
Sam Eden, Wingham Wildlife Park
Gemma Harding, Natural England
Leah Williams, Chester Zoo
James Andrewes, Chester Zoo

Workshop Output

After the two-day workshop, a detailed action plan for the next 6 years was achieved. This action plan will allow all parties to achieve the goals formulated during the workshop within the dedicated timeframe and also provides clarity on what output is required for the specific action to be deemed successful.