



Allihies, County Cork, Ireland
<http://www.friendsoftheirishenvironment.org>

7 December 2006

Submission on the *Draft Forestry and Freshwater Pearl Mussel Requirements; Site Assessment and Mitigation Measures*

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1. Introduction

There is no animal more important than the fresh water pearl mussel *Margaritifera margaritifera* (FPM) in the Republic of Ireland in terms of our European responsibility. Experts agree that over 90% of all FPM individuals in Europe died out during the 20th century, leaving small populations scattered across the EU. Ireland has approximately 46% of the EU pearl mussel individuals remaining.

The pearl mussel is listed on the most recent International Union for Conservation of Nature and Natural Resources (IUCN) Red Data List as in danger of worldwide extinction. Yet none of our better pearl mussel sites can be considered to be in a favorable conservation status.

The unexpected catastrophic loss of pearl mussels in the Owenriff River in the summer months of 2004 is symptomatic of inappropriate forestry practices in sensitive catchments. Experts suggest that similar catastrophic events have probably occurred in many other Irish *Margaritifera* rivers in recent years. The threat of extinction is demonstrated by the declining current number of adult mussels in Irish rivers. Present Irish lack of controls will, therefore, inevitably lead to the continued decline of the mussels and their habitats until they become extinct in Ireland.

It would be wrong to use forestry activities as a scapegoat for all the problems that have occurred in FPM catchments. It is acknowledged that intensification of agriculture has adversely impacted on the status of some pearl mussel rivers long before forestry clearfell operations began. Intensification of development, road building and poorly functioning sewage treatment are all sources of sediments and nutrients that are damaging to pearl mussels. Removing the risk from forestry practices will have no positive effect if the other sources of silt and nutrient are not removed as well.

However, the risk to *Margaritifera* populations from coniferous plantation has been known to National Parks and Wildlife Service (NPWS) since Special Areas of Conservation (SAC) designations began and was highlighted in the European Action Plan for the species, published in 2000.

The agreed response by other EU member states for the protection of FPM catchments is to return them to natural low management vegetation, either continuous cover native woodland or unimproved rough grassland with light grazing. Systematic removal of clearfell plantations from FPM catchments has formed an essential part of conservation management plans in England, Sweden, Finland, Czechoslovakia, and Germany.

This outline identifies the principle weaknesses identified by Friends of the Irish Environment in the proposed Irish response.

2. The Terms of Reference

The terms of reference of the group producing these Requirements were to 'provide guidance on the planning and execution of forest operations that are effective in conserving Margaritifera, cost efficient and implementable.' In the context of the Habitat's Directive, economic arguments ('cost effective') can only be considered under Article 6(4), after an impact assessment has been carried out, and the impact assessment has led to a likely negative outcome of an operation, and there is an absence of alternative solutions. Only at this stage can it be considered whether the plan or project must nevertheless be carried out for imperative reasons of overriding public interest. The terms of reference infringe the assessment process required by European law.

3. The proposed Requirements have no legal authority.

It is not proposed to give the Requirements statutory standing. They will have no legal power unless they fall under a Statutory Instrument signed by a Minister based on primary legislation.

Normally, Forestry Guidelines are enforced by being conditional on grants. Thus the Forestry Biodiversity Guidelines must be followed during initial forestation or the grant can be withdrawn on the standard post-planting inspection which is itself a mandatory condition of the grant. There are no grants for felling or commercial reforestation and there is no inspection of reforestation.

There is a licence for felling and the Requirements must be a condition of any Felling Licences. Although the revised assessment form for sub-threshold forestry projects will assist in identifying sites that require EIA, the information supplied by an applicant for a Felling Licence at the moment is insufficient to determine the sensitivity of the site. This must be significantly revised if it is to provide a meaningful basis for subsequent decisions.

4. They are inadequate in geographical scope

The proposed requirements are limited to 25 SAC rivers (not catchments) which have FPM as an interest. 125 rivers have records of living mussels within 45 different catchments. This means that 100 other rivers which host the FPM will receive no other protection. The Wildlife Act also specifically protects the FPM from any activities that either kill, injure or disturb the FPM. The Requirements must therefore apply to the FPM wherever it occurs. It is unjustifiable if the failure to extend the protection to all FPM sites is not based on scientific considerations but solely on the limited jurisdiction of the pending European infringement proceedings.

Key non-SAC rivers, particularly in the Cork and Kerry area, must be given priority for rapid assessment (particularly for age profile), and the moratorium

of all forestry activities must remain until such an assessment has taken place. If there are found to be rivers with recruiting populations, then these should be given the strictest of SAC protection.

5. No environmental assessment has been done

Before the current moratorium is lifted, there must be a comprehensive study, with very limited experimental cutting and a subsequent land use strategy in non-FPM catchments. This will assist in assessing the potential for the removal of very small areas at greatest distance from the river early in the growing season with the removal of brash and encouragement of natural vegetation and regrowth. The suitability for the reforestation of the felled area with permanent native woodland without fertilisation should be assessed.

The physico-chemical parameters, economic factors and the degree of success of land rehabilitation should be documented carefully for each experimental assessment. The assessment should be carried out independently of those with an economic interest (unlike the Owenriff Working Group) and the assessment team should include at least one university group that specialises in nutrient and sediment movements in soils or has experience in these nutrient issues in a forestry situation. Conservation felling of young coniferous forestry where some natural vegetation remains (and may mitigate against sediment and nutrient release) should be included in the terms of reference.

Finally, the issues of sedimentation and nutrient release from forest sites are the subject of current research by the Western River Basin District's Forest and Water Quality Group and any Requirements are premature pending their recommendations.

6. The extent of the rivers designated to which the protection applies is limited to 6 km from the site of the FPM.

This is neither reasonable nor scientific, as sediment transportation (nutrient enriched by forestry activities) is not limited. Where sediment infiltrates gravels, juveniles die through lack of oxygen. Where suspended solids load open waters, an adult mussel kill ensues. Once a sediment load enters a river that holds a pearl mussel population, it continues to cause harm on a long term basis.

In the case of suspended solid transport, Bernoulli's equation applies: there is absolutely no scientific basis for defining a distance between upstream sources of silt input and downstream FPM populations from which the mussels would be immune to the dangers of silt. A turbulent, high velocity flow will transport far more sediment than a slow flow, and will travel large distances until the flows slow. Pearl mussel populations begin in the first area of stable gravel, i.e. slower flow, in rivers that are high energy in their upper reaches.

The sediment will accumulate selectively on the more stable substrates rather than on those more susceptible to regular resorting during flood conditions. Unfortunately, the FPM also selects these areas of stable substrates and are therefore severely and selectively affected by sedimentation that may have originated at any point upstream of them, often much further than the 6 km suggested in these Requirements.

Mussels which have survived an initial silt episode will be stressed from the food and oxygen deprivation they experienced when clammed up during the episode. If there are then further incidents of mobilisation of this or other silt during the recovery period, the stressed mussels are far more susceptible to death than mussels in a cold river in unstressed conditions. They may continue to die over several months, particularly during the summer.

Enriched sediment also provides a medium for macrophyte growth, a negative indicator in a FPM habitat. Macrophytes smother the mussel habitat and trap more sediment which exacerbates the problem and creates long term negative ramifications.

The Minister for Agriculture has informed the Dail in a written parliamentary reply on the 23rd of November 2006 that 'The text itself of the draft Requirements was agreed with the Department of Environment, Heritage and Local Government before issue for public consultation.' In relation to this point, the Minister's reply would raise doubts about the communication between the Minister and the NPWS scientific staff responsible for the Freshwater Pearl Mussel Research Branch - Aine O'Connor and Jim Ryan. Their views should be sought directly on this point to ensure that the best scientific opinion has been correctly transmitted.

The proposed 6 km restriction defies the laws of physics.

7. The definition of soil types is inadequate

The definition of peat soil in this document depends on the depth of the soil. Soils which are being used or are potential areas for agriculture, horticulture, or forestry require a classification scheme which defines the special soil characteristics essential for evaluating their ultimate use. In this context, peat soils are defined as organic soil materials that have 20% or more organic matter. This is the definition which requires a higher level of protection in the European Communities (Good Agriculture Practice for Protection of Waters) Regulations 2006 [Schedule 2: Table 13 Note 2, Table 17 Note 1, Table 19 Note 1, Table 21 Note 1]. The definition used by the Forest Service must be amended accordingly.

The inclusion of peaty podzols (which have more than 20% organic matter) in areas to be covered by the Requirements would go some way to ensuring the full protection required by law for the FPM. Their omission from these Requirements would be scientifically indefensible.

8. The control of forestry operations is unspecified

8.1 Sediment traps

The Draft document states that 'A series of small sediment traps are required'. Presentations to the Owenriff Working Group have demonstrated that in fact the opposite is true. Very large traps followed by filtration beds are needed to slow down and trap small particle sizes.

8.2 Brash removal

The Draft document states that "brash should be allowed to remain *in situ* until after needle shed and then windrowed". Brash is a source of phosphorous and this recommendation should not be prescriptive.

8.3 Timing

"Where possible, carry out operations from April to October, as ground conditions tend to be drier during this period". Restrictions must be imposed that depend on the condition of the pearl mussel's habitat as well as the weather conditions. Felling during an algal bloom in a catchment, for instance, should not be allowed and adherence to Fisheries Boards warnings should be a condition of these Requirements and of any Felling Licence.

8.4 Responsibility

The Draft Requirements state that it is the responsibility of forest owners to identify and apply those measures that are appropriate to their particular forest. The application of these Requirements requires decision processes which are complex in nature and require a depth of ecological understanding in order to carry out judgements that depend on ecological values. It must not be left to unqualified forest owners.

The minutes of the Owenriff Working Group indicate the wide range of scientific expertise and the depth of knowledge that must be applied on a case by case basis. These would be beyond the ability of the average landowner.

8.5 Monitoring

The persons responsible for monitoring are not documented in the draft Requirements. As well as decisions on methodologies, operations themselves need to be carried out with a substantial level of ecological supervision. There must be Fisheries Board personnel or aquatic biologists notified in advance of felling and the implementation of the Requirements should be independent of the Forest Service.

The references in the Requirements to monitoring of water quality/biological monitoring do not include the extent of this monitoring or specify who should carry it out. The issue of payment for monitoring is absent from the Requirements. Any effective regime of protection requires that these issues be clarified.

There must be thorough and independent assessment with ecologists on site throughout the period of the operations and at agreed intervals following the end of the operations. A regular and clear reporting mechanism between the Forest Service and NPWS is critical. Full information on the beginning, duration and end of operations must be provided by the Forest Service for NPWS, and the results of ecological assessments provided by NPWS for the Forest Service. In the event of damage, the legal responsibility falls on the Minister responsible for that sector. Thus, if a private land owner assessed that their felling operations were 'appropriate' and then went forward and felled trees causing damage to mussels or their habitat within an SAC at some remote distance, the resulting EU legal action and fine would be on the Government, not the individual.

