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CONSERVATION MANAGEMENT OF THE FRESHWATER PEARL MUSSEL *Margaritifera margaritifera* Part 1: Biology of the species and its present situation in Ireland

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1. INTRODUCTION

The freshwater pearl mussel *Margaritifera margaritifera* has attracted much interest in recent years due to its interesting life cycle, ecology, ability to produce valuable pearls and, most importantly, decline which has left many populations extinct or seriously depleted.

Margaritifera margaritifera is one of two European species of pearl mussel which are now on the International Union for the Conservation of Nature and Natural Resources (I.U.C.N.) red data list (the other being *M. auricularia*). The same species have Council of Europe protection under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern convention). The European Union Directive on the Conservation of Natural and Semi-Natural Habitats and of Wild Fauna and Flora (Habitats Directive) lists *M. margaritifera* under Annex II (species whose conservation requires the designation of special conservation areas) and Annex V (species whose taking in the wild and exploitation may be subject to management measures), and *M. auricularia* under Annex IV (species of community interest in need of strict protection). Under Irish law, it is illegal to interfere with *M. margaritifera* (Statutory Instrument No. 112, 1990); thus pearl fishing is currently outlawed in the country. The hard water form of pearl mussel *Margaritifera durrovensis* (Phillips, 1928) is restricted to one small population in Ireland, and has been the subject of recent taxonomic debate as to whether it is a distinct species, sub-species or simply an eco-phenotype of *M. margaritifera* (Chesney *et al.*, 1993; Moorkens, 1996). For the purposes of conservation, it is described separately, but treated as within the taxon *M. margaritifera* (van Helsdingen *et al.*, 1996). Thus, it enjoys the same level of legal protection as the latter under Irish and European law.

2. SPECIES IDENTIFICATION, BIOLOGY AND LIFE-CYCLE

2.1 Species identification

There are about 20 species of freshwater bivalves in Ireland today, 16 of which are less than 20mm in length and belong to species of the pea and orb mussels (*Pisidium spp.* and *Sphaerium spp.*). Of the other four species, one is the recent introduction *Dreissena polymorpha*, the zebra mussel, up to 50mm long with an easily identifiable striped pattern and sharp, almost triangular shells. The three remaining species are over 50mm as adults, and include the swan mussel (*Anodonta cygnaea*) and the duck mussel (*Anodonta anatina*), both of which have thin shells with a greenish brown colour. Finally, *Margaritifera margaritifera* is large (up to 140mm), with an oval-shaped heavy black shell often eroded at the umbone (apex) (Figure 1). Occasionally *Anodonta anatina* populations have dark shells which gives the appearance of *M. margaritifera*, but a closer look at the shells' weight and shape should determine its identity. A key to large bivalves found in Ireland is given in Appendix 1.

2.2 Feeding of the adult mussel

Pearl mussels are filter feeders. Water enters the mantle cavity via the inhalant (lower) siphon, flows over a series of gills, and exits from the upper mantle cavity via the exhalant siphon (Figure 2). Food particles entering with the water get coated in mucus and transferred to digestive grooves. There they are sorted by size, and the small, digestible matter is passed to the digestive tract of oesophagus, stomach and intestine. Larger particles pass directly to the exhalant siphon. Strong adductor mussels

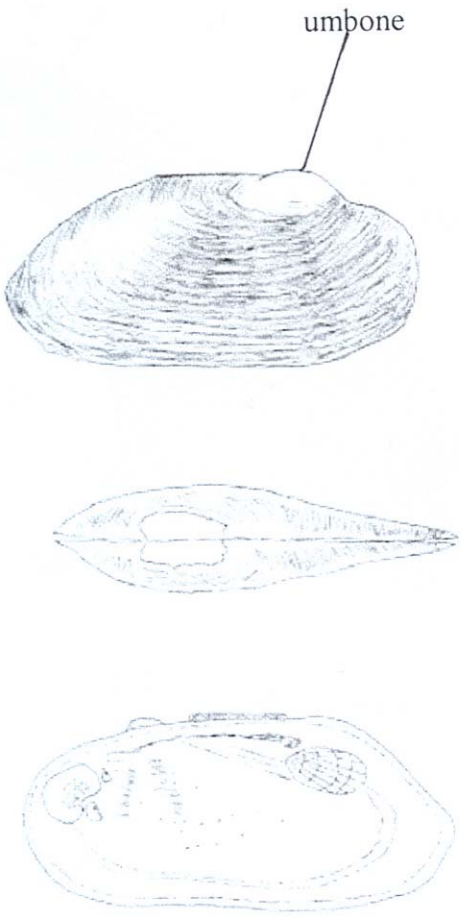

Figure 1. The freshwater pearl mussel *Margaritifera margaritifera*.
Top: exterior view of right valve; Centre: dorsal view of shell;
Bottom: interior view of right valve.

