

# **A Strategy for Conservation of the Freshwater Pearl Mussel in Ireland**

The National Parks and Wildlife Service

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## **SUMMARY**

The objective of this strategy is to ensure the long-term survival of the species in Ireland, while maintaining its broad geographic range. The strategy sets out a prioritised approach to the implementation of measures necessary to conserve the species.

The measures required to restore pearl mussel habitat in the 27 catchments are resource-hungry, in terms of staff, money and expertise. Many of the measures are new and will require testing and further development. It is neither possible nor desirable to implement all necessary measures across the 27 catchments in this first planning cycle.

The national conservation strategy advocates the full implementation of measures in those catchments where:

1. The largest pearl mussel populations occur.
2. The mussel population is closest to favourable conservation status and, thus, has the greatest chance of demonstrating a recovery (using the criteria set out in the Third Schedule to S.I. 296 of 2009).
3. The mussel habitat is most likely to demonstrate improvements in the ecological quality objectives set out in the Fourth Schedule to S.I. 296 of 2009.
4. The impacting pressures are best understood and, therefore, the measures are expected to be effective.

The strategy prioritises eight of the 27 populations and encompasses approximately 9.6 million or 80% of the Irish freshwater pearl mussel population. This equates to approximately 37% of the EU freshwater pearl mussel population. It also proposes particular measures for the Nore pearl mussel population and a freshwater pearl mussel population in the South East.

This prioritisation will allow for the effectiveness of the pearl mussel measures to be fully and properly tested and, more importantly, will give the greatest chance that the largest pearl mussel populations in Ireland and the world will return to favourable conservation status in the short to medium term.

The approach seeks to ensure the wise use of resources to deliver the optimal nature conservation benefits. The national conservation strategy will be reviewed at the end of the first Sub-basin Management Plan-cycle.

# 1 A National Conservation Strategy for the Freshwater Pearl Mussel (*Margaritifera margaritifera* and *M. durrovensis*)

## 1.1 INTRODUCTION

### 1.1.1 Background

The freshwater pearl mussel, *Margaritifera margaritifera*, is endangered worldwide and in serious decline throughout its range. Ireland is considered to host approximately 46% of the EU population of the species, and has approximately 96 individual populations within 139 rivers and a handful of lakes. These populations range in size from hundreds of adult individuals to almost 3 million individuals. It is clear, therefore, that Ireland has a very significant international responsibility for the conservation of the species.

Ireland also holds the only population of the endemic *M. durrovensis* (Nore pearl mussel) which is very closely related to *M. margaritifera*.

### 1.1.2 Ecological Status

Both species are extremely sensitive to sedimentation and eutrophication. The sources of the sediment and nutrients that impact on mussels are distributed throughout the catchments and not just found within or immediately adjacent to the populations.

In 2007, Ireland reported to the EU that all of its pearl mussel populations were in “bad” conservation status (NPWS, 2007<sup>1</sup>). Since then, one population, the Bundorragha in Co. Mayo, has recovered to favourable status. This is believed to be due to reductions in the overgrazing pressures within the Bundorragha catchment, combined with the increased frequency of flood events in the last four to five years leading to wash-out of fines from the river substratum.

### 1.1.3 Legal position

Under the Habitats Directive (92/43/EEC) and the European Union (Natural Habitats) Regulations (S.I. 94 of 1997), Ireland is required to designate Special Areas of Conservation (SAC) for the freshwater pearl mussels *Margaritifera margaritifera* and *M. durrovensis*. Ireland listed *M. margaritifera* as a qualifying interest in 19 SAC, within which 26 populations are identified. *M. durrovensis* is listed as a qualifying interest in one SAC.

In response to ECJ case C-282/02 under the Dangerous Substance Directive, Ireland made the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations (S.I. 296 of 2009). These regulations introduced ecological objectives for the 27 populations listed as qualifying interests of SAC. The Regulations also required the development of 27 WFD Sub-basin Management Plans, with an additional set of programmes of measures to reduce the pressures responsible for mussels’ unfavourable conservation status.

The development of the Sub-basin Management Plans has been completed. The work involved collating historic and NPWS data on pearl mussels, as well as existing data on pressures within the catchments, and augmenting both through detailed field survey. A National Conservation Working Group was set up to advise on the Plans, with representatives from relevant Government Departments and Agencies, including agriculture and forestry. The process of developing the Plans has led to the formulation of a draft conservation strategy for the species, as well as detailed programmes of measures.

## 1.2 MAIN OUTCOMES FROM SUB-BASIN MANAGEMENT PLAN PROJECT

The analyses conducted by the project demonstrated the following:

- One population has recovered to favourable conservation status<sup>2</sup>.

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<sup>1</sup> <http://www.npws.ie/publications/euconservationstatus/>

<sup>2</sup> The Habitats Directive requires that Member States report on the “conservation status” of the Annexed habitats and species. Conservation status is divided into “favourable” (a pass) and “unfavourable” (a failure). Unfavourable conservation status can be further divided into “unfavourable inadequate” and “unfavourable bad”. In Ireland, the

- 26 populations are in unfavourable conservation status (including the sole population of *M. durrovensis*).
- A few populations are relatively close to favourable conservation status, but have too few juvenile mussels as a result of deterioration in habitat condition.
- Many of the remaining populations and their habitats failed all criteria and objectives as set out in S.I. 296 of 2009. In the worst cases, a total absence of juvenile mussels was combined with significantly elevated mortality rates in adults and extremely bad habitat conditions.
- One population may be extinct<sup>3</sup>.
- The principal cause of the species' decline is sedimentation, with eutrophication also a significant factor.
- The rate of population decline relates to the number and magnitude of the pressures in the catchment.
- The most significant pressures across the 27 catchments are:
  - (point sources)
    - Quarries, sand and gravel pits
    - Wastewater treatments plants (WwTP)
  - (diffuse sources)
    - Agriculture (including overgrazing)
    - Forestry
    - On-site wastewater treatment systems (OSS)
- Other more localised pressures include peat extraction, flow regulation, abstractions and morphological changes to the river bed and banks.

