Note:

This downloaded document combines all five individual research priority recommendations documents finalised in February 2012. These documents were produced by the National Platform for Biodiversity Research to identify the research priorities in Ireland in a number of key sectoral areas. The documents may be downloaded individually from the NPBR website www.biodiversityresearch.ie/news.html.

The five documents are as follows, and have been combined in the following order:

1. Research recommendations of the Agriculture, Grasslands and Soil Working Group of the National Platform for Biodiversity Research
2. Research recommendations of the Freshwater Working Group of the National Platform for Biodiversity Research
3. Research recommendations of the Marine Working Group of the National Platform for Biodiversity Research
4. Research recommendations of the uplands, wetlands and peatlands working group of the National Platform for Biodiversity Research
5. Research recommendations of the Invasive Alien Species Working Group of the National Platform for Biodiversity Research

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Research recommendations of the Agriculture, Grasslands and Soil Working Group of the National Platform for Biodiversity Research

February 2012

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Summary

Biodiversity is essential for human life. It generates goods and services including the provision of food and medicines, the protection and regulation of water flow, the support of soil formation together with numerous social and cultural benefits. Without which, there would be no economies, no societies - and no human life.

Biodiversity loss is probably the greatest challenge human societies face today. Although the world's attention is almost exclusively focused on economic crises and climate change, a recent review on identifying planetary boundaries for human welfare identified biodiversity loss as the most critical.

Ireland, along with every other nation, faces enormous challenges in terms of halting biodiversity loss in the years ahead, not just in terms of implementing the many actions that are set down in the National Biodiversity Plan, but in many cases, in deciding what action is appropriate. The decisions we take in the next few years will have far-reaching consequences for biodiversity and therefore must be based on thorough knowledge of the problems, interactions and dependencies involved. This kind of knowledge will only be available by conducting appropriate and comprehensive scientific research.

There is currently a lack of understanding and knowledge regarding biological diversity (BioChange, 2011) and an urgent need to develop scientific, technical and institutional capacities to provide basic understanding upon which to plan and improve appropriate conservation measures. This lack of hard scientific data has been highlighted by the Convention on Biological Diversity (CBD) and by various other national, European and international regulations and by the National Biodiversity Plan.

The initiation, development and delivery of appropriate policy to meet national and EU obligations must be based on relevant and rigorous research knowledge by both collating existing knowledge and conducting appropriate new research where knowledge gaps are shown to exist. Since the conservation, enhancement and sustainable utilisation of biodiversity and biological resources must underpin all areas of environmentally based legislation; there is a clear necessity for the integration of scientific advice into policy-making and delivery.

In October 2009, a working group of scientists (see Section D) that included senior policy representatives drawn from the NPBR was formed. The purpose of this working group was to examine the Biodiversity Knowledge Programme for Ireland (EPA, 2006) with a view to revising this document, prioritising research needs to help inform policy and to further establish knowledge gaps that hinder Ireland in meeting national biodiversity objectives in relation agriculture, soils and grasslands. This review identified seven priority areas essential to implement our legislative requirements and to meet the challenge of halting the loss of our national biodiversity in this sector of the landscape. Section A of this document deals with enabling actions necessary to facilitate biodiversity research, while Section B deals with the most urgent research priorities required in the area of agriculture, soil and grasslands (hereafter referred to as "agriculture").

A. Enabling Actions

1. Integration of the policy environment

A number of EU Directives and national legislation dictate how we manage our national biodiversity. While responsibility for the implementation of these Directives falls into the brief of different government departments, the reality is that the majority of these issues are cross cutting and simply cannot be implemented by any one department without the cooperation of other related departments.

Currently biodiversity research support across different government departments is fragmented, scattered and largely uncoordinated. This has led to a lack of coherence between departments attempting to implement the various Nature Conservation Directives and conduct the necessary research required for their implementation. This lack of coherence is a hindrance to fulfilling our legislative requirements and is an extremely inefficient use of government funding. It has resulted in an overlap of research projects and a lack of awareness across departments of where the knowledge gaps actually lie.

Policies are often developed without sound scientific evidence. This is a direct result of a lack of communication between policy makers and scientists. There is a lack of awareness among scientists of the policy time frames and a lack of coordination of research efforts to meet the needs of policy makers. This is particularly evident in the development and implementation of the CAP in Ireland. To improve the development and implementation of agricultural policies relating to biodiversity scientific delivery timeframes must be linked to policy timeframes.