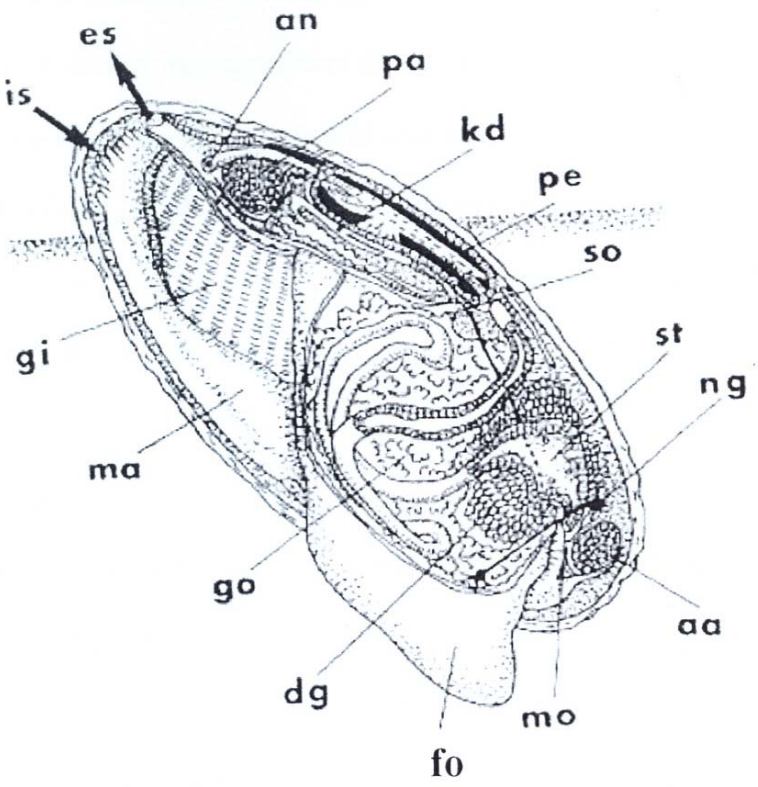

Figure 2. Anatomy of the pearl mussel *Margaritifera margaritifera* (after Ziuganov *et al.*, 1994).

aa - anterior adductor muscle; an - anus; dg - digestive gland; es - exhalant siphon; fo foot; gi - gills; go - gonads; is - inhalant siphon; kd - kidney duct; ma - mantle; mo - mouth opening; ng - nervous ganglia; pa - posterior adductor muscle; pe - pericardium; so – sexual opening; st - stomach.

close the shells, and they can remain tightly shut during adverse conditions. Protractor, retractor and elevator mussels control the movement of the foot, allowing the mussel to move slowly and bury. Under normal conditions, pearl mussels are buried by up to two-thirds of their length with the siphons exposed to the flowing water above the riverbed. Occasionally, trails can be seen on sandy riverbeds suggesting that mussels can move up to two metres along the riverbed in a relatively short space of time.

2.3 Life cycle

Members of the pearl mussel family, Margaritiferidae, have a complex life cycle (Fig. 3). They have a long life, living to more than 100 years of age (Comfort, 1957), maturing between 7 and 15 years of age (Meyers and Milleman, 1977; Smith, 1978; Young and Williams, 1984a), and can have a prolonged fertile period lasting into old age (Bauer, 1987). The sexes are normally separate. The male releases sperm into the open water through its exhalant siphon, which is carried to the eggs via the female inhalant siphon, and fertilisation occurs in the female's brood chambers (Smith, 1979). The eggs develop into the larval stage, called glochidia, which are first brooded in the female gills, and then, at approximately 80μm in length (Young and Williams, 1984a), are released into the open water in high numbers. An average of 9.8 million glochidia were found to be produced per female under suitable conditions in this annual release (E. Ross, 1988). A small percentage will be inhaled by passing salmonid fish (Bauer and Vogel, 1987), which act as the pearl mussels' temporary hosts. Glochidia are simple organisms with little more than a pair of shells, an adductor muscle to snap them shut, and a layer of cells which can absorb and digest nutrients (Ziuganov et al., 1994). The valves close on a filament of the salmonid gills. The dense layer of outer cells on the glochidia contain numerous microvilli, suggesting that nourishment is