Detailed management measures are being designed to eliminate or mitigate the impacts caused by the various pressures. For the Plans to succeed, it is critical that the measures used should be as cost-effective as possible. In general, point source pressures can be managed. However, diffuse pressures are significantly more difficult to manage because they are more challenging technically, they often arise even when agricultural activities comply with the rules of GAEC and existing controls and incentives are insufficient to achieve the very high water quality required by the mussel species.

All discharges to water require authorisation, under a range of legislative controls. Under S.I. 296 of 2009, all authorised discharges must be examined, and if necessary reviewed, by the 22<sup>nd</sup> December 2011 (Regulation 13) to bring them into compliance with the pearl mussel environmental objectives. In addition, engineering solutions are well developed for treating wastewaters. Thus, a clear mechanism exists for achieving the required discharge standards for quarries, sand and gravel pits, WwTPs, etc.

Of the significant diffuse pressures, on-site wastewater systems (OSS) may be the most manageable. Firstly, there is a range of solutions available for their upgrade, from conventional septic tanks to mechanical aeration systems, and from natural/augmented percolation areas to constructed wetlands. In addition, improved operation and maintenance of existing systems is likely to yield significant reductions in pollution. Secondly, in response to the ECJ Judgement in the case C-188/08 under the Waste Directive, Ireland is preparing new legislative controls for on-site waste water treatment systems that will provide for the monitoring and inspection of such systems.

The agricultural and forestry pressures identified in pearl mussel catchments come, in the main, from land-use that is inappropriate to the physical setting, such as conversion to intensive grassland through drainage and heavy fertilisation, or clearfell forestry on peaty soils. There are many cases of small-scale on-farm activities which, in combination, impact on the condition of the rivers and their mussel

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conservation status of SAC pearl mussel populations is incorporated into the classification of Water Framework Directive (WFD) status, so that only favourable pearl mussel populations can be classified as "good" or "high" under the WFD, while unfavourable populations can be no better than "moderate" WFD status.

<sup>3</sup> Note: one population, the Aughavaud, appears to be extinct, however further survey is required to confirm its status.

populations. Consequently, remediation of the pressure will require appropriate management, which will include options ranging from land-use change to reductions in agricultural/forestry productivity.

In addition to eliminating/mitigating existing pressures, there is also a need for measures to prevent future increases in pressures. The new European Communities (Environmental Impact Assessment) (Agriculture) Regulations, S.I. 456 of 2011, Planning and Development (Amendment) (No. 2) Regulations, S.I. 454 of 2011, European Communities (Amendment to Planning and Development Regulations) Regulations, S.I. 464 of 2011 and associated guidance documents, arising out of ECJ case C-66/06, will provide an important framework for control of agricultural intensification in pearl mussel catchments. The new European Communities (Birds and Natural Habitats) Regulations also provide mechanisms for the control of potentially damaging activities within the catchments of pearl mussel SAC populations. The development of the associated policy, guidance, training and enforcement mechanisms will be key to the effectiveness of these Regulations.

To summarise, the main pressures causing sedimentation and/or nutrient enrichment impacts in pearl mussel catchments are various point sources and agriculture, forestry and on-site systems. Of the measures needed to manage these pressures, the most difficult, and costly, are likely to be those associated with agriculture and forestry.

### **1.3 CONSERVATION STRATEGY**

All 27 SAC catchments have widespread, multiple pressures that present significant technical challenges. It must be recognised that it will not be possible, for a wide variety of technical reasons<sup>4</sup>, to fully implement and/or detect the benefits of all measures across the 27 catchments within this Sub-basin Plan cycle. Technical restrictions, therefore, heavily influence the date by which favourable conservation status can be restored.

It is clear that it will not be possible to restore some of the 27 populations, because of the low number and poor condition of the remaining mussels, the bad status of the mussel habitat and the magnitude of the pressures in the catchment. It is now evident that such problems existed even at the time of some designations.

The proposed conservation strategy aims to achieve the maximum conservation outputs, in terms of numbers of mussels and populations sustained over the long-term, for the restoration effort.

#### **1.3.1 The need for prioritisation**

To achieve maximum conservation benefits for the resource investment, prioritisation of the implementation of measures is essential. This is best achieved by concentrating on a number of populations/catchments, rather than spreading resources across all catchments. The main effort will, therefore, concentrate on the biggest and best populations, where confidence in the likely effectiveness of the measures is highest. This approach can justify expenditure, avoid disproportionate costs and prevent unnecessary restrictions on economic, social, cultural or other activities. Such an approach is, furthermore, likely to receive the greatest political and stakeholder support and, therefore, have increased chances of success.

The approach also provides for better testing and assessment of the effectiveness of the various measures, by applying such measures to those catchments where the pressures are clearly separated spatially, and responses in the mussel and its habitat are more likely to be detectable over the life-time of the plan.

#### **1.3.2 Prioritisation process**

Dr Evelyn Moorkens has recently published a paper<sup>5</sup> (attached), based on work conducted under the Sub-basin Management Plan Project, that proposes a prioritisation system and grapples with the need

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<sup>4</sup> Examples include the time it will take for excess phosphorus stored in soils to be lost to water, or an effective buffer zone to develop or time constraints arising out of public procurement rules.

<sup>5</sup> Moorkens, E.A. (2010) Addressing the Conservation and Rehabilitation of *Margaritifera margaritifera* populations in the Republic of Ireland within the framework of the Habitats and Species Directive. *Journal of Conchology*, Vol. 40 No. 3

for a conservation strategy. The overall aim of the paper was to develop a conservation strategy to ensure the long-term survival of the species on the island of Ireland and, thus, the maintenance of an important part of the species' natural biogeographic range. A secondary aim was to maintain the broad geographical and genetic range within Ireland. The paper advocates:

1. Prioritisation of the largest populations, in order to maintain the largest possible portion of the national population;
2. Prioritisation of those populations with the greatest range of age classes, which will increase resilience in terms of their expected survival,
3. Prioritisation of those populations with the greatest occupancy of potential habitat so that catastrophic events are likely to have less severe impacts;
4. Prioritisation of those populations where measures are most likely to lead to improvements in habitat conditions in sufficient time to allow the population to recover naturally,
5. Prioritisation of those populations with the most manageable pressures.