9. The quality of water required

The demanding water quality required by the FPM was not fully understood in the past due to long life cycle of the FPM. The benefit of longer studies now means that we have become aware of the exacting requirements of FPM. The legal obligation falls upon the competent authorities of EU states to maintain pearl mussel rivers to these standards and on the Irish authorities to ensure these standards are met.

In 2004, a review of the population profiles of the rivers initially surveyed in 1991-1994 was made based on new information. The success or failure of reproduction in the years 1991-1994 could be more clearly seen, and a revision of the true health of these populations during the study period was back calculated. A revised set of water quality standards were proposed for these Requirements but have not been included. They are based on the water quality of rivers that had evidence of juvenile survival during the survey years.

Parameter	EPA Q5 Median values	Reproducing Margaritifera Median values
Median Ortho-Phosphate (mg P/l)	0.015	0.005
Median Oxidised Nitrogen (mg N /l)	0.54	0.125
Median Ammonia (mg N /l)	0.03	0.01

Source: Moorkens, Owenriff Working Group, 2005

These standards must be incorporated in the Requirements as they may not be breached.

10. References to other Forestry Guidelines

Current best practice documents for forestry use the term “where possible”.

FPM requirements must be clear and unambiguous. Where this document reverts to best practice Forestry Guidelines, these will need to be amended to remove caveats that allow derogations.

11. Conclusion

The current draft Requirements are scientifically indefensible and will not meet Ireland’s obligations under either European or national legislation.

Significant changes in current intensive coniferous forestry practices are urgently required in FPM catchments. The option of not harvesting a tree crop seems to be absent from these considerations. The Requirements as drafted appear to assume that if all precautions are taken, it will be safe to clearfell. That is not acceptable.

Even without taking FPM into consideration, there are many forests for which there is no economic rationale to fell. How is this issue – which is admitted by all parties - to be addressed?

The assessments suggested above that are required to answer these questions should be begun without delay. The results of the monitoring should be used to amend the proposed Requirements accordingly and to address the issue of non-economic plantations. Until such time as this is done, to lift the moratorium and permit clearfelling on sensitive sites will contribute to the extinction of *Margaritifera margaritifera* in Ireland.

ENDS



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BRIEFING DOCUMENT

*Draft Forestry and Freshwater Pearl Mussel Requirements
Site Assessment and Mitigation Measures*

*Forest Service
Department of Agriculture and Food
November 7, 2006*

*This document by
Friends of the Irish Environment
November 14, 2006*

Fresh water pearl mussel status 2006

The best information at the moment is that there have been records from 131 different rivers. Four populations with prior records are considered to be extinct, 2 former records are considered to be dubious, and 125 rivers have records of living mussels within 45 different catchments. Populations range in size from as low as 1 mussel left alive to 3 million individuals per river. Forty of these have very seriously declined and are unlikely to recover in the wild. Twelve have very significant populations (100's of thousands to millions), but have unsatisfactory recruitment, posing a very serious threat to the world status of the species. A total of 73 rivers are of unknown status, and while there are not likely to be undiscovered millions of mussels, there may be small catchments with significant numbers which may be viable with conservation management, and these need to be identified. The conservation importance of some rivers that now contain small numbers of mussels may be high (e.g. Nore River mussel), as there may be genetic variants that may help with restocking European rivers in the future. [Moorkens, 2006]

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1) Original emails from Parks and Wildlife that led to the OWG Workshop in November 2004 (below 2). They first raise 'the possibility of stopping all clearfelling, fertilisation and re-forestation plans within Margaritifera catchments for the immediate future.' Includes 'we are sitting on fertiliser timebombs (pardon pun) that are now coming to the fore after 50+ years of fertiliser usage for forestry' and the now oft quoted Parks and Wildlife mail reporting being 'stunned at a recent meeting with Coillte and the Forest Service by the amounts of fertiliser used to establish and maintain Sitka Spruce crops on deep peat and the amounts lost to adjacent aquatic systems.'

2) The Owenriff Working Group Technical Workshop, November 2004: Rapporteur's Report. This is the report of the first meeting of all the parties involved in Owenriff Working Group and lays out the positions and the problems. Note in particular McGarrigle of the EPA on the required revision of EPA Q values (see 5 below); Professor Farrell's summary of his research; and Approach to Protecting SAC by the Rapporteur.

3). Modelling potential forestry impacts
The model by which phosphorous impacts are proposed to be calculated by Coillte Teo. FIE has grave doubts about the validity of this model, which Coillte refused to release and which was obtained under the request to the EPA.

4) Scenarios to be investigated by Owenriff Working Group. 'Measures to reduce nutrient input from forestry harvesting in Glengawbeg catchment'. From the 'do-nothing' scenario onwards.

5) Moorkens recommendation on water quality standard revisions. This 'Q6' document gives the best scientific opinion for the protection of the FPM as requiring the Median Ortho-Phosphate mg P/l to be lowered from 0.015 to 0.005.

6) Moorkens letters. These two letters analysis the developing situation from the scientific perspective. The first draws attention to the inclusion of 'economic' criterion in the terms of reference and highlights failures in the assessment process. The second letter raises the issues that should be at the core of the debate on the Requirements.

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1) Original Messages

From: O Connor, Aine
Sent: 30 September 2004 18:58
To: Ryan, Jim; Wilson, John

Subject: Margaritifera and forestry

Following the mussel kills in the Owenriff, I am very concerned that Margaritifera populations in other river catchments are at risk, or will be imminently from algal blooms. Current evidence suggests that clear-felling of conifer plantations in blanket bog and heath catchments leads to massive losses of phosphorus and dissolved organic carbon, as well as other fractions. Until we have, firstly quantified the risk to Margaritifera from clearfelling, re-forestation and forestry fertilisation and, secondly devised a practical approach to protecting Margaritifera from nutrient losses from forestry, I believe that all forestry activities in Margaritifera catchments should be suspended.

I have written to Orla Fahy, ecologist with the Forest Service, asking for her help in establishing what forestry activity is planned within the catchments of the SAC populations. I have also asked Evelyn [Moorkens] to liase with Orla on this issue while I'm on leave.

Finally, I propose that we meet with the Forest Service in November/December to discuss the possibility of stopping all clearfelling, fertilisation and re-forestation plans within Margaritifera catchments for the immediate future.

Aine.

Original Message

From: Ryan, Jim
Sent: 01 October 2004 14:07
To: O Connor, Aine; Wilson, John; Kirby, Noel

Subject: RE: Margaritifera and forestry

The worst problems are associated with fertilised plantations on peat. We were stunned at a recent meeting with Coillte and the Forest Service by the amounts of fertiliser used to establish and maintain Sitka Spruce crops on deep peat and the amounts lost to adjacent aquatic systems. The amounts of Phosphorus detected in the water following fertilisation and clearfelling in a five year study in Cloosh Forest were up to 4 orders of magnitude greater than the limits set for eutrophication by the EPA (i.e. 1200 as opposed to 30ug/litre). Measurements by the Western

Regional Fisheries Board in the Owenriff showed that similar levels were occurring following the recent clearfelling at Letttercraffroe and it is in my view

reasonable to say that that activity was probably a significant contributory factor to, if not the main immediate cause of, the Margaritifera kill in the Owenriff this summer.

We need to ensure that we are consulted about all future afforestation, clearfelling, re-afforestation and fertilisation on peat soils upstream of Margaritifera populations. The current procedures are inadequate as they only take into account forestry sites in or adjacent to SACs while the problem in this case originated 4km away from the Lough Corrib SAC (which includes the Owenriff) and the upper limit of the Margaritifera population and 10km away from the downstream limit of the population and of the kill. Aine is trying to get from Dr. Martin McGarrigle of the EPA the catchment areas for each population and has informally initiated with the Forest Service a review of these potentially damaging activities. NPWS should immediately request Coillte and the Forest Service to undertake an appropriate assessment before giving the Ok for any such activities in these locations and seek to obtain a meeting in November/December with them to discuss a moratorium on such activities until appropriate avoidance or mitigation measures are developed.

In relation to the meeting one possible consideration is that we are currently actively involved with Dr. Kirby on the Working Group which is trying to develop such approaches in the Owen riff. The WG is meeting again in mid-November but I would not expect it to produce any definitive guidance until some time next year. In arranging the meeting we need to ensure that we are not seen to be sidelining that group which is working well and whose efficient functioning we see as essential to developing sustainable avoidance or mitigation approaches to this problem. At the same time we need to take action at a national level to ensure that in the immediate future that no further damage is done to Margaritifera populations. We also need to keep in mind that the EU will be following up the complaint on the issue at both a local, Owenriff, and national level.

Jim

From: Wilson, John

Sent: 06 October 2004 14:15

To: O'Grady, Chris; Brennan, Eamon; Kelly, Jim; Craig, Alan

Cc: Ryan, Jim; O Connor, Aine

Subject: FW: Margaritifera and forestry

Responsibility for the Freshwater Pearl Mussel in Research Branch passed from Martin Speight to Aine O'Connor and Jim Ryan earlier this year. They have moved expediently to engage with the issues and problems arising with the conservation of this Habitats Directive Annex II species. The Owenriff Kill earlier this year has brought forestry practice firmly into the frame.

In the absence of Jim and Aine I am bringing these recent e-mails to your attention and information.

I will be discussing with Jim next week how to take this further but undoubtedly a meeting will be required so that the issues, their substance and their implications, may be discussed further etc.

John

To: Wilson, John; Brennan, Eamon; Kelly, Jim; Craig, Alan;
'tom_corcoran@environ.ie'
Cc: Ryan, Jim; O Connor, Aine

Subject: RE: Margarititera and forestry

Tom,

To note these developments, please, and our intentions to take the matter up with Colilte and the Forestry Service soon, with a view to agreeing effective mitigating measures which can avoid repetition.

You did not meet either Aine O'Connor or Jim Ryan during your walk-around here this morning.

Christopher O'Grady,
Stiárthóir/Director.

Páirceanna Náisiúnta agus FiadhOira/National Parks and Wildlife,
An RannOg Uisce and Oidhreacht Nádártha / Water and Natural Heritage
Division,

An Roinn Comhshaoil, Oidhreachta agus Rialtais AitiUil/Department of
the Environment, Heritage and Local Government.

7 Ely Place,
Dublin 2.

From: O'Grady, Chris

Sent: 06 October 2004 15:03

To: All Divisional Managers; All Regional Managers; All Deputy Regional
Managers; All Conservation Rangers; All Divisional Ecologists

Cc: Wilson, John

Subject: FW: Margaritifera and forestry

Colleagues,

To note the mails beneath, please, and our intention to pursue the important matter further.