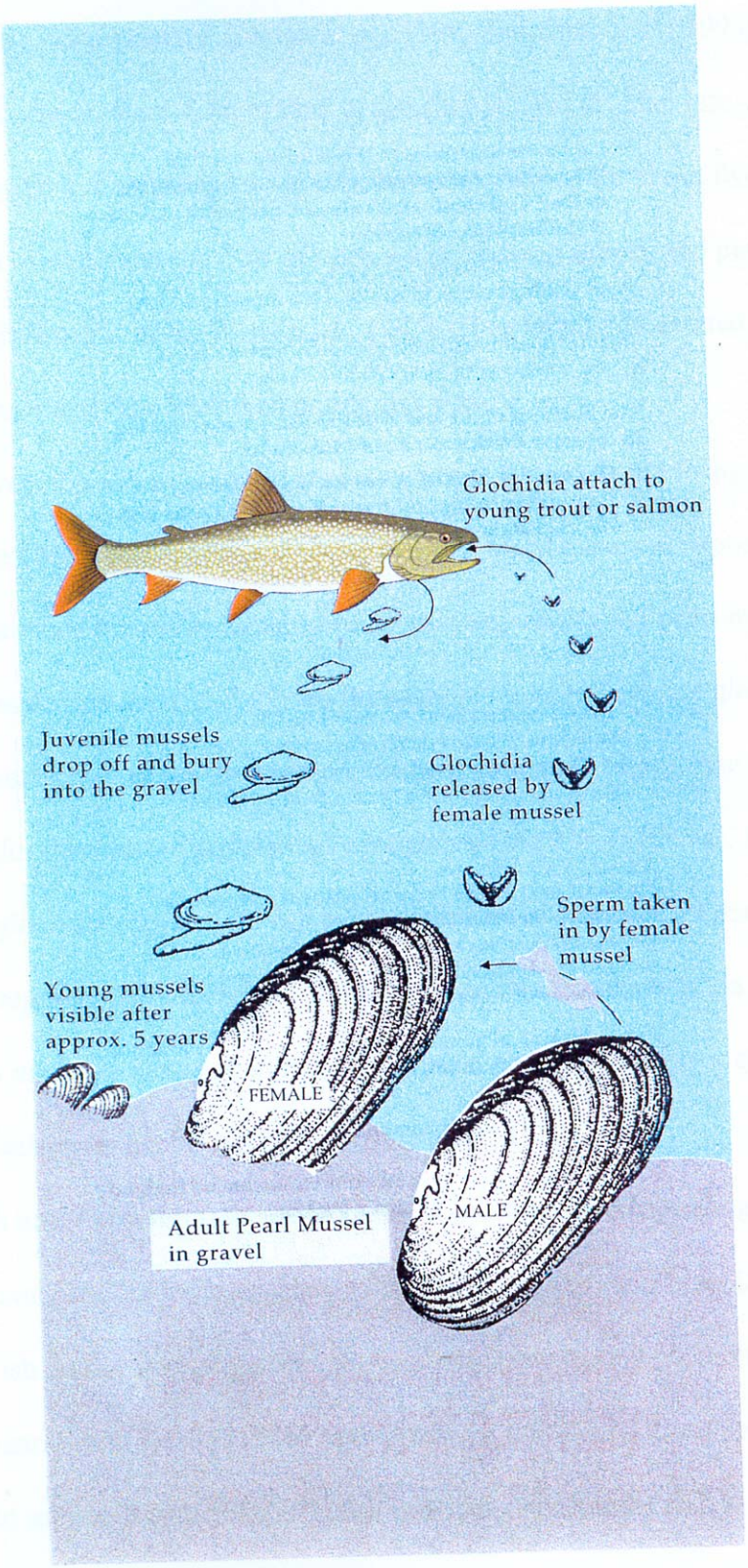

Figure 3. Life cycle of the freshwater pearl mussel *Margaritifera margaritifera*.

absorbed from the gill tissue of the fish host until the glochidia are large and mature enough to exist independently (Nezlin *et al.*, 1994; Ziuganov *et al.*, 1994). During this time they increase to about 6 times their original length and develop into young mussels. They fall off and bury into gravel, remaining buried for about five years, until large enough to withstand the flow of open water, moving stones, and perhaps trout predation (Cranbrook, 1976; Wells *et al.*, 1983). They require an aerated flow of interstitial water and they filter feed during this time.

The retention of a glochidial stage is unusual for a creature living in fast flowing water. Most freshwater molluscs have developed means of depositing eggs safely in gelatinous masses or attached to aquatic vegetation, but pearl mussels release free glochidia downstream, and rely on the salmonid host to keep the glochidia from being transported out to sea. In addition, the host attachment stage may act as a mechanism for dispersal of populations upstream within a river (Oliver, 1993). The survival of glochidia encysted on fish gills in salinities of almost 50% seawater for up to 14 days suggests that movement of fish between river catchments via the sea could have been a useful means of pearl mussel colonisation of isolated river catchments in the diluted sea water conditions of the past (Purser, 1988).

Fish hosts vary throughout the range of pearl mussels depending on the salmonids available. In Ireland, native salmon (*Salmo* salar) and trout (*Salmo trutta*) are used. Fish do not normally suffer any disability from having glochidia attached. Indeed Ziuganov and Nezlin (1988) have proposed that the relationship of pearl mussels and salmon is symbiotic. The fish provides the essential step in the mussel's life cycle, and adult mussels improve water quality by filtering water. Each mussel can filter up to 50 litres of water per day (Ziuganov and Nezlin, 1988). In the Varzuga River in Russia, Ziuganov and Nezlin (1988) estimated that mussels filter 90%

volume of the river in low water years. However, pearl mussels are not capable of using non-native fish (e.g. rainbow trout) for glochidial attachment (Young and Williams, 1984b). Thus, stocking rivers with “coarse fish” or non-local salmonids can seriously affect its mussel population.

Timing of glochidial release varies between populations, but in Ireland it occurs between August and September (H. Ross, 1992; Moorkens, 1996).