For each of the five prioritisations above, a filter was developed. Applying each filter, a population was prioritised or rejected, unless it lay between the prioritisation and rejection thresholds, or the required data were unavailable. The result was a table (Table 9 of Moorkens, 2010) listing the number of prioritisations and rejections and assigning a "priority class" (See also Appendix I). The priority classes are presented in Table 1 below, listing each population by name.

**Table 1** Prioritisation of the 27 Irish SAC populations of freshwater pearl mussel, following the application of five filters (Moorkens, 2010). Note: within a priority class, populations are not listed in ranked order.

Catchment name	Name in Moorkens 2010	Priority Class
Bundorragha	West 1	1
Caragh	South West 1	1
Kerry Blackwater	South West 2	1
Owenriff	West 2	2
Dawros	West 3	2
Gliskeelan	North West 4	2
Owagappul	South West 3	2
Currane	South West 5	2
Newport	West 4	3
Clady	North West 1	3
Eske	North West 2	3
Gearhameen	South West 4	4
Allow	South West 7	4
Cloon	South West 8	5
Owenmore	South West 10	6
Owencarrow	North West 5	7
Bandon	South West 6	7
Leannan	North West 3	7
Owenea	North West 6	8
Munster Blackwater	South West 9	9
Licky	South East 1	9
Derreen	South East 2	9
Clodiagh	South East 3	9
Mountain	South East 4	9
Nore	South East 5	9
Ballymurphy	South East 6	9
Aughavaud	South East 7	9

The priority classes in this table represent the current best estimate of the restorability of Irish SAC populations, with confidence that a population can be restored and maintained being highest for priority class 1 and lowest for priority class 9.

Priority classes 7 and 8 represent populations that require further investigation in order to properly assess their restorability.

### **1.3.3 NPWS recommendations on conservation strategy**

In Table 1 above, four broad groups were identified and it is proposed that a different conservation strategy is appropriate for each. The groups are illustrated by the coloured shading: Group 1 (green) contains priority classes 1 and 2; Group 2 (amber) contains priority classes 3 to 6; Group 3 (grey) contains priority classes 7 and 8; and Group 4 (red) contains priority class 9. The following are the conservation strategies proposed for each:

#### **Group 1 (priority classes 1 and 2)**

- **8 populations**
- **80% of the total national population**
- **8.5 % of the total area of the 27 catchments(= 497 km<sup>2</sup>)**
- **Lowest pressures, including relatively few point source discharges**

These eight populations contain approximately 9.58 million mussels, are the closest to favourable conservation status and the most restorable.

This group should be prioritised for conservation measures above all other groups. Resources would be focussed on the eight populations and all measures identified in the individual Sub-basin Management Plan or identified during that Plan's lifetime, would be implemented. This includes all measures required to eliminate, reduce or mitigate diffuse pollution as outlined in both the River Basin and Sub-basin Management Plans. The full implementation of diffuse measures would require the development of a dedicated agri-environmental scheme. The implementation of diffuse measures also requires the production of freshwater pearl mussel catchment strategic plans for forestry, containing detailed long-term strategies and forest management options. Strict controls on land-use changes will be required. A co-ordinate monitoring programme will be required to assess the success or otherwise of the various measures undertaken.

#### **Group 2 (priority classes 3 to 6)**

- **7 populations**
- **6% of the total national population**
- **14.1 % of the total area of the 27 catchments (= 825 km<sup>2</sup>)**
- **More widespread and intense pressures, particularly diffuse pressures. Significant point source discharges in some catchments.**

These seven populations, totalling over 700,000 mussels, are considered to have reasonable resilience that will allow adult mussels to persist for the medium-term; however confidence is lower than for Group 1 that the populations can be restored to favourable status. These populations do not contain juveniles (< 30 mm shell length), but typically do contain representatives of all other size ranges. The pressures on Group 2 populations are greater, the catchments are typically larger and, consequently the measures and resulting restrictions on catchment-users are proportionately greater.

The recommended strategy for these populations is to implement a selection of the key measures, to monitor the effectiveness of such measures and to re-evaluate the restorability of the populations at the end of the first planning cycle (2015).

Key measures will include reduction or mitigation of significant point-source pressures, such as quarries and WwTPs. In some of the Group 2 populations, a small number of point sources are considered likely to contribute the majority of the sediment and/or nutrient inputs and, therefore, must be remediated in order to improve the species' habitat.

Confidence in the restorability of Group 2 populations should have improved at the end of the first planning cycle by two means. Firstly, implementation of key measures, including those required by the River Basin Management Plan, may have led to sufficient habitat improvements to show that the population can be returned to favourable conservation status. Secondly, testing and improving the pearl mussel measures in the Group 1 catchments will demonstrate their effectiveness. Critically, more accurate cost-benefit analyses of the measures will be possible at the end of the first planning cycle, allowing more focused investment.

The remaining required measures would be implemented for Group 2 populations in the subsequent planning cycles where it has been demonstrated that their effectiveness justifies any costs and restrictions on catchment-users.

**Group 3 (priority classes 7 and 8)**

- **4 populations**
- **1.2% of the total national population**
- **10.5 % of the total area of the 27 catchments (= 615 km<sup>2</sup>).**
- **Pressures similar to group 2**

Information is lacking on the population-size, the within-catchment distribution, and/or the age-ranges of these four populations, hence their restorability could not be fully assessed.

The key measure for the Group 3 populations is further investigation into the mussel populations, such as mapping the distribution of mussels and their potential habitat, and developing age to size regressions. These measures would allow the populations to be reclassified into the other priority classes. In terms of the other proposed measures, Group 3 catchments should be treated as for Group 2, i.e. the key measures, such as reduction or mitigation of significant point-source pressures, should be implemented.