Christopher O'Grady,
StiOrthóir/Director,

Páirceanna Náisiúnta agus Fiadhülra/National Parks and Wildlife,
An Rannog Uisce and Oidhreacht NádUrtha / Water and Natural Heritage
Division,

An Roinn Comhshaoil, Oidhreachta agus Rialtais AitiUil/Department of the
Environment, Heritage and Local Government.

[Mails quoted above from Aine O'Connor and Jim Ryan were attached to this mail.]

From: Kirby, Noel
Sent: 07 October 2004 13:17
To: O'Grady, Chris
Cc: Craig, Alan; Sweeney, Michael; Ryan, Jim; Wilson, John
Subject: RE: Margaritifera and forestry

Chris

I believe this requires a Margaritifera meeting in Athlone or somewhere central. Having looked at the Owenriff situation it is my impression that we are sitting on fertiliser timebombs (pardon pun) that are now coming to the fore after 50+ years of fertiliser usage for forestry. I spent my younger fishing days on Lough Leane and if you saw a pair of mallard on a day's fishing you remembered it, today I gather birdlife is far greater in variety and numbers. Why, thanks to loads of nutrients making their presence felt over the past 20 years or so. This I feel is what is happening now on the Owenriff and I strongly believe is about to happen in many other situations.

Especially where older forestry is adjacent to large water bodies nutrients have been flowing freely for years, accumulating and now are having a serious effect on the water quality. When we inspected traps (straw bales) in the forestry at the head of Owenriff system we found that water was freely flowing over the bales which were not having any effect whatsoever in filtering the nutrient loaded water going into the lake. Coillte staff present thought nothing of this and assumed that they had done a good job with the bales. Also cut timber was stacked within 30m of a stream on site and the Forest Service guidelines are that timber must be stacked 50m from any water body. Again Coillte were party to this and had done nothing about it. Nutrients can flow from cut timber. Standard recommended procedures for protecting water bodies in the Owenriff system are not being applied by Coillte while felling. Water lily leaves at the mouth of the outlet stream at the head of the system were 2-3 times larger than they should be! They are being well fed there! The Owenriff Working group are organising a "Nutrients in a Forest system and associated problems" seminar in Nov. next. Maybe this should be expanded for our staff but we want to keep it workable for the group, i.e. small numbers attending. We need a nutrient profile of what is in the system including sediment analysis to show exactly how loaded the time bomb is for the Owenriff.
Noel

From: Wilson, John
Sent: 07 October 2004 14:51
To: Kirby, Noel; O'Grady, Chris
Cc: Craig, Alan; Sweeney, Michael; Ryan, Jim
Subject: RE: Margaritifera and forestry

Noel, Thanks for that - as indicated will be speaking with Jim on his return next week to progress the discussions we require. Open to all suggestions at this stage - agreed it involves all Divisions.

Be in touch next week

John

From: Ryan, Jim
Sent: 12 October 2004 14:21
To: Wilson, John; Kirby, Noel; O'Grady, Chris
Cc: Craig, Alan; Sweeney, Michael

Subject: RE: Margaritifera and forestry

While a briefing session for Wildlife Management is a good idea I do not think it should occur at the upcoming seminar. This seminar is intended solely to inform the Working Group of the impacts of different forest operations and to begin the process of looking for mitigation measures. To involve anyone else at this stage would threaten the cohesion of the group which is still in a very delicate confidence building stage. We were quite close to an outright conflict between the forestry and fisheries side at the last meeting but managed to quieten things down and agree that the best approach was to work on an agreed joint program of investigations.

It may be sensible to build a parallel Working Group within NPWS-DEHLG to discuss this issue and to develop a strategy for dealing with it away from possible conflicts with other organisations.

From: Wilson, John
Sent: 12 October 2004 15:44
To: Ryan, Jim; Kirby, Noel; O'Grady, Chris
Cc: Craig, Alan; Sweeney, Michael
Subject: RE: Margaritifera and forestry

I agree with this as the way forward. We should meet on Alan's return to develop further following the Workshop in Mid November - date not yet agreed. In that way Aine will be back from leave and Jim will be able to report on the Workshop. To be arranged

John

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2) Rapporteur's Report

Workshop – Forestry and Water Quality in the Owenriff Catchment

19 November 2004

Department of Communications, the Marine and Natural Resources

Dublin 2

This Workshop, which was organised by the Owenriff Working Group on Forestry and Water Quality, was called to order by the chair, Dr. Eugene Hendrick. Attendees included both members and non-members of the Working Group.

Background Context

Documents circulated by Dr. Jim Ryan to the Working Group members prior to the meeting highlighted the gravity of the unexpected catastrophic loss of pearl mussels (*Margaritifera*) in River Owenriff in the summer months of 2004. An ecological concern of itself, the sudden loss of the mussels was also of immense significance due to the fact that it occurred in a designated Special Area of Conservation. In the context of the EU Habitats Directive, which fundamentally requires an anti-degradation policy relative to important natural habitats, the sudden loss of so many mussels could have serious implications for Ireland vis-à-vis the European Union's enforcement of its Directives.

In August 2004, on being alerted to the kill of pearl mussels in the Owenriff catchment and the suggested involvement of forestry, the Forest Service convened a meeting of stakeholders involved in the regulation and practice of pearl mussel conservation, fisheries management and forest management in that area. Out of this meeting was formed the Owenriff Working Group, which was established with the aim of developing and agreeing best practice in relation to forest management in the Owenriff. The Owenriff Working Group organised this Technical Workshop in order to gather views and best expert opinion to support the practical decision-making process ongoing within the Working Group.

Neither a targeted nor ambient water quality / biological quality monitoring programme was in place sufficiently near the precise locations where the loss of the mussels occurred that could lend insight into the environmental status of the river immediately prior to the loss of the mussels. However, disparate examinations in previous years of both water quality and biological conditions at points relatively near the area in question suggested that the pearl mussel population was healthy and water quality was very good to excellent.

Agriculture, together with miscellaneous land activities, is the dominant land use in the Owenriff catchment. Managed forestry is also a significant land use within the catchment of the R. Owenriff where the loss of mussels occurred. The main owner of managed forests is Coillte Teoranta (hereafter, Coillte), The Irish Forestry Board. Most forests are situated on peat, which overlies granite bedrock.

Owing to the lack of high resolution ongoing water quality / biological quality monitoring in the area, coupled with the lack of synoptic land management data, the exact cause or causes of the catastrophic loss of the pearl mussels has not been established. However, it is reasonable to presume that some or all of the following factors contributed:

- Ambient air and water temperatures in summer 2004;
- Increased concentrations of nutrients in the water column, particularly phosphorus;
- An growth of filamentous algae of considerable intensity and duration, probably stimulated by elevated nutrient concentrations in the water column;
- Adverse dissolved oxygen in the water column owing to the night time respiration of the algae;
- Increased turbidity in the water column, caused by the presence of algae and possibly other stimuli.

At the Meeting

The Chair opened the meeting by stressing that the purpose of the Workshop is to gather views and best expert opinion to support the practical decision-making process ongoing within the Owenriff Working Group (see above). To this end, formal invited presentations were made by:

- Evelyn Moorkens
- Trevor Champ (for K. Rogers and representing the Western Regional Fisheries Board)
- Donal Keegan
- Myles MacDonncadha
- Paddy Kavanagh
- Martin McGarrigle
- Ted Farrell
- Kjersti Birkeland

A synopsis of each presentation follows.

Moorkens

The presentation supplemented a written report from Dr. Moorkens, which was circulated to Working Group members prior to the meeting. In her presentation, Dr. Moorkens outlined her involvement with the R. Owenriff over nearly 15 years. She also provided an overview of the unique lifecycle and rigorous environmental requirements of freshwater pearl mussels. She observed that 2004 was the first year of which she was aware that water quality declined in the Owenriff. Prior to the summer of 2004, the Owenriff population of pearl mussels exhibited the best distribution of ages of any known locations of these mussels in Ireland, there may be others not yet known but of equal quality, but these are unlikely to be more than a handful. Her investigations of the mussel population in R. Owenriff during summer 2004 indicated a total disappearance of members in the 0-5 year old range. She presumed this had been caused by algal blooms observed in the river, and the subsequent smothering of the young members of the mussel population by algal deposition. This would have created adverse dissolved oxygen conditions in the sediments in which the young mussels live during the

first 5 years. The adverse environmental conditions were probably exacerbated by low stream flow and high water temperature. Dr. Moorkens also proposed a set of water quality criteria that, from her research, were associated with healthy pearl mussel populations in Ireland. These new water quality levels were revised substantially downwards from levels recommended by her in 2000, based on her previous research into the distribution and status of Irish pearl mussel populations. She explained to the group how she had revised her original criteria and why this revision was deemed necessary. She also stated that pearl mussel are very demanding of oxygen (high oxygen requirements) and very sensitive to nutrients and silt.

Champ

Champ, speaking on behalf of Kevin Rogers and the Western Regional Fisheries Board, gave a visual account of the ecological problems (excessive algal growths) in the Owenriff system during 2004. Such extensive algal growths are normally associated with elevated concentrations of nutrients. He emphasized the importance of the Owenriff as trout and salmon spawning areas. Water quality sampling in 2002 had indicated that MRP in the river was “very low” and on the order of what had been measured in 1999. In contrast, samples collected in September / October 2004 (after a flood event) from forest drains and / or streams in the vicinity of a clear-felled forest plantation returned very high results for P in the range of 2 mg L^{-1} .

Keegan

Keegan reviewed the role of the Forest Service and emphasised that its mission was “development compatible with protection of the environment”. He stated that, while there was no ban on afforestation within the Owenriff catchment, it was practically impossible to get approval for such activity due to the high environmental sensitivity of the area and the fact that the soil type is deep peat. The last approval had been granted in 1993 (330ha of forestry in private ownership). All felling licences were granted only after consultation with relevant parties. Likewise, aerial application of fertiliser to forest plantations was by permit only, was underpinned by science, and involved a consultation process. Furthermore, aerial applications were continuously

monitored. Figures on fertiliser applications over the years were being assembled; some data were presented (e.g., the last application was of urea in 2000 to a private plantation). Mr. Keegan pointed out that felling of trees on Coillte properties in 2004 in the Owenriff catchment occurred after the algal bloom on the river was first observed. In addition, “doing nothing” with the afforested areas was, in his view, not compatible with protecting environmental quality.