3. ECOLOGY

Margaritifera margaritifera is found in clean, well-oxygenated rivers which flow over non-calcareous rock. These waters have little calcium and are generally low in nutrients. Unlike the swan and duck mussels, *Anodonta cygnaea* and *A. anatina,* which live in calcium-rich waters, and live for only a few years, the nature of the *M. margaritifera* habitat means that the pearl mussel grows slowly, taking many years to build up its layers of shell. There is one population in Ireland from hard water, which is known as *Margaritifera durrovensis* (Phillips, 1928). While this population is a source of scientific and taxonomic interest (it is regarded by some specialists as a separate species), it is more important to note that it is highly endangered, with few adults left and no juveniles (Moorkens and Costello, 1994).

As well as waters which are high in oxygen, poor in mineral and organic content, the substrate of the river bed is of great importance, and determines in which areas within a river the pearl mussels can survive. Clean gravel and sand are essential to a healthy population. Within this substrate, oxygen can move freely to the juvenile mussels, which are still buried. If this substrate becomes clogged with silt, oxygen can no longer reach juveniles and they die (Buddensiek *et al.*, 1993). If un-naturally large quantities of silt accumulate on the riverbed, or the bed becomes coated in filamentous algae, no juveniles will survive and adults can become stressed, clam their shells shut, and begin to waste away and die (Moorkens, 1996). In some rivers, mussels are associated with shaded areas of river (Gittings *et al.*, 1998), but in very clean waters, they are found in high numbers in open, unshaded areas (Moorkens, 1996).

4. HISTORY

4.1 Evolutionary History

The family Margaritiferidae (Bivalvia : Unionoida) consists of a number of different genera with a disjunct relict distribution in North America, Europe, East and South-Eastern Asia (Baranescu, 1990). The largest genus is *Margaritifera* which is circumpolar in distribution. The other genera all have more southerly ranges from the central United States of America to Thailand, China and Borneo (Starabogatov, 1970; Baranescu, 1990). Fossil margaritiferids have been recorded from Cretaceous and Jurassic material in North America, Europe and East Asia (Starabogatov, 1970). Margaritiferid anatomy also suggests this to be one of the oldest families amongst the Mollusca, with such primitive features as undeveloped siphons, an incomplete diaphragm and use of all gills to brood larvae (Hannibal, 1912). They are thought to have evolved from the marine Mesozoic Trigonioididae (Baranescu, 1990).

During the ice ages, populations may have been restricted to more southerly refugia in Europe. While there is anecdotal evidence that individuals can survive temporary freezing, there have been no ice age fossils of *M. margaritifera* found in Ireland, although fossils found of *M. durrovensis* may be inter-glacial (Mc Millan and Zeissler, 1990). It is likely that repopulation occurred from Europe after the end of the last ice age (Purser, 1988).

4.2 Cultural History

Freshwater pearl mussels have been associated with man since at least the Bronze Age, where shell valves were thought to have been used as utensils for scooping up food, and for ornamental purposes (Dixon, 1865). In Europe, mussel

flesh was used to fatten geese, to fertilise land and as bait for fishermen (von Hessling, 1859). Of most importance was the discovery that some individuals produce pearls. Caesar is said to have returned to Rome with a breastplate covered in British pearls (Jackson, 1925) and ever since, mussel populations throughout the species' range have been exploited for pearls. This has lead to the decimation of many famous populations, with thousands of mussels being killed in the pursuit of one pearl (Goodwin, 1985). There is evidence that pearl fishing is still occurs in Ireland, in spite of legislation banning it totally. In recent years, some of these fishermen have been from other countries, where there is a more widespread knowledge of the threat of pearl fishing and there have been convictions and prison sentences for this crime.

5. PRESENT STATUS AND DISTRIBUTION

The presence of *Margaritifera margaritifera* in Ireland has been referred to for centuries. The oldest references relate to important pearls and pearl-fishing rivers, the earliest being from c.1094 regarding the presentation of an Irish pearl from the Bishop of Limerick to the Archbishop of Canterbury (Went, 1947). Distributional information engendered by interest in Natural History came much later, with Stelfox (1911) giving the first vice-county based distribution map, showing that 23 of the then 40 vice-counties in the island had pearl mussel records. With the benefit of hindsight, his comment that this species was "seemingly scarcer than in former times in many rivers, perhaps owing to depredations of the pearl-searchers and their wanton destruction" seems remarkably astute. Jackson (1925) gave more detailed distribution accounts, naming rivers by county, and mentioning populations in 22 out of the 32 counties in Ireland. One of these reports was erroneous, the Sligo record was actually from a Mayo site, but recently pearl mussels have been found for the first time in Sligo (D. Cotton, pers. comm.). A decline in biological recording meant that by the time the first 10km square Molluscan Atlas which included Ireland was published, there were only 8 records for *M. margaritifera* since 1950 (Kerney, 1976). More recent work (Lucey, 1993; Beasley and Roberts, 1996; Moorkens, 1996) has found that the species is still widespread, with at least remnant populations well dispersed around the country away from the central limestone plain, in soft waters lying mainly on granite or sandstone bedrock, except for the *M. durrovensis* population in the lime-rich river Nore (Fig. 4).