**Group 4 (priority class 9)**

- **7 populations**
- **0.35% of the total national population**
- **66.9 % of the total area of the 27 catchments (= 3,919 km<sup>2</sup>)**
- **A large number of significant point sources and highly intensive agricultural land use over large areas of the catchments.**

The population estimate of 41,700 mussels across the seven catchments is an absolute maximum figure, and the total number of adult mussels is likely to be significantly lower.

Owing to the very large catchments and the intensity of pressures on the Group 4 populations, it is very unlikely that the measures, if applied and irrespective of cost, would be effective. Implementation of measures in these catchments, while unlikely to achieve anything for the conservation of the species nationally, is likely to significantly damage the political and social will to engage with conservation efforts for better populations.

Our current state of knowledge indicates that these populations did not merit a “C” or higher rating when the SAC were designated, as a result of the poor “size and density of the population” and, in particular, the poor degree of “conservation of the features of the habitat which are important for the species concerned and restoration possibilities” (see also Appendix II).

Therefore, we recommend that the populations should be removed from the First Schedule to S.I. 296 of 2009, with the consequence that the Sub-basin Plans for these populations and their Programmes of Measures would no longer be pursued and that examination and review of discharges to their catchments would not be required. We also recommend that no conservation objectives be set for these populations within the site-specific conservation objectives for the SAC. Finally, we recommend that the rating of these populations on the Natura 2000 standard data forms be reduced to non-significant (“D”). This could result in the de-listing of *M. margaritifera* from three SAC (Slaney River Valley SAC, Lower Rive Suir SAC and River Barrow and River Nore SAC).

With the adoption of this strategy, at least some of the Group 4 populations are likely to go extinct, but even with limitless resources and full implementation of the Sub-basin Management Plan measures, extinctions are likely to occur.

**1.3.4 The Nore and South East**

There is a legal requirement under the Habitats Directive to conserve the Nore pearl mussel. In addition, Dr Moorkens recognised four geographical regions within the national range of *M. margaritifera*



(Moorkens, 2010). NPWS fully supports the principle of conserving at least one *M. margaritifera* population from each of the four regions. It is very unlikely, however, that any of the south-eastern SAC populations, including the Nore, can achieve favourable conservation status.

There is a high risk of extinction of the Nore pearl mussel (estimated population: c. 550 adults, catchment area: 1,059 km<sup>2</sup>). The population continues to decline at an alarming rate as a result of sedimentation. It is questionable whether there is a long-term future for the Nore pearl mussel in the Nore catchment, owing to the poor status of the habitat and the magnitude of the pressures. An ongoing captive breeding programme remains the main measure for ensuring the short- to medium-term survival of the species. Unfortunately the Nore pearl mussel breeding programme, operational since 2005, has proven extremely challenging technically and the chances of success are low (see section on captive breeding below).

The recommended strategy for the Nore pearl mussel is that captive breeding be continued and a range of both point source and diffuse measures implemented in the Nore catchment. These measures should be concentrated in key areas and on the most significant pressures, e.g. remediation of significant point sources, reduction of diffuse agricultural losses adjacent to and immediately upstream of the largest concentrations of mussels. At the end of the first planning cycle, the restorability of the mussel habitat in the Nore should be re-evaluated.

In order to maintain the geographical range of *M. margaritifera* in Ireland it will be necessary to produce a Sub-basin Management Plan and implement a Programme of Measures for one further population in the South East. However, it is considered unlikely that any of the six south-eastern populations currently in Group 4 can be restored. Survey of mussel distribution, demography and habitat in the Avonmore, Co. Wicklow in 2011, unfortunately indicated that other south-eastern populations are in equally poor, if not poorer, conservation status.

Selection of a south-eastern population on which to concentrate conservation efforts requires careful consideration. While point source pressures are considerably greater in the South East, so too are agricultural pressures, and both will need to be tackled to restore pearl mussels to favourable status. The scale of the south-eastern catchments, in terms of area, and the extent of agricultural pressures are extremely large (e.g. the area of the Munster Blackwater catchment is more than 4.6 times greater than the areas of all eight Group 1 catchments combined, the next largest Group 4 catchment (excluding the Nore), the Derreen, is more than 1.5 times larger than the largest Group 1 catchment, the Caragh).

NPWS proposes to conduct further survey of the status of the freshwater pearl mussel population and its habitat in the Derreen River in SAC during 2012 to fully assess the population's recoverability. The Derreen is considered worthy of further investigation as a result of historical data on the population and the pressure data on the catchment provided in the draft SBMP. If following this survey, it is considered possible and practical to restore the Derreen pearl mussel population, the draft SBMP will be completed.

### **1.3.5 Captive breeding**

Dr Moorkens (2010) emphasised the high risks associated with reliance on captive breeding for the long-term survival of the species:

*Relatively high rates of loss of adult mussels kept in captivity (up to 50% in a year) and the low success rates of juvenile survival in attempts at captive breeding in the Republic of Ireland demonstrate that such ex-situ captive breeding attempts are unlikely to be useful for long term projects where parallel river habitat rehabilitation would be slow to achieve its aims.*

NPWS recommends extreme caution with the use of captive breeding. The pearl mussel occupies a very complex, disturbance-driven habitat and continues to have a somewhat cryptic biology, particularly with respect to its sensitivity to potential pollutants, or its specific food requirements. Projects throughout Europe (Luxemburg, Belgium, Germany, Scotland, England, Wales, Northern Ireland) have demonstrated that it is not possible to consistently or accurately artificially create the conditions required by the species. Losses of both juvenile and adult pearl mussels have frequently been encountered in captivity. In the US, where multi-million dollar projects are very successful in breeding many rare mussels, scientists do not attempt to breed *M. margaritifera* because of its complex biology. In addition, captive breeding is extremely costly, with attempts in Ireland costing the state (through the NRA and

NPWS) in excess of €720,000 since 2005<sup>6</sup>. However, as stated above, in the absence of any other realistic alternatives, the current conservation strategy for the Nore pearl mussel, *M. durrovensis*, is to continue the captive breeding programme.