MacDonncadha

MacDonncadha presented Coillte’s perspective on the Owenriff catchment, including a history of forest management within the catchment since the establishment of the earliest conifer forest plantations. He provided an overview of water quality sampling performed in association with forestry operations under Coillte’s management going back to 1992. He also outlined the decision scheme based on water quality sampling by which Coillte assesses the extent to which, if any, operations are impacting surface water quality. As part of Coillte’s programme for Sustainable Forest Management (SFM), water quality sampling pre- and post- operations is now routinely done at selected locations around the country. Selection of these sampling points is done based on site/catchment sensitivity, MacDonncadha explained. Harvesting might last a couple of months, with 3 samples taken during the felling period. He presented results from recent Coillte water quality sampling, which were compiled for streams on OSI 6-inch maps in the vicinity of Lettercraffroe Lake, where clearfelling had occurred in 2002, 2003 and 2004. Sampling points included some forest drains as well as natural watercourses flowing into and out of the Lake. Coillte’s Biodiversity Action Plan focusing on freshwater pearl mussels was also described (it having been circulated to the Owenriff Working Group in August 2004). It was based on data presented by Moorkens in a NPWS Manual dated 2000. MacDonncadha ended his presentation with a brief review of how forest management plans are developed and what issues they address. He gave an outline of Coillte’s current forest management plans for the Owenriff catchment, which are currently suspended while under discussion within the Owenriff Working

Group. He stated that it is Coillte's view that a significant risk of wind-blow exists and precludes a "do nothing" option. In the past, there had been a fish farm on Lettercraffroe Lake, though no further details were available at present.

Kavanagh

Kavanagh gave an overview of activities underway under the Water Framework Directive, particularly by the Western River Basin District (WRBD). He presented the characterisation performed by WRBD of the Owenriff catchment to date, and pointed out that a characterisation report of the entire district had to be completed and submitted by mid-December. Land use is categorised using satellite imagery and water quality conditions are assessed using existing datasets, particularly those maintained by EPA. Under a nationally-agreed system of categorisation, water bodies are being classified as either: at significant risk; probably at significant risk; not at risk; or probably not at risk. The level of certainty in assigning classification reflects both the completeness of the datasets used and what the available data indicate.

McGarrigle

McGarrigle gave an overview of reference conditions for oligotrophic rivers. He also described commonly observed impacts of forestry on aquatic resources, based on his own observations during fieldwork. He reported that previous biological sampling in the Owenriff generally resulted in predominantly satisfactory "Q values" although on occasion unsatisfactory conditions had been recorded in Oughterard due to excessive filamentous algae in particular. McGarrigle stated that the system of Q values long used by EPA would have to be revised in order to fit the requirements of the Water Framework Directive— in particular ecological reference conditions for Margaritifera sites will be stricter than the current Q5 criteria which are based on water quality considerations alone. He admitted that for areas that had not exhibited water quality problems, physico-chemical water quality data were rather sparse. In high quality Q5 (potential reference sites for the Water Framework) median values for MRP are 0.010 to 0.015 mg/L and for nitrite + nitrate nitrogen the median is 0.54 mg/L. Some of these sites may be N

limited. The Q values recorded for the Owenriff may be insufficient to protect the pearl mussel. In addition, the presence of Margaritifera in the Owenriff would have influenced the Q value.

Farrell

Prof. Farrell presented data from several research projects he had conducted which measured the impacts of forestry operations on surface water quality. He also reviewed briefly the key factors influencing the retention of phosphorus in terrestrial environments. Studies of forestry operations on both mineral and peat soils indicated different responses in the transport of P from the two soil systems. Retention of P on the peat soils was poor with episodic losses of P following certain management practices (e.g., fertilisation, clear-felling, etc.) being of high concentration (high in relation to freshwater aquatic environments). (This study (CATCHMENTS Project) had mainly focused on clear-felling Losses for the long-term study showed a cyclical pattern with higher P levels in the summer months. Size of a clear-fell was not so important in itself; the decisive factor was the proportion of a catchment clear-felled on a single occasion as this would influence the concentration, or dilution of the active agent (P, acidity etc.) in the surface waters of the catchment. He expressed the opinion that P is highly mobile in forest peat soils. One study of fertilisation of a forest plantation on a cutway peat soil (BOGFOR project) revealed a direct relationship between P concentrations in drainage water and fertilisation rate. He further stated his view that a “do nothing” approach was not viable and suggested additional possible management practices to reduce the losses of P resulting from forestry operations on peat, which included creating water retention structures made of mineral soil, through which drainage water would seep. He acknowledged the practical difficulties of bringing in this soil material to remote areas; nevertheless, he said if it could be accomplished the iron (Fe) and aluminium (Al) naturally present in mineral soil should significantly reduce the solubility of the P in the drainage water, thereby resulting in seepage water with a much lower P content.

Birkeland

Birkeland summarized her experiences in 3 Scottish catchments that provided habitat for freshwater pearl mussels. She pointed out that guidance exists in Scotland for the management of forests in respect to water quality protection. While each catchment experienced slightly different water quality impacts as a result of forest operations, siltation was a universal problem. Physical damage to stream beds as a result of machinery crossing was also a frequent problem. Her view was that the Scottish guidelines facilitated adequate water quality and habitat protection in the main; however, problems did arise due to lack of awareness and follow-up on the part of individuals involved on the ground with harvesting. A catastrophic loss of pearl mussels in one catchment had been experienced, and this was due to a 1-in-300-year flood event (i.e., the flood and resulting changes to the stream channel). She emphasised that pearl mussels are very sensitive to silt and elevated P levels. In her experience of working with forestry practitioners at all stages of the forest cycle, it was her impression that correct application of the Forests and Water Guidelines was an excellent approach in preventing most problems arising. Good liaison with forestry practitioners, including contractors, was necessary to ensure that this occurred.

The Rapporteur's Impressions from the Meeting

Caveat: In contrast to the previous section summarising the technical presentations (which speakers accepted for accuracy), this section attempts to convey, as noted above, the "impressions" the Rapporteur formed on the basis of the presentations and ensuing discussion at the Workshop. These impressions are personal opinions tempered by the Rapporteur's own expertise in the general area of diffuse pollution identification and control. As the Workshop was the Rapporteur's only interaction with the Working Group, these opinions are formed without benefit of an in-depth awareness of all that had transpired since formation of the Working Group and prior to the Workshop. The Rapporteur accepts that, as personal views, these impressions are fully debatable and may not be shared by those attending the Workshop. These comments are offered not as criticisms, but as

observations that will hopefully help the Working Group achieve its objective(s).

Focus

In the presentations and the ensuing discussion by both Working Group members and non-members, three key stakeholder views were presented:

- Concerns for the loss of the pearl mussels and associated habitat degradation, especially as it occurred in a designated SAC;
- Concerns about how to continue the considerable forestry operations in the Owenriff catchment in an environmentally sustainable manner according to “best practice” in relation to forest management;
- Concerns about a fragmented approach to catchment-scale water quality management due to the exclusive focus on a single land use, i.e. forestry. (While it is recognised that the Working Group was set up specifically to address forestry issues, in order to address immediate concerns about planned clear-felling, there was an acknowledgement among many Workshop attendees that catchment-scale water quality management needs to include all users within a catchment.)

It is natural and expected that stakeholders in any complex problem setting should argue their own particular points of view. But, while there may be acceptance at some level of the three points noted above, there appeared to be a lack of convergence on what precipitated the rather catastrophic disappearance of the pearl mussels and how best to avoid future problems of this nature. Indeed, the very purpose of the Workshop was to seek advice in regards to the latter point. Experience elsewhere would suggest that such a consensus is very useful in solving catchment scale water quality problems.

Although the aim of the Working Group is to develop and agree best practice for forest management in the Owenriff catchment, the fact that the focus of this objective is clearly in the context of Owenriff catchment suggests that the best practices sought must (a) endeavour to avoid the situation that

developed in summer 2004 with the pearl mussels and (b) be compatible with the environmental requirements of pearl mussels over the long term. Consequently, the search for best practice in regard to forest management in regards to water quality protection ideally would develop from an understanding of why precisely the situation in summer 2004 did develop. Whether such an understanding can be developed with existing data and resources may be debatable. The significant challenge of any investigation seeking to detect and control diffuse pollution is to establish unequivocally a one-to-one (or cause-and-effect) relationship between land management practices at one or more specific locations within a catchment and actual water quality impacts.

Nevertheless, presentations at the Workshop were a useful step toward achieving the Working Group's objective as these presentations documented the demanding environmental requirements for pearl mussels (Moorkens's presentation), the collection of strategies used by Coillte and the Forest Service to manage forest lands and conduct forestry operations in environmentally responsible ways (Keegan's and MacDonncadha's presentations), and potential additional managerial strategies that might be useful in regards to forestry practice (Farrell's and Birkeland's presentations). While the disappearance of the pearl mussels in summer 2004 is very worrying, perhaps equally disturbing is the fact that ecological changes in the Owenriff catchment (Champ's presentation) suggest an insidious, longer term problem with nutrients in these sensitive waters. The extent to which this nutrient problem is or is not directly, or even primarily linked to forestry operations in the Owenriff catchment has not been established, but the research reported in Farrell's presentation clearly indicated the potential for high losses of P from forestry conducted on peat soils.

While the Working Group has a precise objective and focus, which is a good thing, it would be prudent to continually reassess this focus to help assure that the correct question (or questions) is being addressed. The complexity of diffuse pollution is a significant obstacle to its control, and the Working Group deserves credit for proactively addressing at least one element of this

complex problem. However, one should not lose sight of the fact that all users of the landscape (and indeed of water resources) in a catchment have the potential to negatively impact water quality, although that potential is not generally uniform among all users.

Problem Definition

As suggested above, having a reasonable hypothesis about the likely cause or causes of the problem experienced in summer 2004 with the pearl mussels is essential to developing a reasonable and effective response capable of preventing future occurrences. It should be recognised that while adopting a course of action based on best professional judgement is logical, practical and expedient, and indeed possibly the only viable way forward in the short term, such an approach may do little to address the problems that caused the catastrophic loss of the pearl mussels in R. Owenriff. This can happen if the wrong problems are tackled, if a threshold within the catchment the triggers such problems has already been exceeded, and / or if the inherent response time within a catchment for adverse conditions to be righted is long.

For example, if the problem developed simply due to unusual, but natural causes, there would be little point in making a massive managerial effort to correct the uncontrollable. If it were the result of chronic conditions (as perhaps suggested by McGarrigle's reference to past ambient biological surveys) that had finally exceeded the assimilation capacity of the aquatic system, the response to such a causation would certainly be different than if the problem were the result some acute (in time and magnitude) stimulus. It would seem obvious, therefore, that there would be considerable benefit to be gained from continuing the search for better definition of the likely cause or causes of the problem, so that actions (including forest management) can be targeted to specifically address these root causes.