While new distribution maps show that pearl mussels are widespread in Ireland, the status of these populations is a different matter. In a recent study of 32 living populations of *M. margaritifera*, it was found that only 8 had young mussels present

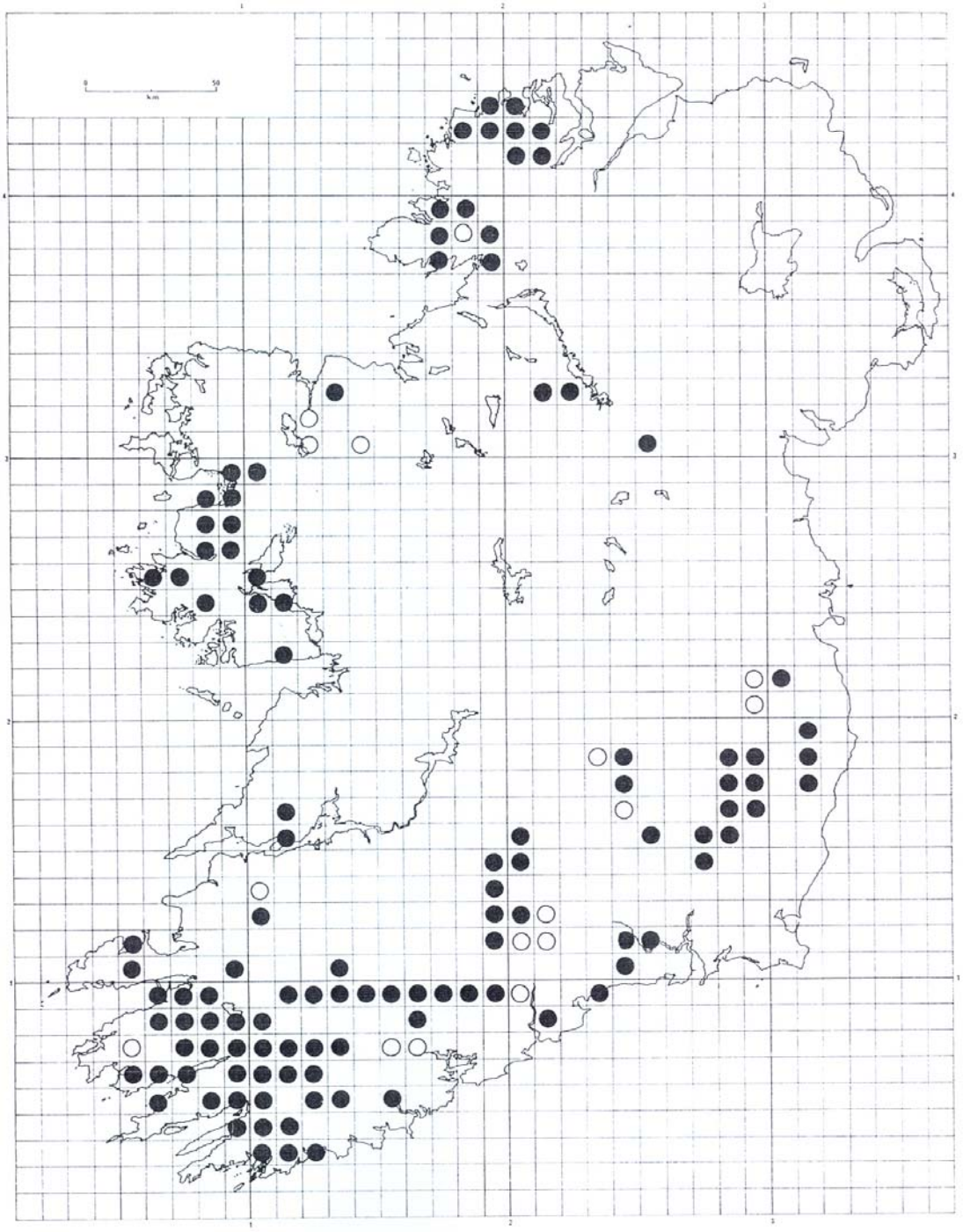

Figure 4. Distribution of *Margaritifera margaritifera* in Ireland (including *M. durrovensis*) since 1987. Data from Beasley and Roberts (1996), Lucey (1993), Moorkens *et al.*, 1992, Moorkens (1996), and Duchas data. Open circles = dead shells only, closed circles = living mussels.

(Moorkens, 1996). In some of these populations, the last successful recruitment of young dated back to the 1960s or early 1970s. In many cases the first cause of decline may have been, as Stelfox suggested, pearl fishing. However, since the 1970's, the main cause for decline has been deteriorating river quality, and the largest populations are to be found in remote areas with the least changes to the river channel, and with the least intensive agriculture, forestry, industry or human pressure within the catchment (Moorkens, 1996).