#### 1.4 THE JUSTIFICATION FOR THE RECOMMENDED CONSERVATION STRATEGY

1. The Habitats Directive requires Ireland to secure both pearl mussel species at favourable conservation status.
2. The Group 1 catchments are amongst the smallest SAC catchments, totalling only 8.5% of the total area of the 27, but contain 80% of the national population. The area of intensive land uses<sup>7</sup> is smaller than in larger catchments and the implementation of diffuse measures will be much less costly and likely to be more effective.
3. While the prioritised populations may be the biggest and most resilient, all are declining (even the Bundorragha, which is at favourable conservation status, has had periods of reduced recruitment and will, therefore, show a population decline with natural mortality before reaching stable numbers). If sustainable recruitment is not restored to the three largest populations, the numbers of mussels lost will be extremely large – over two million in the next ten years – or 17% of the national population.
4. Irish studies have demonstrated how rapidly pearl mussel populations can decline once a certain tipping point has been reached in terms of habitat deterioration. With the exception of the Bundorragha, all of the Group 1 catchments have had significant increases in pressures recently, including increases in once-off houses, land reclamation and clearfelling of coniferous forestry. If measures are not now taken, habitat conditions are likely to deteriorate further such that minimal or no recruitment will take place and ultimately leading to increased adult mortality. Once the juvenile habitat has deteriorated to the level where there is little or no effective recruitment, it will be much more difficult to restore favourable conservation status, and will require more intensive measures and significantly more time.
5. On the other hand, the Group 1 populations should be easiest to restore to favourable status, based on the filter system used by Moorkens (2010). In particular, the juvenile habitat of these populations is close to favourable status, at least part of the time.
6. While the Bundorragha returning to favourable conservation status is of great assistance, many stakeholders and members of the public in Ireland remain convinced that extinction of the species is inevitable. There is, therefore, a great need to demonstrate that populations are restorable and sustainable long-term. The sooner this can be demonstrated, the more populations may ultimately be restored.
7. As environmental quality objectives (Fourth Schedule, S.I. 296 of 2009) have been set based on best expert judgement of the habitat conditions required by the species, there is a critical requirement to test whether these objectives will support populations that are sustainable long-term. The sooner a population can be restored to favourable conservation status, the sooner we can establish the accuracy, and if necessary modify, these objectives.

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<sup>6</sup> Note, juvenile Nore mussels were first produced in 2009 and again in 2010, and uncertainty remains high as to their chance of survival.

<sup>7</sup> Filter 5 prioritised catchments with < 20% intensive land-use.

## **2 Plan for the implementation of diffuse agricultural measures in the eight priority freshwater pearl mussel catchments and the Nore**

For the eight priority pearl mussel catchments, the principal agricultural measure in the Sub-basin Management Plans is to develop specific farm plans for target areas of the catchment. The target areas are to be defined based on a combination of high risk physical settings and high risk agricultural land uses/intensity. Target areas for riparian measures along the River Nore will be identified adjacent to and upstream of the extant population. The development of such farm plans requires significant work and collaboration between the National Parks and Wildlife Service of the Department of Arts, Heritage and the Gaeltacht and the Department of Agriculture, Fisheries and Food.

The flow diagram in Figure 1 outlines the process required to develop and implement the farm plans. The key measures are:

1. The employment of a team of dedicated farm advisers, and
2. The availability of funding for the necessary plans.

Resources for these measures will be pursued through various means, if this roadmap is agreed.

The broad agricultural pressures have been identified in the draft Sub-basin Management Plans, based on desk study and field surveys in 2009 (Task 1, Figure 1). This work is being further refined by NPWS, by assessing the significance of each agricultural pressure identified. The more detailed information will be presented in the final Sub-basin Management Plans.

The process of identifying target areas (Task 2) is ongoing and involves collaborative efforts by NPWS and DAFF. A risk assessment of individual farms within the eight catchments is being carried out, based on:

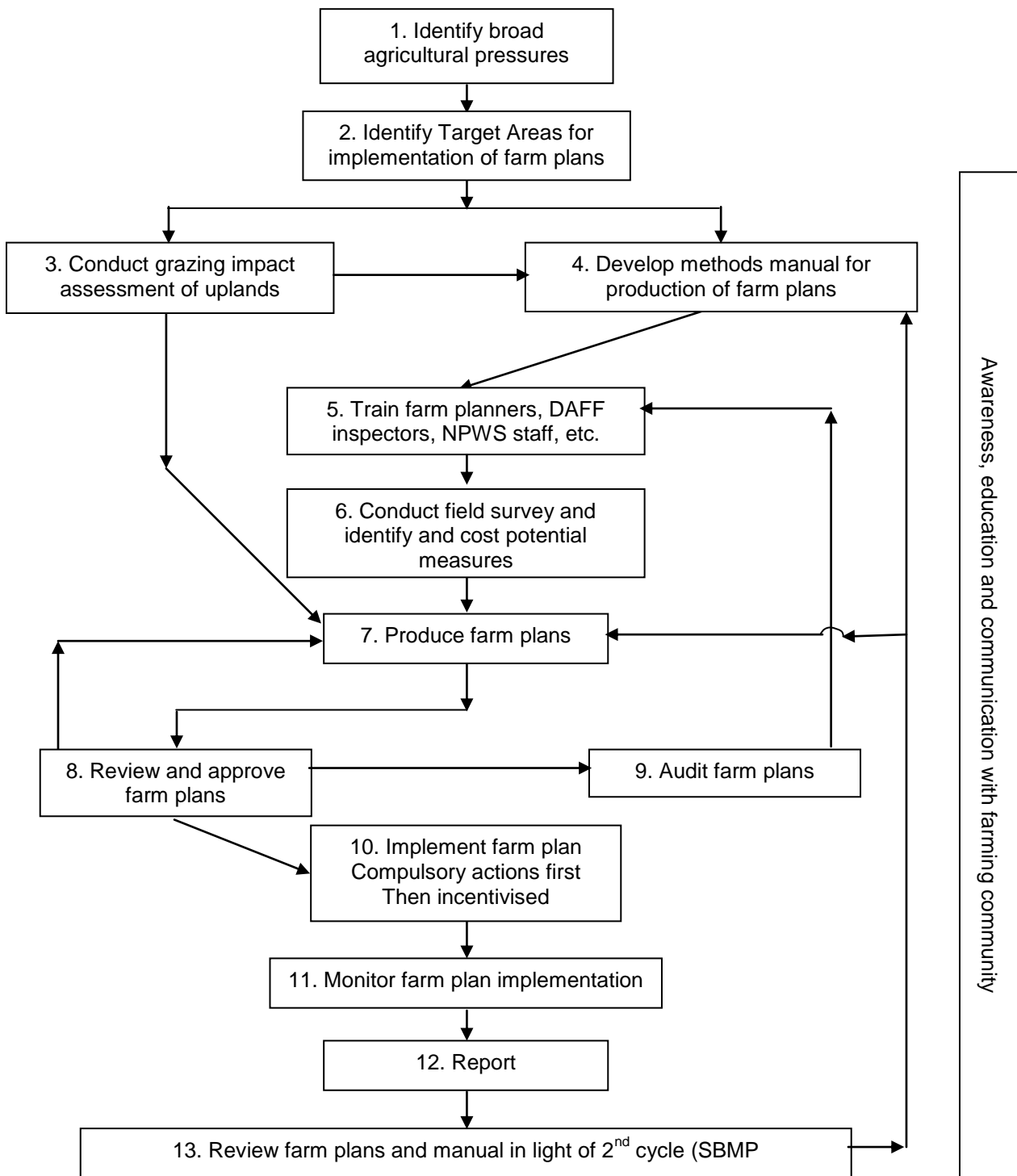
1. Intersection with a 400 m wide buffer fringing all third and higher order rivers,
2. Bovine stocking rates,
3. Sheep stocking rates.