It was not obvious from the Workshop that efforts in this regard had progressed very far. On the habitat side, nearly 5 months or more after the loss of the mussels, no intensive and co-ordinated programme to identify

possible causes of the problem seems to have been initiated. Agencies still appeared to be in the “talking stage” about the co-ordination of water quality monitoring. And, data mentioned in earlier correspondence among Working Group members had yet to be assembled, or at least fully analysed, at the time of the meeting. Granted resources (time and money) are always a limitation, and granted much more had probably been done than was evident from the Workshop. The point is that “problem definition” is a crucial first step toward “problem solution”.

Given that the R. Owenriff (presumably) has a normally high flow velocity, which implies that pollutants would be moved through the system rather quickly, presentations made at the meeting seem to suggest that the cause of the conditions that gave rise to the loss of pearl mussels in summer 2004 was a chronic deterioration of water quality due to increased nutrient concentrations (and subsequent algal stimulation), exacerbated by climatic conditions.

According to Moorkens, the catastrophic loss of the mussels was “probably” due to the development of prolonged anoxic conditions in the river sediments that were the habitat for mussels of the 0-5 year age class that was completely lost. The effects of sedimentation, algal respiration, and the biochemical oxidation of organic matter on dissolved oxygen in aquatic, including benthic, environments is well established scientifically. What is less clear in the Owenriff during the summer of 2004 is why these conditions developed. Keegan pointed out that the most recent forest harvesting activities in the Owenriff catchment occurred after the problems with mussels were observed. In addition, according to information provided by MacDonncadha showing the location of harvesting relative to the location of the pearl mussel population, any acute, immediate effects of harvesting on water quality in close proximity to the mussels would be “buffered” by Lough Lettercraffoe, notwithstanding the potentially contradictory impacts of a long established fish farm in the area. Indeed, according to figures presented by MacDonncadha, forestry (under both private and Coillte management) makes

up only 20% of the Owenriff catchment land area, and 25% of that forested area currently consists on unplanted upland blanket bog and heath habitat.

The presentation by Farrell left little doubt, however, that significant concentrations of phosphorus (P) are lost from artificially fertilized peat systems, including those supporting forestry. Measured P losses in research on the impacts of forest operations on surface water quality conducted and reported by Farrell were in excess of concentrations mooted by Moorkens to be necessary for the protection of pearl mussel habitats. Indeed, data presented by MacDonncadha for MRP in forest drains in the Lettercraffoe management area were in excess of Moorkens' recommended P concentrations. It is noted that the concentration of MRP below which Coillte decides forest operations are having negligible water quality impacts (i.e., 10µg/l) are 2 times the concentration now suggested by Moorkens to be required at pearl mussel habitats. Whether the managerial techniques described in the Forest Service's "Forestry and Water Quality Guidelines" are capable of keeping P losses down to the concentrations mooted by Moorkens is open to discussion, especially in the context of forest operations on peat.

Birkeland described experiences in managing forest operations in margaritiferid catchments in Scotland. While adverse water quality effects, especially sedimentation, have resulted from forestry operations, there have not resulted the catastrophic losses of pearl mussels that occurred in the Owenriff. Although it is not correct to equate the Owenriff catchment with those described by Birkeland (e.g., peat was not a dominant soil type), her observations may suggest that unusual climatic conditions in summer 2004 exacerbated dissolved oxygen problems in the aquatic and benthic environment.

Approach to Protecting SAC

It seems ironic that an area of such ecological importance (i.e., a SAC) seems to be omitted from any ongoing monitoring programme at an intensity that could signal the onset of potential habitat problems. Instead, it seems to be

expected by resource managers that “appropriate” planning of land use activity is sufficient to guarantee the protection / maintenance of habitat quality. As McGarrigle pointed out in his presentation, environmental managers generally have few water quality data in areas that have not previously exhibited water quality problems. Obviously, it is impossible to provide high-resolution continuous assessment of environmental conditions (e.g., landscape activities, water quality, biological diversity, etc.) at large scales. Nevertheless, given the critical importance of SAC at both national and international levels, it is surprising that more isn’t being done to provide some sort of “early warning system” consisting of integrated environmental monitoring that can signal potentially troublesome changes. It should be possible to devise such a system that makes effective use of existing resources from national, regional and local levels by supplementing them with a cadre of well trained volunteers. This approach is not dissimilar from how precipitation and other climatic measurements are made in many countries.

In Summary, Matching Rhetoric to Reality

From the documents circulated prior to the meeting, from the presentations made at the meeting, and from the ensuing discussion during the meeting, there can be little doubt that a degradation of habitat occurred in R. Owenriff during summer of 2004, resulting in the catastrophic disappearance of significant numbers of freshwater pearl mussels. If these are hugely significant events, as stakeholders indicated, then the actual deployment of resources and the intensity of attention devoted to both (a) precisely defining the most likely cause(s) of the event, and (b) targeting remedial actions to the cause(s) must match this importance.

The Working Group was established to determine best practice in relation to forest management in the Owenriff catchment. It is difficult for the Rapporteur to envisage how the Working Group will determine best practice in relation to forest management in the Owenriff catchment without first specifying what the best practices must achieve. In the context of Owenriff catchment, it would seem that this specification can be developed only from knowing what caused the events of summer 2004, however an implicit requirement is that the

practices should enable achievement of water quality to the specifications required by Margaritifera. And, as forestry is only one of the land users in the catchment, it is equally difficult to envisage how solutions can be developed without the full participation of all catchment users. Unfortunately, the development of scientific understanding and the integration of diverse interest groups can be tedious, expensive and slow. Given limited resources (time, money, labour) the Working Group (and indeed other stakeholders) might do well to focus on developing a scientifically credible explanation of what led to the events in summer 2004 and the link to forestry operations. In the longer term, at least one stakeholder (T. Champ) expressed the opinion that the Owenriff catchment was a unique ecosystem with respect to the Water Framework Directive and was worthy of a special intensive study due to its sensitivity. Such a detailed investigation also seems warranted due to the catchments SAC designation.

Respectfully submitted,

William L. Magette, PhD

Rapporteur

UCD School of Architecture, Landscape and Civil Engineering

8 December 2004; Revised 2 June 2005; Finalised 10 October 2005

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3) Modelling potential forestry impacts

1. Introduction

Due to the ecological importance and sensitivity of the FPM it is vital that we are aware of the consequences of any actions we plan for catchments in which they are located.

2. Background

If an empirical cause-and-effect relationship can be established we can usually model this quite accurately and predict the effects of a given course of action. In the case of the nutrient emissions at Lettercraffroe we have, as yet, failed to establish this type of relationship between all the possible inputs and the levels of nutrient being measured. The means by which the nutrient is released may be a combination of soil, climate, rainfall, water table, fertilisation, weather and foliage factors (and possibly others) and the construction of a comprehensive model of such a system would be a difficult task.

However we do have, by way of water sample results resulting from the harvesting of a defined area, an indirect means of linking the action of harvesting with resulting nutrient levels. It is proposed here that we use this relationship to begin modelling the potential impacts of our actions. Some important safeguards are described below.

2.1. Conservative initial assumptions

Due to the importance of safeguarding the welfare of the Freshwater Pearl Mussel and the lack of statistical measures of our confidence in the model we must apply very conservative assumptions during its initial use. For this reason the model is run with the 'worst case' scenario of nutrient runoff. After a review period of one year, the model will be re-calibrated based on further water sampling and experience both within and outside the catchment.

2.2. Continued water quality monitoring

The water quality testing upon which the model is based was undertaken at the Lettercraffroe site was part of a simple monitoring programme and the results represent the unique circumstances of the site, the timing and method of its felling, the prevailing weather and other variables. For this reason much less confidence can be attached to the model accuracy and the use of concurrent water quality monitoring to verify and subsequently calibrate the model is vital. If breaches of water quality standards occur despite the use of conservative assumptions as described above this water monitoring will highlight the need to cease activity in the catchment.

3. The model

3.1. Approach

The basic approach is to estimate a 'worst-case' scenario of the mass of Phosphorus runoff from a clearfell site in the Owenriff catchment. The surface area of the waterbody or sub-catchment in which the site is found is also calculated. An estimate is then made of the rainfall that impacts the catchment

and is available to drain from it. The model assumes that the nutrient runoff is dissolved in the drainage water. Given that the rainfall amount will be constant over the catchment, the higher the proportion of the catchment being felled at any one time, the higher the concentration will be of the nutrient in the water.

A simple equation describes the approach:

$$P_CONC = (CP \times LOAD) / (RAIN \times (1-EVAP))$$

Where:

- P_CONC = the average concentration of P in the drainage waters discharging into the receiving waterbody (ug P/L)
- CP = Felling Threshold (the % of the catchment being felled in any one period)
- LOAD = the amount of nutrient which will leave the site, post-felling (mg/Ha/Yr).
- RAIN = the rainfall (mm). Typically 1500mm
- EVAP = the evapotranspiration rate (%). Typically 30%

Assumptions:

- all sources of P are included in the LOAD figure
- no seasonal variation is modelled
- no maxima or minima are given
- in this simple version of the model no reduction of nutrient runoff over subsequent years is modelled
- the LOAD figure is net of any absorption by buffer zones, mineral soil, etc. In the conservative approach adopted here, no absorption is assumed.
- No downward adjustment is made to the LOAD figure to allow for the dry periods in which no nutrient runoff will occur to any watercourse

3.2. Selection of a LOAD figure for site runoff

Given that annual rainfall and evapotranspiration (loss of rainfall water to the atmosphere) are relatively constant in the west of Ireland the main variable in the equation is that of the nutrient load per hectare of nutrient (LOAD) and the percentage area being felled (CP). Of these, we can expect the LOAD factor to drive our planning and that the CP figure will be an output of the model which will be used as a planning guideline. We can also expect that a common upper limit (e.g. 30 ug/l) will be selected for P concentration (P_CONC) to ensure it does not cause eutrophication. This then brings us to consideration of the correct LOAD figure to select.

In order to estimate the nutrient load in Lettercraffroe a water sampling point was chosen that is totally within the area felled in 2004. Sampling point 2 drains a catchment of approximately 12.7 ha within the clearfell site.

Table 1 MRP and Total P water sample results for position 2 for a 12-month period beginning August 2004.