Mainland Europe has experienced a great decline in pearl mussels over the last century (Dyk & Dykova, 1974; Wells *et al.*, 1983; Bauer, 1983, 1987, 1988). The decline in Ireland has come slower and later than on the more industrialised European mainland. Reduced populations cannot clean the water they live in, by filtration, as effectively as can more numerous natural populations, to the probable detriment of fish populations and general river water quality. We have the potential to conserve and improve conditions for the mussel populations that we are still lucky enough to have. By doing so we would not only be honouring our obligations under international conservation legislation like the EU Habitats and Species Directive, but also enabling this species to once more play its role in maintaining high quality water in Irish rivers.

6. THREATS

To assess the threats to freshwater pearl mussels, their most important requirements must be reiterated. Previous sections have discussed the need for clean, well-oxygenated water, which is low in minerals and nutrients, and a clean riverbed including well-oxygenated gravel and sand substrate. Their life cycle shows the need for large numbers of glochidial larvae in order to have a statistical chance of being inhaled by a passing salmonid - thus there is likely to be a minimum number of reproducing individuals within a unit of mussel population below which it becomes unviable. Anything that directly or indirectly interferes with the above requirements would constitute a threat to *M. margaritifera*. The main threats which have been identified as occurring in Ireland are listed below. This minimum population sub-unit is regarded as being 500 reproducing individuals within 0.5km of river.

6.1 Nutrient enrichment

Use of artificial fertilisers, spreading of slurry, untreated sewage and industrial waste with a high biological oxygen demand (BOD), even when at low levels as a point source of enrichment, combine to increase nutrient levels within a river system to an extent which can in time change the river from oligotrophic to mesotrophic to eutrophic. Initial negative effects may be stress on the filter feeding mechanism within adult mussels, adapted for systems where nutrients are low (adults “clam-up” in the presence of high suspended solids). Excessive nutrients encourage filamentous algal growth, which then coats the bed of the river, leading to oxygen deprivation below the substrate surface, making it uninhabitable for juvenile mussels. As the alga dies, it decomposes into fine organic silt which reaches deeper into the interstices of

the gravel, causing long term clogging and less chance of fresh oxygenated water reaching the substrate.

6.2 Pollution incidents

Severe single pollution events, such as slurry, silage, sheep dip or industrial spills, are well known for causing large fish kills (McCarthy, 1988; McCarthy and Moriarty, 1989; Moriarty, 1990). In a pearl mussel river, the effects of such an incident can range from loss of the salmonid fish which are essential to the mussel's life cycle, to long term stress and death of adult and young mussels from oxygen deprivation, to immediate death of the entire mussel population from toxic poisoning, as has happened following the release of sheep-dip into a system.

6.3 River bank erosion

Erosion of riverbanks is caused at sites where cattle enter the river to drink, or is the result of removal of bankside vegetation. Whatever the cause, the effects are the same, the eroded banks fall into the water and are reduced to silt by the force of the current, to be deposited downstream to coat the river bed. The banks are then unstable and are vulnerable to further episodes of erosion by the same causal factors and at times of flood.

6.4 Forest plantation

In preparing areas for forestry, the ground is ploughed and ditched, following which a series of drills are cut and considerable quantities of artificial fertiliser are applied. The consequent runoff of soil and nutrients to nearby rivers causes problems as outlined above. If the forestry is on a steep slope in the river valley, and on poorly

buffered acidic land with peaty soil, both of which are often the case in *Margaritifera* catchments, the problem becomes more extreme, with large quantities of peat silt entering the river. If the forestry is coniferous, the problems continue as the trees mature and cause acidification of the river. Harvesting the crop later causes another massive influx of silt, due to soil exposure and run-off accompanying clear-felling activities.

6.5 Road building

Development of a road or building works close to a river can result in the introduction of silt from run-off, leading to problems as described above.

6.6 Bog drainage and arterial drainage schemes

Drainage of bogs in the upland regions of river catchments can lead to large quantities of peat silt being carried into the river. This silt is fine and large quantities can be carried long distances downstream and fill in the smallest substrate interstices. Widespread drainage of farmland changes the flow regime within a river, and can cause bank erosion, and erosion of the substrate within the riverbed.

6.7 Salmonid stocks

A healthy pearl mussel population relies on a healthy salmonid population. Each glochidium produced can only survive for 24 hours without finding a fish host (Young and Williams, 1984b). The same authors calculated in field studies with healthy salmonid stocks that failure to find a host within this 24 hours occurred 99.9996% of the time (Young and Williams, 1984a). They also found a 95% loss of glochidia while attached to fish. A reduced fish population could have an immediate

effect on the viability of a pearl mussel population. Restocking of salmonids from stocks not originating in the catchment into which they are released can also be very detrimental, since the introduced stocks can prove unsuitable for glochidial attachment (Young and Williams, 1984b).

6.8 Pearl fishing

Pearl fishing has become untenable in the majority of mussel rivers as adult numbers have dropped so low that the statistical chance of finding a pearl has become negligible. In Ireland, it is therefore the best populations of mussels that are most at risk of being fished for pearls. Anecdotal evidence and evidence from dead shells has shown that at least 5 of the 8 rivers known to contain reproducing mussel populations have been fished in the recent past (Moorkens, 1996).