The risk assessment and development of site-specific measures for upland areas (Task 3) was separated from that for lowland areas, owing to the existence of a method for assessing grazing damage in the uplands. The data generated from the upland assessments will be fed into the relevant farm plans, which will contain measures for both upland and lowland parts of the farm. NPWS has an on-going project to map erosion in upland and peatland areas of the Bundorragha, Dawros and Owenriff catchments (Task 3, Figure 1). Both private and commonage lands are under investigation. The aim is to identify the causes of such erosion and to inform the measures necessary in future farm plans. The existing methodology for assessing the impact of grazing on the uplands has been modified to incorporate all risks of soil erosion resulting from grazing and other pressures.

New methods need to be developed for the production of pearl mussel farm plans for the lowland areas (Task 4), because compliance rules and farm plans to date have concentrated on the avoidance of nutrient loss rather than sediment loss. The development of such methods is a complex task and will require the input of a number of agricultural and ecological specialists.

Once the methods are developed, dedicated farm advisers will be trained (Task 5). These will conduct detailed field by field surveys (Task 6) and produce farm-specific plans, incorporating the findings from the upland survey as necessary, and detailing specific measures and costings (Task 7). These plans will be reviewed (Task 8) and will be subject to auditing (Task 9). NPWS and DAFF staff will also be trained so that farms can be properly inspected (Task 5).

Once a plan has been approved, it must be implemented (Task 10). It is proposed that farmers will receive payment to bring them into compliance with the Sub-basin Management Plan, i.e. to implement the farm plan. The implementation of each farm plan will need to be closely monitored (Task 11).



**Figure 1.** Outline Plan for the Implementation of an Agri-Environmental Scheme in the eight priority pearl mussel catchments.

### **3 Plan for the implementation of diffuse forestry measures in the eight priority freshwater pearl mussel catchments**

The forestry measure in the sub-basin Management Plans for the eight priority catchments requires the production of detailed FPM Catchment Strategic Plans for Forestry. These Strategic Plans for Forestry will critically inform the mechanisms through which site sensitivity and risk to FPM populations can be assessed and evaluated leading to the selection of appropriate forest management options – under the legislative, system and scheme control of the Forest Service. The intention is to produce the eight Strategic Plans for Forestry by the end of 2012.

In 2008, the Forestry and Freshwater Pearl Mussel Requirements, which were developed by the Forest Service of DAFF assisted by the NPWS, came into force and include site-specific risk assessments and mitigation for high risk operations within a 6km hydrological distance from the pearl mussel populations. As part of the Strategic Plans for Forestry the Requirements, particularly the site assessment and mitigation forms (Forms A and B) will be reviewed and the revised forms will be implemented in the top 8 catchments. In the remaining 19 catchments, current procedures (Forms A and B required within the 6km zone) will continue throughout the lifetime of the first Sub-basin Management Plans.