Sample date	MRP	Total P
31-Aug-04	521	832
14-Sep-04	1235	1623
20-Sep-04	966	1194
30-Sep-04	912	952
22-Dec-04	455	491
15-Mar-05	493	566
15-Jun-05	373	514
09-Aug-05	596	736
Mean	694	
Median	558	

This means that on any one sampling occasion within the first year after clearfelling we would expect a concentration of 694 ug/L of P to be found in a watercourse draining this sub-catchment. On a per hectare basis we will assume that each of the 12.7ha contributed equally to the nutrient runoff to give an average contribution of 54.5 ug P/L per hectare drained (694/12.7). A rainfall figure of 1500mm, when reduced for evapotranspiration is 1050mm (1500*0.7). This translates into 10,500 m³ (10,500,000L) per hectare per year (1.05m x 10,000m²) of water volume in runoff.

$$54.5 \text{ ug/L} * 10,500,000 \text{ L per hectare per year} = 572,472 \text{ mg P/Ha/yr}$$

Worked example using this load factor:

Q. What concentration level will arise from cutting a certain percentage of the catchment?

$$A. P_CONC = (CP \times LOAD) / (RAIN \times (1-EVAP))$$

With

$$\begin{aligned} CP &= 0.05 \text{ (5\%)} \\ LOAD &= 572,472 \text{ mg P/Ha/Yr} \\ RAIN &= 1500 \text{ mm/Yr} \\ EVAP &= 0.70 \text{ (70\%)} \end{aligned}$$

$$(0.05 \times 572,472) / (1500 \times (1-0.70)) = 27.3 \text{ ug/L}$$

This indicates that if we fell 5% of the catchment area and experience the same concentration of P runoff as was found in sample #2 in Lettercraffroe then we will record a P level of 27.3 ug/L at the drainage point of the catchment.

Arranged differently, the same equation will return the permissible felling area (as a percent of total catchment size) which will allow a water quality criterion to be met. For example,

$$C_p = (P_CONC \times RAIN \times (1-EVAP)) / LOAD$$

Q. If we are aiming for a target concentration level of 30ug P/L then the what catchment percent can we fell at a given nutrient runoff level?

$$A. C_p = (P_CONC \times RAIN \times (1-EVAP)) / LOAD$$

With

$$\begin{aligned} P_CONC &= 30 \text{ ug P/L} \\ RAIN &= 1500 \text{ mm/Yr} \\ EVAP &= 0.70 \text{ (70\%)} \\ LOAD &= 572,472 \text{ mg P/Ha/Yr} \end{aligned}$$

$$(30 \times 1500 \times (1-0.70)) / 572,472 = 5.5\%$$

This indicates that we may fell up to 5.5% of the catchment area without breaching the 30 ug P/L limit at the catchment outlet.

3.3. Is the Lettercraffroe site a valid site for a national LOAD figure?

There are numerous sources, including the scientific literature, British Forestry Commission, LIFE project results, data emanating from the Borrishoole catchment clearfelling study and Coillte experience based on water monitoring conducted before, during and after its activities that would indicate far lower levels of runoff than experienced in Lettercraffroe. The high levels of runoff experienced in Lettercraffroe have not yet been fully explained but it is likely that they are closely linked to the level of fertilisation that the site received in the past. No other Coillte land in the catchment received the same high level of fertiliser input.

These lower levels are reflected in the table below and correspond to increase in the percent of catchment which can be felled in any one year (Felling Threshold). The LOAD figures do not assume any buffering of the water or absorption by vegetation of any nutrient in runoff. The design features now being incorporated into Coillte felling plans will improve the buffer between felled areas and open water courses significantly over that which operated in the Lettercraffroe situation and the effective LOAD on any open watercourse is likely to be a lot less than the conservative assumptions made here.

Regarding the lands outside Lettercraffroe but which are still in the Owenriff catchment a different LOAD figure is proposed. This figure, of 0.15 Kg/Ha/Yr of phosphorous, is roughly one third that of the Lettercraffroe figure. It is expected that the water quality monitoring work being undertaken in the Borrishoole catchment in North Mayo will support this LOAD level as a conservative estimate of the potential runoff on sites outside Lettercraffroe.

3.4. Recommendation

- That a limit of 5% of the Lettercraffroe catchment be felled in 2006.
- That a 20% felling threshold apply to the wider Owenriff catchment

- That water sampling continue in the catchment as a means of verifying that the model is not under-predicting forestry-related nutrient load on the receiving waters.
- That the LOAD estimate be reviewed in light of the water sampling results in January 2007 and a new catchment felling threshold be calculated as appropriate.

Table 2 Estimated LOAD and corresponding catchment felling threshold

Catchment	LOAD (P Kg/ha/yr)	Equivalent mean runoff conc. per felled ha	Max percent catchment felling
Lettercraffroe	0.57	54.5	5%
Owenriff (outside Lettercraffroe catchment)	0.15	14.3	20%

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4. Scenarios to be investigated by Owenriff Working Group
Measures to reduce nutrient input from forestry harvesting in Glengawbeg catchment

Draft list for discussion produced by Áine O Connor
16th June 2005.
Revised 11th November 2005.

Additions and comments are requested from all members of the Working Group. Please forward comments to Myles MacDonncadha.

The following are the proposed scenarios for discussion and further investigation:

1. The “do nothing” scenario
2. Whole-tree removal
3. Brash removal
4. Felling outside of the growing season
5. Drain blocking
6. Reducing the annual area of forestry felled
7. Manipulating site water flows/levels
8. Soil Interactions

4.1. Background

The fundamental problem is the addition of nutrients to the aquatic system leading to biological changes. Specifically, increased nutrient availability within the main channel of the Owenriff river has led to excessive and prolonged growths of filamentous algae, which have in turn, led to juvenile and adult kills in the freshwater pearl mussel population. These biological impacts are more likely to occur when nutrients are made available during the growing season and when weather and flow conditions are favourable. The principles behind the removal/reduction of these biological impacts are:

1. Removing the nutrients from the catchment
2. Reducing the annual input of nutrients to the aquatic system.
3. Timing the release of nutrients so that they do not lead to biological changes

4.2. Further Details

- 1) The “do nothing” scenario
This requires:
 - a quantification of the risk involved in and the benefits arising from leaving the trees in situ (preferably including

a prediction of the area likely to be knocked through wind throw over time)

- details of the relationships between wind throw and
 - tree height
 - aspect
 - stand area
 - tree species
 - soil characteristics
 - other factors
- details of the damage caused by wind throw, e.g. the likelihood that the root mat will lift leaving bare ground or that the trees will snap
- details of any available data, facts or figures for nutrient and sediment loss resulting from wind throw.
- Details of any other problems known to result from wind throw

The other scenarios to be investigated can be considered “mitigation” scenarios are should be determined by the results of the research of the Working Group to date, which has elucidated that:

1. Phosphorus is not being retained by the peat soil and that the P concentration of the soils around Lettercraffroe is negligible.
2. The majority of the nutrients entering the aquatic system after forest harvesting come from decomposition of the brash.
3. The nutrient contribution of decomposition of the tree roots is not yet known.
4. The damage to the freshwater pearl mussel population is directly related to nutrient availability during the growing season.

Following from these facts, the following scenarios are suggested for mitigation of the nutrient inputs from forest harvesting:

2) Whole tree removal

The trees would be removed from the catchment by cable/sky-line and would be disposed of off the site. This option has the advantage of removing most remaining nutrients from the catchment, i.e from the brash and timber. It would also possibly involve less surface disturbance if sky-line methods are used.

3) Brash removal

Removal of the brash from the site could occur during or after harvesting. If brash removal is achieved during harvesting, the use of artificial substrates to support the movement of machinery across the peat needs to be investigated. Again, all material will need to be disposed of outside of the catchment. Surface disturbance will be muck greater than for sky-line option.

4) Felling outside of the growing season

Felling outside of the growing season will only be effective if nutrient loss is associated with the period during and immediately after the harvesting and if the sources of the nutrients are removed. The data does not yet appear to be conclusive in regard to the seasonality and duration of the nutrient losses. It appears the release of nutrients results from biological activity, i.e. the decomposition of the brash, however there may also be some physical/chemical processes involved. The latter could lead to nutrient losses throughout the year and may make this option less effective. Another difficulty associated with felling outside of the growing season is greater disturbance to soil.

5) Drain blocking

Drain blocking may have some potential in retaining the nutrients on the peat by promoting growth of vegetation. This will only be effective if the slope is appropriate and if there is a good extant ground cover of vegetation. If the nutrients can be taken up by “new” vegetation the rate and timing of the loss of the nutrients from the site to the aquatic system could be altered.

6) Reducing the annual area of forestry felled

This area has been investigated and modelled by MMD and MMG.

7) Manipulating site water flows/levels

Contact between water and decomposing brash will be critical to loss of nutrients to surface waters. Removal of brash from all drains and streams during harvesting and allowing decomposition to occur on land may reduce the nutrient loss to water (if nutrients are taken up by new growth). JK has discussed the possibility of experimental manipulations with the harvesting team, whereby a SP of 5-10ha could be felled and that team would remove all brash from streams and drains during felling (water sampling before, during and after operations). Machinery passes combined with removal of trees can cause the water table on site to rise. This may, as a result, increase the rate of loss of nutrients to water. Consideration should also be given to keeping the water table at clear fell sites down by eliminating stream blockages etc and to the impact of surface run-off from machine tracks.

8) Soil Interactions

Historic fertilisation and management of plantations may have led to the accumulation of “pockets” of residual fertiliser in the soil (particularly applicable to Lettercraffroe property). While soil analysis to date has demonstrated negligible P concentrations in peat soils at Lettercraffroe, more extensive sampling may yield a patchy distribution of soil nutrients. Water sampling along the length of forest streams and drains may help target areas for soil sampling (/trace the source of nutrients). In terms of mitigation, it is unclear how to deal with residual soil nutrients. If nutrients are found to have

a highly patchy distribution, it may be possible to remove some soil from the site.

Investigation of the various scenarios should address:

- Effectiveness of measures in conserving the freshwater pearl mussel population
- Practical considerations
- Technological requirements and
- Financial implications

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5. Margaritifera in the Owenriff River, Co. Galway, 2004

The pearl mussel *Margaritifera margaritifera* was once a very common Holarctic species, and at the beginning of the 20th century was widespread in what are now the European Union countries. However, experts agree that over 90% of all *Margaritifera* individuals died out during the 20th century, leaving small populations scattered across EU territories (Bauer, 1988). The pearl mussel is listed on the most recent International Union for Conservation of Nature and Natural Resources (IUCN) Red Data List as Endangered (Baillie and Groombridge, 1996), the species being in danger of worldwide extinction.

The Owenriff River has been known for many years as an important pearl mussel river (Jackson, 1925), and supports one of the most important *Margaritifera* populations in the country, being one of the few remaining rivers to be actively recruiting young (Moorkens, 1996).

In May 2004 I was made aware that the river was suffering from an algal bloom throughout its length, as far upstream as its uppermost reaches.