Drivers: Maximum value for money for the funding of biodiversity research relating to agriculture to deliver maximum impact of the research results. Multiple legislative drivers in this regard include: EIA (Agriculture) Regulations 2011, Birds and Habitats Directives, the Planning and Development (Amendment) Regulations 2011, the Regional Planning Guidelines 2010-2022.

Overarching need: A clear and coordinated inter-departmental system to facilitate targeted biodiversity research programmes, designed to facilitate the implemention of legislative requirements.

To facilitate the coordination of inter-departmental systems the following specific measures are required:

The establishment of an inter-departmental working group, including the relevant key technical experts to:

1.1 Ensure coordinated research effort and knowledge sharing between departments and agencies to maximise efficiencies and research effort of direct relevance to the implementation of legislative requirements.

1.2 Evaluate impacts, compatibilities and conflicts between government policies and biodiversity objectives and economic practice. This review should be based around the relevant sectors.

1.3 Identify policy blind spots and suggest methods that might be used to resolve policy conflicts. This should also include developing the required actions from existing research recommendations e.g. responsibility for dealing with invasive non-native species.

1.4 Identify more effective ways of integrating existing knowledge from both fundamental and applied research thereby facilitating evidence-based policy making.

1.5 Identify, develop and demonstrate appropriate policy implementation tools (e.g. recommend methodologies for habitat identification, prioritisation and assessment, monitoring, use of indicators and evaluation tools).

1.6 Identify appropriate and innovative Departmental mechanisms to finance Natura 2000 initiatives, including an assessment of the efficacy of current funding provided through the RDP.

1.7 Identify how Government policies can be used as opportunities for biodiversity enhancement.

2: The coordination and dissemination of biodiversity data (including metadata)

The work of both policy and scientists is frequently hindered by the lack of access to, or knowledge of, previously generated national biodiversity research. The National Biodiversity Data Centre has assisted greatly in providing access to biodiversity datasets on species. However biodiversity research data is still housed in a disparate manner. There should be a co-ordination of research funding agencies to ensure that data arising from such projects are available in a central location. A working group drawn from the National Platform for Biodiversity Research and the National Biodiversity Data Centre should work together to develop a framework for the collation of all data and metadata and the establishment of a user friendly and fully

comprehensive portal for access to this data. In addition, a standardisation of the approach to metadata entry needs to be agreed and disseminated.

Drivers: It is essential that the results of nationally funded biodiversity research is publically available to assist in both the formulation of biodiversity policy, delivering legislative requirements and on-going research needs. Previously conducted biodiversity research will provide "added value" if accessible.

Overarching need: The coordination and dissemination of biodiversity data (including metadata).

To facilitate the coordination and dissemination of biodiversity data the following specific measures need to be undertaken.

2.1 All existing biodiversity data resources need to be collated and centralised. This includes information contained in Environmental Impact Statements currently held by local authorities.

2.2 Protocols for data exchange and data sharing need to be developed and co-ordinated.

2.3 National biodiversity metadata entry should be agreed and standardised.

2.4 Development & co-ordination of national database standards.

2.5 Biodiversity research outputs should be disseminated as a two way process. This should include the attendance of policy makers at biodiversity research related events and conferences together with the appropriate format for the dissemination of research results by the funding agencies.

2.6 Conducting integrated analysis of newly available biodiversity data sets relating to Agriculture, Grasslands & Soils that have been collated by the National Biodiversity Data Centre and other organisations.

3: Funding of biodiversity research

Biodiversity research in relation to agriculture is currently funded through two separate mechanisms. These are:

(1) Priority targeted research identified by government departments and agencies (e.g. Teagasc, Department of Agriculture, Food and the Marine, National Parks and Wildlife Service, the Environmental Protection Agency and the Heritage Council) that is necessary to implement legislative requirements.

(2) Open-call, competitive, peer-reviewed funding for biodiversity research in the University and NGO sectors, generally funded by the Department of Agriculture, Food and the Marine (Research Stimulus Fund) and the Environmental Protection Agency (STRIVE). Additionally EU funding programmes have contributed large research grants in this area.