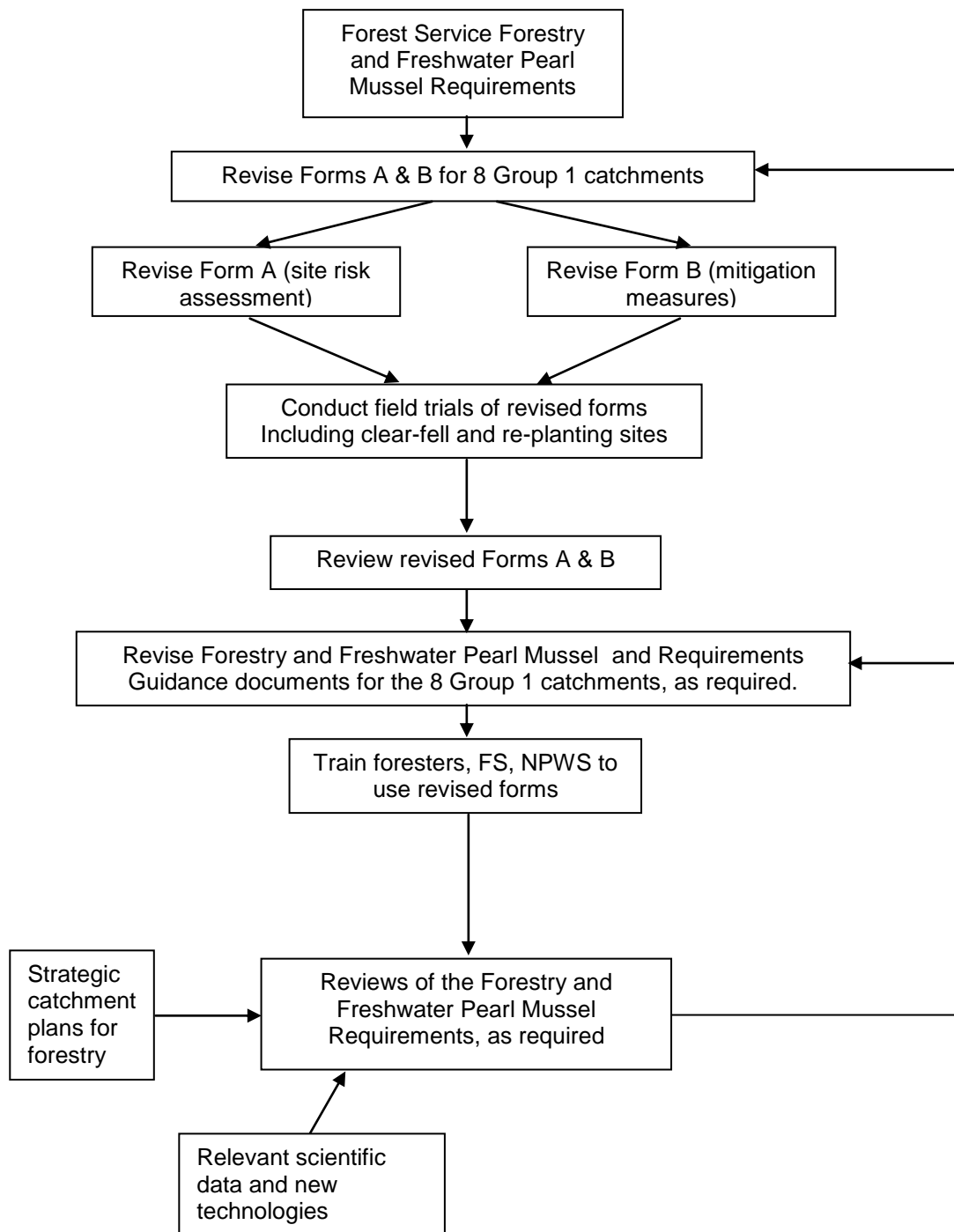
The tasks involved in the review of the Requirements are detailed in Figure 2 below, as well as the interaction between this review and the Strategic Plans for Forestry.

The tasks involved in the production of the Strategic Plans for Forestry are summarised below and in Figure 3. Discussions will be required between DAFF and the NPWS on the development of the Strategic Plans for Forestry.

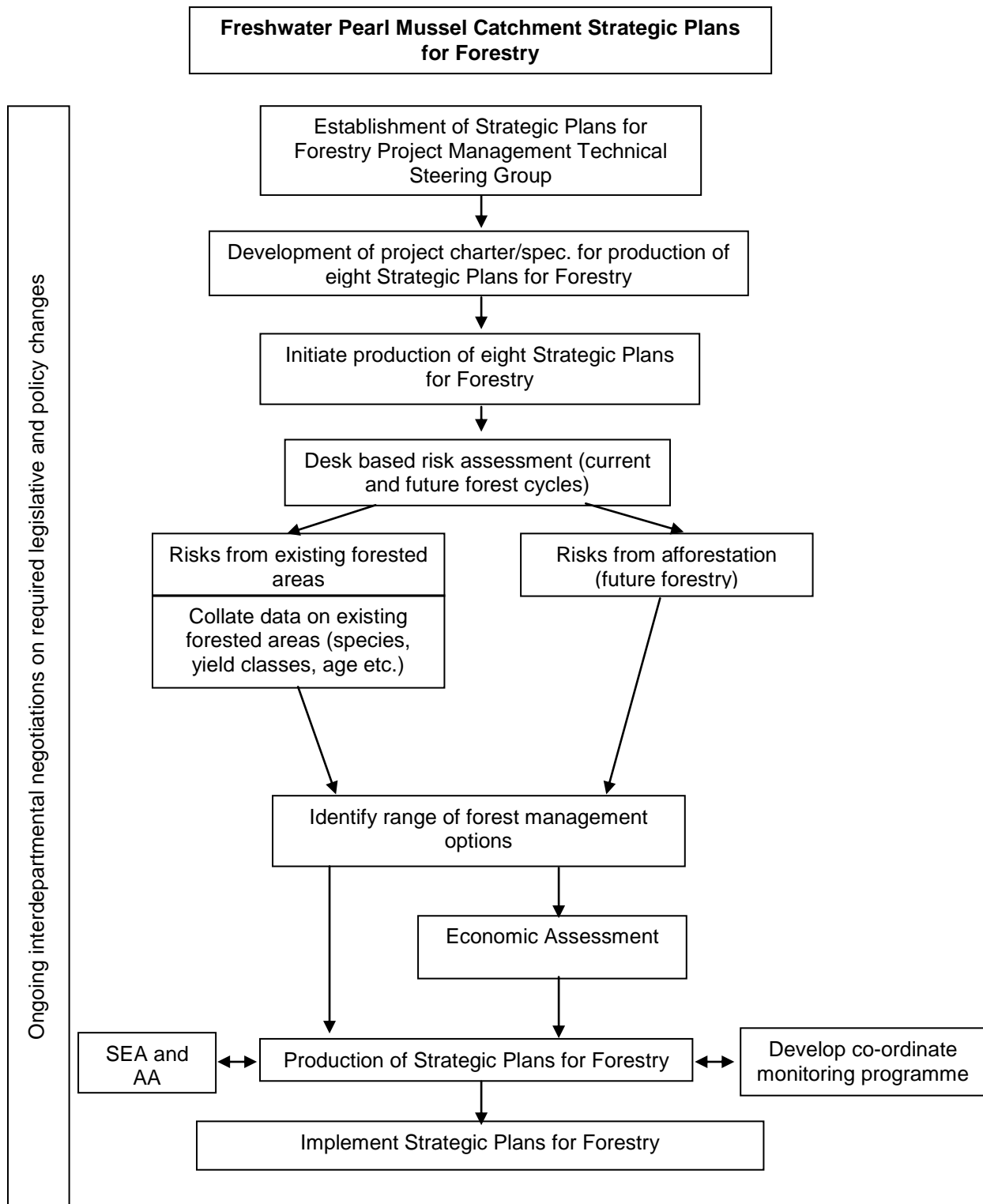
The initial task towards the development of Strategic Plans for Forestry is to complete a catchment characterisation through analysis and evaluation of FPM population status and assessment of forestry in terms of its type, age class, location and ownership within the catchment using information available from the DAFF forest inventory. These assessments will inform the final Strategic Plans for Forestry. The desk-based risk assessment will identify high risk sites and forest operations and will recommend a range of forest management measures on a site sensitivity basis.