On July 5th and 6th 2004 I visited the river. A recent flood had taken most of the filamentous algae away. A pearl mussel kill had occurred, but it was difficult to quantify the severity, as many dead shells were likely to have been carried away by the flood. Dead shells varied in age from the youngest mussels, dead but still buried in the sediment, to the oldest of the population in excess of 100 years of age. Searches in the gravel in the vicinity of the dead mussels showed no evidence of young mussels. Subsequent searches of deeper pools evidenced that some young mussels were still living. However, it is likely that a large percentage of the 1-5 age class of this river had been eliminated at this stage.

Later, in July 2004, the filamentous algae grew throughout the length of the Owenriff River again. I looked at the river in more detail from 19th to 29th August 2004, and carried out a number of transect counts, and gravel searches, both in shallow and deep water. A further mussel kill had occurred in the interim, with dead shells ranging from the smallest post-transformation juveniles of 3mm in length to the oldest 100 year old individuals. Although considerable effort was put into finding smaller living juveniles, they were not found during the later survey. Many of the living mussels within the gravels were found to be showing signs of severe stress and many were moribund. A brief visit made on 2nd and 3rd of October confirmed that more mussels had died during the month of September.

Pearl mussel populations decline where algae, organic silt or inorganic silt block the gaps between the gravel stones of their river bed habitat, and the flow of water in the interstices becomes very restricted. Without adequate water movement and replacement, oxygen levels become exhausted and mussels die (Buddensiek et al., 1993). The most vulnerable ages within the population are the juvenile and younger mussels living exclusively within the gravels, and these are killed first. This leads to populations of adult mussels

that become older but do not replace themselves. In extreme cases of silt or pollution, the adult mussels will clam up, and their innate response is to remain clammed until the detrimental conditions have passed. During this time they are not filtering food or oxygen. If these conditions persist for more than a few hours, the mussel becomes stressed and may die from lack of oxygen. This is generally the cause of large adult mussel kills, such as have occurred in the Owenriff River during 2004.

Elevated levels of nutrients in rivers can cause pearl mussel mortality directly as well as indirectly through suffocation by algal growth and silt. Bauer (1988) demonstrated a direct negative effect on juvenile mussels, with mortality when phosphate levels were elevated above a P content of 0.03 ppm. Mortality also occurred when BOD rose above 1.4 ppm. Mortality of adults occurred when nitrate levels rose above 0.5ppm N.

Indirect effects due to eutrophication may occur at lower levels, depending on the system. Clearly the algal bloom in the Owenriff was triggered by nutrient levels, in particular, the limiting levels of phosphate that were intolerably high for the mussels.

In 2000, Margaritiferid water quality levels were proposed, based on research carried out during PhD research (Moorkens, 2000). Ortho-phosphate maximum levels were proposed to be 0.06 mg/l P, with nitrate levels to be kept below a maximum of 1.7 mg/l N, Ammonia below a maximum of 0.10 mg/l N. These figures were based on the water quality levels measured in pearl mussel rivers that had evidence of some recruitment in the 10 years prior to the research project (1991-1994), i.e. young mussels of 10 years of age or less were present. The caveat was made that these were initial proposals for Margaritiferid water quality, and that there were two potential sources of error. These could result in the standards being erroneously high and demanding, or erroneously low in standard. The estimated standards would be found to be too high if the river water quality was better than it needed to be for Margaritifera, and this would be proven if the water quality in reproducing rivers declined and the pearl mussel populations remained healthy. The estimated standards would be found to be too low if a review of the rivers showed that pearl mussel populations with the above standards were actually in decline, and could not in effectively sustain recruitment. It is difficult to determine if the river quality is high enough to maintain young mussels in the substrate over the 5 to 10 years that they remain buried. This can only be confirmed by a later survey.

In 2004, a review of the population profiles of the same rivers were made, from visits made to these rivers approximately ten years after these initial surveys. The success or failure of reproduction in the years 1991-1994 could be more clearly seen, and a revision of the true health of these populations during the study period was back calculated, and a revised set of water quality standards are now proposed, based on the water quality of rivers that had evidence of juvenile survival during the survey years. Ortho-phosphate maximum levels are now proposed to have a median value of 0.005 mg/l P in Margaritiferid quality rivers, with nitrate levels to be now have

a median value of 0.125 mg/l N, Ammonia now having a median of 0.01 mg/l N.

The following errors may be considered in these new estimates:

1) Potential error 1.

Water quality is too demanding if the river water quality was better than it needed to be for Margaritifera, and this would be proven if the water quality in reproducing rivers declined and the pearl mussel populations remained healthy. This error is becoming increasingly unlikely, as rivers with only slightly depressed quality from this had pearl mussel recruitment problems.

2) Potential error 2.

The estimated standards would be found to be too low if a review of the rivers showed that pearl mussel populations with the above standards were actually in decline, and could not in effectively sustain recruitment over a longer tenn. As the most vulnerable part of the pearl mussel's life is during the first five years, and the pearl mussel populations with these water quality levels successfully grew mussels to above this age during the study period, an error from this source is also increasingly unlikely. However, long term surveys need to continue to ensure that these water quality levels can sustain the required numbers of juveniles successfully to maintain a healthy population. This will only become evident over time.

3) Potential error 3.

Inaccuracy could be caused if the snapshot water chemistry measurements used in the above surveys did not reflect the actual water chemistry make-up of the rivers surveyed. The water chemistry values for each river is based on an average of once monthly sampling by the local authorities, and true water quality conditions should be based on more frequent sampling. Unfortunately, continuous auto-logger sampling can not be carried out for Phosphorus, and this is likely to be the most critical nutrient level for Margantiferid quality. The 2004 Margaritiferid quality requirements are considered to be accurate. They reflect the very high water quality demanded for this species, and explain why 90% of Irish populations are functionally extinct by no longer being able to recruit young. The water quality requirements are more demanding than the typical values found in EPA-defined Q5 categories of Irish rivers:

Parameter	EPA Q5 Median values	Reproducing Margaritjfera Median values
Median Ortho-Phosphate (mg P/l)	0.015	0.005
Median Oxidised Nitrogen (mg N /l)	0.54	0.125
Median Ammonia (mg N /l)	0.03	0.01

The quality required for Margaritiferid waters therefore should be considered to be a class above Q5, and requires a new standard, potentially Q6. While in

the past this demanding quality was not fully understood, the benefit of longer studies means that more accurate revision of the work of Moorkens and Bauer is possible. Now that we have become aware of the exacting requirements of Margaritifera, the legal obligation falls upon the competent authorities of EU states to maintain pearl mussel rivers to these standards.

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Dr Evelyn A. Moorkens B. A. (Mod.), H. Dip. (Ed.), M. Sc., PhD, M.I.E.E.M., C. Env.

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6) Moorkens Letters

DR EVELYN A. MOORKENS B. A. (Mod.). H. Dip. (Ed.), M. Sc., PhD,
M.I.E.E.M., C. Env.

Mr. Noel Foley
Divisional Inspector, Environmental Audit and Forest Protection,
Forest Service,
Department of Agriculture and Food,
Social Welfare Building,
Oliver Plunkett Road,
Letterkenny,
Co. Donegal.

Cc Dr Jim Ryan, NPWS
Dr Áine O'Connor, NPWS

26/4/06

Dear Noel,

Many thanks for your invitation to the meeting on Forestry and Margaritifera that took place on 9th March 2006. Having attended and considered the proposals for forestry and pearl mussel guidelines, I would like to make some comments, which I hope will be helpful for the ongoing work of addressing forestry practices in pearl mussel catchments.

I would particularly like to address the issues of economic factors, the wider impact assessment approach and the prioritisation of Margaritifera populations.

1) Economic factors

In advance of the meeting, the Technical Working Group on Forestry and Margaritifera produced draft guidelines for all relevant forestry operations which could affect Margaritifera populations in the rivers designated SAC for that species.

The work of the group included a review of existing Forest Service guidelines and Coillte's Environmental Impact Appraisal Procedure in terms of their effectiveness for protecting Margaritifera, as well as a review of relevant published scientific data. The terms of reference were to provide guidance on the planning and execution of forest operations that are effective in conserving Margaritifera, cost efficient and implementable.

I am uncomfortable with these terms of reference at this stage in the decision making process of how to proceed with forestry activities in Margaritifera catchments. I agree entirely that all operations must be

effective in conserving *Margaritifera*, and must be able to be implemented. However, I think the presence of a criterion that refers to cost effectiveness at this stage is inappropriate.

In the context of the Habitat's Directive, economic arguments can only be considered under Article 6(4), after an impact assessment has been carried out, and the impact assessment has led to a likely negative outcome of an operation, and there is an absence of alternative solutions. Only at this stage can it be considered whether the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, in which case the Member State must still take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 (in this case ensuring the viability and recovery of pearl mussel rivers in Ireland) is protected.

2) The wider impact assessment approach

Under the Habitat's Directive therefore, before consideration can be given to Article 6 (4) of the Directive, Article 6 (3) needs to be addressed. Article 6 (3) states:

“Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.”

It has been well documented that *Margaritifera* has undergone a serious decline throughout its range, and while the Irish populations have remained in a healthy state longer than most European populations, most Irish rivers have reached the stage where conservation action is now needed to secure these populations in the long term. The water and river bed quality requirements for *Margaritifera* are extreme; they are a species of highly sensitive river conditions where no unnatural inputs of silt or nutrients can be absorbed by the rivers without negative effects. Having visited many pearl mussel populations throughout Europe and over 16 years of study of the species, it is my opinion that the long term conservation strategy for managing these catchments sustainably will have to be a return to semi-natural and very low intensity land use.

The causes of decline of *Margaritifera* in Ireland have been any land use that has contributed to run-off of silt and/or nutrients. The source of silt and nutrients is likely to be a combination of intensive agriculture with fertiliser input and/or over-grazing, poorly treated sewage input, arterial drainage and

river course modifications, and fertiliser and silt arising from forestry. In most catchments all of the above are likely to have contributed to the decline of pearl mussel populations, but in some catchments particular sources have caused the most problems. It is likely that agricultural intensification is the main problem in some of the midlands pearl mussel populations. It is also likely that forestry is the greatest cause of problems in rural Margaritifera catchments with a high level of afforestation in an otherwise unimproved and rural area. Under the Habitat's Directive, all of the activities that threaten the conservation status of Margaritifera need to be addressed.

The added difficulty with forestry is that for afforested areas, the problem has already been created. We are faced with a situation that, where trees are already in place, there is likely to be an impact whether the trees are removed or left unfelled. Unlike sewage point sources that can be treated to a high level and essentially stripped of Phosphorus, afforested areas must be treated as a problem where the damage has to some extent already occurred, and where the future damage must be limited as far as is possible.