6.9 River modification

Canalisation of a river changes its flow regime and substrate content. A recent study found a strong negative correlation between rivers that had been canalised and the presence of pearl mussels (Moorkens, 1996). Other modifications that could damage a pearl mussel river are the building of large weirs or dams which would create a barrier to the movement of either mussels or salmonids. The clearing of vegetation from riverbanks, especially the removal of trees, is most detrimental. Algal growth is promoted in the absence of shading trees, and the river water quality suffers when the filtration effect of the roots of river-edge trees is removed and nutrients run directly to the river. Removal of vegetation also creates riverbank instability, leading to bank collapse and subsequent siltation.

6.10 Overgrazing

Overgrazing by sheep is a well known problem in parts of Ireland. In some situations, the blanket of vegetation on highly grazed hillsides has been removed, and exposed soil can be carried by rain into the river below to add to its silt load.

6.11 Water abstraction

Abstraction of river water close to pearl mussels can lead to a lowering of water quality and a raising of water temperature which could adversely affect a population. This is particularly a problem when periods of low rainfall lead to reduced flow in river channels.

6.12 Introduction of exotic species

The restocking of *Margaritifera* rivers with non-native fish stocks has been found to be detrimental to pearl mussel reproduction, because glochidial encystment cannot take place, and the non-native fish may out compete native fish of the same species, making the problem for pearl mussels worse over time (Valovirta, 1998).

The potential for negative effect of an exotic mollusc introduction cannot be ruled out. Recently the zebra mussel *Dreissena polymorpha* has reached Ireland and spread to a number of linked waterways (Minchin and Moriarty, 1998). Serious infestations of unionid mussels by *Dreissena* in North America has lead to their decline in populations where both taxa are present (Schloesser and Kovalak, 1991). The zebra mussel appears to spread by attaching to the hulls of boats and while most pearl mussel rivers are not within the navigable catchments, there is a strong possibility that zebra mussels will make their way to the Barrow navigation, and

possibly to the river Nore, or the Barrow and Suir tributaries, some of which do have pearl mussels (Moorkens *et al.*, 1992). However, the requirement of zebra mussels for a higher calcium content in water than that normally tolerated by *Margaritifera* should ensure that negative interactions between these species are localised and do not affect the vast majority of remaining Irish *Margaritifera* populations.

7. CONCLUSIONS

Nearly all of the negative influences upon pearl mussel populations detailed on the proceeding pages are continuing in rivers throughout the country. Indeed, with increasing use of the land by man the intensity of these negative influences is in many cases still increasing. It can thus only be concluded that, without active intervention aimed at halting and reversing negative impacts on pearl mussel rivers, more of the remaining populations of pearl mussel are doomed to die out, as has happened already in most parts of Europe where this mollusc once occurred.

There is a clear need to define measures which may be taken to maintain and improve pearl mussel populations. A second publication in this series will address these issues. The reader should note that a schedule made under the Wildlife Act 1976 prohibits all collection of pearl mussels in Ireland and that a range of actions, deemed deleterious to the mussel and/or its habitat, are covered under the statutory instruments relating to the establishment of Special Areas of Conservation under the EU Habitats and Species Directive, as detailed in Appendix 2.

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APPENDIX 1

Key to large bivalve mussels found in Ireland

1 Triangular shaped shell with zig-zag stripes, mussels attached to substrata by byssus threads, maximum adult size 40mm (Fig. A1)……..……***Dreissena polymorpha***

(for distribution see Minchin and Moriarty, 1998)

- Free-living mussels, not triangular in shape…….. 2

2 Shell has hinge teeth present (check dead shell)...…… 3

- Shell has no hinge teeth present, but often has a wing…….. 4

3 Shell black in adult, eroded at the umbone, up to 150mm long (Fig. A2)……..….***Margaritifera margaritifera***

- Shell brown/black in adult, not eroded at the umbone, up to 110mm long (Fig. A3)……... ***Margaritifera durrovensis***

4 Shell is of uniform thickness (check dead shell), up to 150mm long, living animal yellow (Fig. A4)…… ***Anodonta cygnaea***

(for distribution see Lucey, 1995)

- Shell has areas of thickening near umbone, up to 100mm long, living animal cream in colour (Fig. A5)…… ***Anodonta anatina***

(for distribution see Lucey, 1995)

The following figures are from Ellis (1962) except for Fig. A2 (2).

Fig. A1 *Dreissena polymorpha* (1) Left valve, (2) Dorsal view.

Teeth

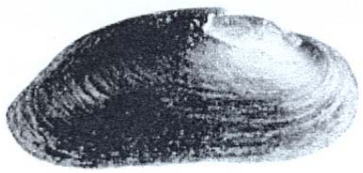

Fig. A2 *Margaritifera margaritifera.* (1) Inside of right valve showing teeth, (2) View of right valve.