The recommended management measures for existing and future forests will produce the programme of forestry measures and strategies for each Strategic Plan for Forestry. The economic implications of the measures and strategies will be assessed prior to the development of the Strategic Plans for Forestry.

The draft Strategic Plans for Forestry will then require Strategic Environmental Assessment and Appropriate Assessment. These assessments will inform the final Strategic Plans for Forestry. Once the final Strategic Plans for Forestry have been adopted, they will be implemented. Any forest application for consent or licence will be informed by the Strategic Plans for Forestry and subject to Forest Service procedures, including the Appropriate Assessment Procedure. The Strategic Plans for Forestry will be of five-year duration, apart from the first plans which will be reviewed in 2015.



**Figure 2.** Review of the Forest Service’s Forestry and Freshwater Pearl Mussel Requirements.



**Figure 3** Development of freshwater pearl mussel catchment strategic plans for forestry for the eight priority pearl mussel SAC catchments (Sub-basin Management Plan measure 20)

Appendix I The five main filters used by Moorkens (2010) to prioritise the 27 SAC populations.

Filter 1 is population size, filter 2 is demography, filter 3 is population distribution, filter 4 is habitat rehabilitation timescale vs. time to extinction, and filter 5 is extent of intensification of pressures. "P" in the Filter columns indicates that a population passed the filter. "F" in the Filter columns indicates that a population failed the filter. "0" indicates the population neither failed nor passed the pressure filter (filter 5). The grey cells indicate the available data were insufficient to allow proper application of the filter.

Population	Filter 1	Filter 2	Filter 3	Filter 4	Filter 5	Number of Prioritisations	Number of Rejections	Priority Class
Bundorragha	P	P	P	P	P	5	0	1
Caragh	P	P	P	P	P	5	0	1
Kerry Blackwater	P	P	P	P	P	5	0	1
Owenriff	F	P	P	P	P	4	1	2
Dawros	F	P	P	P	P	4	1	2
Gliskeelan	F	P	P	P	P	4	1	2
Owagappul	F	P	P	P	P	4	1	2
Currane	F	P	P	P	P	4	1	2
Newport	F	P	P	P	0	3	1	3
Clady	F	P	P	P	0	3	1	3
Eske	F	P	P	P	0	3	1	3
Gearhameen	F	P	F	P	P	3	2	4
Allow	F	P	P	P	F	3	2	4
Cloon	F	P	F	P	0	2	2	5
Owenmore	F	F	F	P	P	2	3	6
Owencarrow	F	F	F		P	1	3	7
Bandon	F	F	F	P	F	1	4	7
Leannan	F	F	F	P	F	1	4	7
Owenea	F	F	F		0	0	3	8
Munster Blackwater	F	F	F	F	F	0	5	9
Licky	F	F	F	F	F	0	5	9
Derreen	F	F	F	F	F	0	5	9
Clodiagh	F	F	F	F	F	0	5	9
Mountain	F	F	F	F	F	0	5	9
Nore	F	F	F	F	F	0	5	9
Ballymurphy	F	F	F	F	F	0	5	9
Aughavaud	F	F	F	F	F	0	5	9



Most of the scientific recommendations on the designation of Irish pearl mussel SAC were made between 1995 and 1997, generally based on limited scientific data. Post-graduate studies by E. Moorkens, E. Ross, H. Ross and others had contributed very significant knowledge on the distribution and biology of the species, but did not contain detailed information of within-catchment distribution of mussels, the demography of the populations or detailed population estimates. All of these data are necessary to properly assess each population for the Natura 2000 standard data form. In addition, significant scientific advances have since been made on the ecology of the species, in particular the sensitivity of the juvenile mussels to sedimentation and eutrophication impacts.

Owing to the data limitations, the viability of the pearl mussel populations was not properly assessed at the time of designation. Equally, it was not possible at that time to fully assess the status of the species habitat nor its restorability.

Of the populations in priority Group 4, the Mountain and Derreen were principally recommended in 1995 on the basis of geographical range. There was no expert recommendation to select the Ballymurphy and Aughavaud for pearl mussels, rather they were included on the SAC standard data form solely on the basis of the available records for pearl mussel in the Barrow catchment. The Munster Blackwater was designated on the basis of apparent morphological and suspected genetic differences from other Irish populations. These differences have not been substantiated and are now considered to be well within the normal range of variation for *M. margaritifera* (E. Moorkens, pers. comm.). The Clodiagh was designated because of the co-occurrence of white-clawed crayfish. Several other populations with this characteristic have since been identified. The Licky was recommended in 2002, with considerable scientific reservations. It was neither recommended on the basis of geographical range nor population quantity and quality.

Regardless of the scientific validity of designating the Group 4 populations in the first place, the management planning process has clearly indicated that these populations are effectively un-conservable.