The Habitats Directive requires Special Areas of Conservation be maintained or recovered to favourable conservation status. In order to carry this out, the national governments must implement Habitats Regulations to control activities that may damage the conservation status of the Margaritifera populations. If the Habitat regulations are insufficient for the protection of Margaritifera populations with regard to forestry operations, either the Habitat regulations will need to be altered, or else the Forestry Act will need to be changed in order to bring planting, felling and replanting subject to the objectives of the Habitat's Directive.

The possible mitigation measures conceived by the working group for Margaritifera SACs included the use of buffer zones and Standard Forest Service Guidelines, which are considered to be the current best practice methods. Given the sensitivity of the pearl mussel, it would seem that these mitigation measures should be carried out as a matter of course in all Margaritifera catchments. However, no study has been carried out as to what other mitigation measures could prove effective in limiting felling damage. There has been no clear advice as to whether replanting should take place, what species of tree or alternative land cover is likely to restrict the damage to the rivers in the long term. This causes me great concern, as these activities are essential to the potential for the success of these populations into the future.

Without a full environmental impact assessment of all of the above issues, and an innovative approach to the removal of the damage solely from a conservation viewpoint as a first principle, I could not endorse the draft guidelines presented by the working group. I would need to see the results of a comprehensive study, with very limited experimental cutting and subsequent land use strategy. I would like to see the potential for the removal of very small areas at greatest distance from the river early in the growing season with the removal of brash and encouragement of natural vegetation regrowth, and similarly the potential for the plantation of the felled area with permanent native woodland without fertilisation. I think that the physico-chemical

parameters, effort (including economic) and success of land rehabilitation should be documented carefully for each experimental assessment. I think that the assessment should be carried out independently of those with an economic interest, and that the assessment team should include at least one university group that specialises in nutrient movements in soils or has experience in these nutrient issues in a forestry situation.

3) The prioritisation of Margaritifera populations

Article 1 of the Habitat's Directive states that the conservation status will be taken as 'favourable' when:

Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and

The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and

There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

For the conservation status of Margaritifera to be considered favourable in Ireland, the security of populations in rivers both inside and outside SACs are taken into consideration. This, along with the protection of Margaritifera under the Wildlife Act, places an importance on every population. I have a legal discomfort in prioritising Margaritifera catchments into those that are "sensitive" and "non-sensitive", with regard to the importance of the pearl mussels in breeding terms. On the one hand, the populations with recent breeding populations could be given priority, as they are the populations that may be the most likely to be saved in the long term. On the other hand, there is an onus of responsibility in protecting the most negatively affected populations from extinction. The international responsibility that Ireland holds for this species cannot be overemphasised. I find it impossible, therefore, to endorse the categorisation of Margaritifera populations in order of importance according to the size and fertility of their populations. A recent publication, based on a European wide study, has suggested that genetic differences between Margaritifera populations show that some small and genetically distinct populations may play a vital role in future recovery programmes for mussels across Europe. The choice of which catchments should be chosen for limited experimental felling needs to lie with the National Parks and Wildlife Service, where other conservation measures such as captive breeding could be explored simultaneously, where they believe pearl mussels to be at significant risk.

I think it is vital that a very clear and methodical approach is taken in the assessment of how best to protect pearl mussels from the negative effects of forestry practice for the future. It is to be hoped that these studies will bring to light a simple, effective methodology that is cost effective in the long term. It is important that this is reached in a manner that upholds Ireland's legal

obligations with regard to the Habitat's Directive. I strongly recommend that the moratorium on felling within Margaritifera catchments be continued until these issues above have been addressed.

Please feel free to contact me if you require any clarification of these viewpoints. I would be glad to assist this process in any way that I can.

Yours Sincerely,
Evelyn A. Moorkens.

DR EVELYN A. MOORKENS B. A. (Mod.). H. Dip. (Ed.), M. Sc., PhD,
M.I.E.E.M., C. Env.

Dr Jim Ryan,
National Parks and Wildlife Service,
7, Ely Place,
Dublin 2

12/9/06

Dear Dr Ryan,

Following the joint meeting of the Steering Group and Working Group on Forestry and Margaritifera of 6th September 2006, to which I was invited as a guest with expertise in Margaritifera, I would like to take the opportunity to make some formal comments to NPWS.

- 1) I welcome the change of terminology as indicated at this meeting from Margaritifera guidelines to Margaritifera requirements. It is of immense importance that such requirements are adhered to strictly. One of the major problems I have with current best practice documents for forestry is the use of the term "where possible". Margaritifera requirements must be clear and unambiguous. Where Margaritifera requirements revert to best practice guidelines, these will need to be amended to remove caveats that allow derogations.
- 2) New forestry within the Eske Catchment in Donegal is of an age that required new guidelines to be implemented during the initial afforestation process. In 2006, an approximate 33% kill of adult pearl mussels was found from the field afforested for a full kilometre downstream. If it is the case that the new guidelines were followed here, it is clear that they do not remove the risk of damage to pearl mussel populations.
- 3) Margaritifera rivers surveyed to date have been found not to be in favourable conservation status. As our surveys have covered the rivers we believe to be the best in the country, it is likely that all pearl mussel rivers will need to be restored rather than maintained in present conditions. While forestry activities are not the only damaging activities

in any catchment, clearfell coniferous plantations pose a very significant risk to mussel populations that have previously enjoyed very high river bed quality, most particularly in catchments that would not traditionally have been farmed in an intensive manner. This does not remove the responsibility from other damaging activities; all damaging activities must be addressed.

- 4) Given the extremely deteriorated status of a number of our SAC rivers for Margaritifera, it is urgent that the status of key non-SAC rivers, particularly in the Cork and Kerry area, be given priority for rapid assessment (particularly for age profile), and that forestry activities are curtailed until such an assessment has taken place. If there are found to be rivers with recruiting populations, then these should be given the strictest of SAC protection.
- 5) The key risk to pearl mussel populations at present is the risk of continued and exacerbated infiltration of river bed sediments with mineral and organic silt from conifers that are already planted on Margaritifera catchments. I remain unconvinced that clearfell activities are the best means of dealing with this problem that is already in place. I would like to see a desk top impact assessment of alternative scenarios, such as whole tree removal versus leaving brash, best coupe sizes etc. I was dismayed to hear at the meeting that while coupe sizes should ideally be small (5 hectares or less), that the Forestry Service were indicating that due to the age of the trees in some Margaritifera catchments much larger coupe sizes will need to be felled. This is a return to recommending small coupe sizes “where possible” and finding that this is not possible due to current tree age and size. In this situation an impact assessment of coupe size versus risk of windthrow will be needed. Decisions on timing of felling activities also need further consideration. The comment at the meeting that the summer of 2006 would have been the “ideal” time to cut trees in the Owenriff was also very worrying, considering there were such low flows, high temperatures and severe algal blooms. I would like to see an impact assessment that includes the risk comparisons of felling during different time periods, such as in September, after algal bloom risk has declined and before the likelihood of winter floods. The potential for effective silt trapping would need to be included in this assessment.
- 6) With regard to the question of distances silt can travel within a catchment, I would like to reiterate in writing that the laws of Physics demonstrate that there is no distance upstream that can be considered to be risk free from sediment transport on to pearl mussel beds. Sediment will travel as far as the energy driving it allows, the underlying driver is the energy of the flow, described by Bernoulli’s equation as : $\text{energy} = z + p + v^2/2g$, where z is elevation, p is pressure, v is velocity and g is acceleration due to gravity. The key characteristic as far as sediment movement is concerned is v , velocity, especially as it is raised to the power of 2. A turbulent, high velocity

flow will transport far more sediment than a slow flow, and will travel large distances until the flows slow. Pearl mussel populations begin in the first area of stable gravel, i.e. slower flow, in rivers that are high energy in their upper reaches. There is absolutely no scientific basis for defining a distance between upstream sources of silt input and downstream Margaritifera populations from which the mussels would be immune to the dangers of silt. To do so would be a clear breach by NPWS of its responsibility to this species.

- 7) Removing of sediment at source, long before it can reach pearl mussel beds, is obviously a key factor in dealing with current afforestation in Margaritifera catchments. Dr Reinhard Altmüller outlined the very large sizes of sediment traps and filtration beds needed to prevent sediment transport in the Lutter River. These silt traps were at least an order of magnitude greater in area than those currently utilised in forestry practice. Similarly, the buffer or filtration zones used in the Lutter River were over 100m wide, much larger than those that are being considered in the context of Irish Margaritifera rivers. There is only one chance to remove the highly fertilised forestry from the Owenriff, and from similar catchments that are poised to suffer from future felling activities. It is important to start from a situation that will allow a large enough buffer for silt trapping and filtration during subsequent felling activities. I would like any impact assessment to utilise a design for a large trapping and filtration buffer. I would like to see a report outlining any innovative approaches that may have possibilities for improvement of the situation.
- 8) The risk to Margaritifera populations from coniferous plantation has been known to NPWS since SAC designations began, and was highlighted in the European Action Plan for the species, published in 2000 (Araujo & Ramos, 2000). Given the clear risks to the future of Irish and world populations of Margaritifera, and the international importance of Irish populations currently living, and the fact that this generation will be the last unless the ecological situation of our Margaritifera rivers is improved for the long term, I believe that it would be too great a risk to consider any new clearfell coniferous afforestation, or any afforestation requiring drainage and/or fertilising within Margaritifera catchments in the future.
- 9) It is the policy in conservation catchments for Margaritifera in other EU countries to remove any clearfell forestry. Thus reforestation of coniferous crops for clear felling should not be allowed in Irish Margaritifera rivers. The normal EU practice should be followed of reverting to natural peatland vegetation where possible, or to mixed native woodland schemes or extensive grazing vegetation where tenable. Conservation felling of young coniferous forestry where some natural vegetation remains (and may mitigate against silt and nutrient release) should be investigated, for example in the Owenagappul, and in the young Eske catchment plantation. If both of these plantations were left to maturity (they are on steep hillsides close to the main river

channel with large numbers of pearl mussels nearby), the outcome would be catastrophic at the end of their rotation. The risk to the Owenagappul River population of *Margaritifera* should not be underestimated. There have been two fertiliser applications amounting to approximately 600kg per hectare of rock phosphate (14% P) on over 40hectares, or 3400kg of P introduced to the catchment during the last 6 years.

- 10) In effect, the above concerns all indicate that a catchment plan is needed for each key pearl mussel river. In order to plan the most appropriate action for each catchment, all information on current forestry size, age, slope, fertilisation history, road / track and drainage history will be needed. It is vital that all parties are willing to cooperate in order to achieve the best end result. This will also have to be carried out in terms of agriculture and septic tank activities as well.

Please do not hesitate to contact me for any clarification of the above points. I would be grateful for correspondence outlining the final agreed forestry and *Margaritifera* requirements, and the means by which they will be implemented.
Yours Sincerely,
Evelyn Moorkens.

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