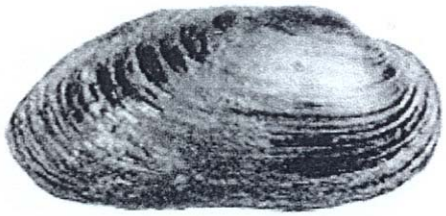

Fig. A3 *Margaritifera durrovensis.* View of right valve.

Wing

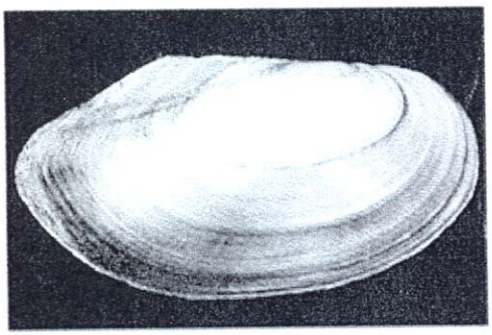

Fig. A4 *Anodonta cygnaea.* View of right valve.

Fig. A5 *Anodonta anatina.* View of left valve.

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APPENDIX 2

Below is the text of the Notice of Notifiable Actions relating to *Margaritifera margaritifera.* This notice is sent by Duchas, National Parks and Wildlife to landowners whose land is proposed for designation as an SAC for the protection of *Margaritifera margaritifera.*

NOTICE OF NOTIFIABLE ACTIONS

Under STATUTORY INSTRUMENT 94 of 1997, made under the EUROPEAN COMMUNITIES ACT 1972 and in accordance with the obligations inherent in the COUNCIL DIRECTIVE 92/43/EEC of 21 May 1992 (the Habitats Directive) on the conservation of the natural habitats and species of wild fauna and flora, all persons must obtain the written consent of the Minister for Arts, Culture and the Gaeltacht before performing any of the operations listed below on, or affecting, the habitat of the species, *river lamprey, sea lamprey, brook lamprey, salmon, twaite shad, white-clawed crayfish, fresh water pearl mussel* **where they occur on these lands / water areas**

Where a landowner has a current approved plan under the Rural Environmental Protection Scheme or any scheme which the Minister considers to be equivalent s/he need only notify the Minister of activities not covered in the plan.

The activities which should not be undertaken before consent are;

- grazing of livestock above a sustainable density (as defined in approved farm plans) within 30m of the river or stream
- grazing by livestock treated within the previous week with a pesticide which leaves persistent residues in the dung
- supplementary feeding of stock within 30m of the river or stream adding lime within 30m of the river or stream
- adding fertiliser of any sort within 30m of the river or stream extracting water for irrigation or other purposes
- operation of boat angling or shore angling business restocking with fish
- reclamation, infilling, ploughing or land drainage within 30m of the river or stream
- reseeding, planting of trees or any other species within 30m of the river or stream
- removal of trees or any aquatic vegetation within 30m of the river/stream
- use of any pesticide or herbicide in the river or stream or within 30m of the river or stream
- dumping rubbish or other materials or disposing of any chemicals or wastes in streams/rivers or into water-courses running into them

- dumping, burning or storing any materials within 30m of the river/stream including the land spreading of used pesticides (e.g. sheep dip).
- alteration of the banks, channel, bed or flow of the river or stream
- harvesting or burning of reed or willow.
- causing siltation
- operation of commercial recreation facilities (e.g. bird watching tours)
- introduction (or re-introduction) into the wild of plants or animals of species not currently found in the area
- any other activity of which notice may be given by the Minister from time to time

Please note that it is an offence under the Wildlife Act 1976 to kill injure or disturb these species or to destroy their breeding places.

Please note that the activities listed below may *require a licence or consent from another statutory authority (e.g. the local planning authority, the Minister for the Marine or the Minister for Agriculture, Food and Forestry).* **The activities listed below must be *notified to the Minister for Arts, Culture and the Gaeltacht when they are not regulated by another statutory authority***

- fishing for fresh-water pearl mussels
- culture of crayfish
- construction or operation of an aquaculture facility.
- fishing for eels or salmon
- bank maintenance and grading
- creation of weirs and dams

EXPLANATORY NOTE

The Minister for Arts, Culture and the Gaeltacht has the responsibility under these Regulations to implement the European Union Directive on the protection of habitats. This Directive sets out a procedure for ensuring that the farming and other management within a designated site (Special Area of Conservation) is done in a way which will not damage the environment. The legal mechanism to achieve this objective is to serve on landowners and occupiers a notice stating that they must consult with the Minister before doing certain things.

In most cases the Minister's objective of sustainable farming will be met by a continuation of the current agricultural practices and after the consultation period, the farmer will continue to farm as slhe always has. In some cases an intensification of agriculture (e.g. an increase in stock numbers) will not be environmentally sustainable and will not be acceptable to the Minister. In these cases the activity must be discontinued and a compensation system will be invoked. There are legal penalties for persons who ignore this procedure.

The restrictions apply to "habitats" such as "sand dunes" or "blanket bog" or to certain populations of species (such as lampreys *at spanning beds). The Minister's staff in the National Parks and Wildlife Service will assist anyone who is in doubt about where the habitat or species is on their land.*