The funding of agricultural related biodiversity research is largely uncoordinated amongst the various funding agencies and departments that fund biodiversity research. Often departments are unaware of projects and their outputs that are being funded by other departments which can lead to inefficiencies, overlap and a lack of prioritised research funding. There is a need to establish a mechanism for coordinated research funding and the dissemination of research results. The McCarthy Report (McCarthy, 2009) indicates coordination and efficiencies in research funding might be best achieved through a single stream of funding. However, it would be more appropriate if funding for targeted research remained with the relevant department to ensure research needs for legislative requirements will be delivered. The development of an interdepartmental/agency group is necessary to ensure that research referred to in (1) and (2) above is targeted at previously agreed research priorities.

Drivers: Maximum value for money and efficiency for the funding of agricultural biodiversity research to deliver maximum impact of the research results through coordinated funding mechanisms.

Overarching need: A clear and coordinated funding mechanism to ensure the most urgent research needs are delivered.

To facilitate coordination of the funding of biodiversity research, the following specific measures are required:

3.1 Establish an interdepartmental/agency group (referred to in section A. 1) to coordinate agricultural biodiversity research to:

- Maximise efficiencies and ensure research is targeted in a prioritised manner
- Identify a funding mechanism that has the capacity to manage competitive research calls on the themes identified in section B.
- Establish a mechanism to ensure funders discuss proposed research funding with policy experts, for example through a funding referral officer, established within the NPWS, available to assist in devising and evaluating research proposals.

B. Urgent research priorities

4: Areas of high biodiversity value

Areas of high biodiversity value including biodiversity hotspots are areas that support natural ecosystems that are largely intact and where native species and communities associated with these ecosystems are well represented. As the natural values of such areas are assumed to be largely intact, undertaking action now to identify these areas and to maintain favourable conservation status within these areas has the potential to provide value-for-money by optimising resources for conservation and maximising current research effort. The current, planned or potential anthropogenic activities in areas of high biodiversity value place their natural values at risk and it is likely this risk will increase in the future in the absence of active conservation management.

The protection of areas of high biodiversity value is a cross-cutting issue that will require the engagement and commitment of a number of government departments and can only be achieved by the implementation of the measures in Section A.

Drivers: The identification and conservation of areas of high biodiversity value will facilitate Ireland's legal requirements under numerous EU Directives and national legislation (Habitats Directive, Birds Directive, Flora Protection Order, the Convention on Biological Diversity, Agri-Environment Regulation, Water Framework Directive and the European Landscape Convention).

***Overarching research need*:** The identification of areas of high biodiversity value, the evaluation of threats to these areas and the production of effective conservation management strategies to protect their conservation interests.

To facilitate the identification of national terrestrial biodiversity hotspots the following specific measures are required:

4.1 The production of national inventories of species.

4.2 The national spatial and temporal patterns of Annex I species and Annex II habitats within agricultural and grassland ecosystems.

4.3 The establishment of the status and distribution of rare or threatened species in agricultural and grassland ecosystems.

4.4 The undertaking of nationwide surveys of agricultural and grassland habitats of national and European importance that have not been the subject of previous surveys or where such surveys have delivered insufficient information.

4.5 The undertaking of nationwide surveys of those species of national and European importance in agricultural and grassland ecosystems that have not been the subject of previous surveys or where such surveys have delivered insufficient information.

4.6 National surveys of species listed in the EU Birds Directive. Specifically, to undertake national surveys of the distribution and status of declining farmland habitats to enable early identification of necessary remedial actions to protect associated threatened species.

4.7 'Pre-emptive' national surveys of 'amber-list' taxa within agricultural and grassland ecosystems to enable early identification of necessary remedial actions.

5: Habitat management and restoration

One of the major factors in the loss of biodiversity in Ireland has been habitat loss, fragmentation and degradation caused by changes in management. Biodiversity on farms is under constant threat from the dual forces of abandonment and intensification. This can often take place on the one farm due to on farm polarisation of management, with concentration of agricultural activity on the improved agricultural land with abandonment of more marginal areas. Lack of understanding of the management requirements of species and habitats is a contributing factor with certain measures under current agri-environmental schemes advocating fencing off and zero management in the absence of clear management information.

Ireland has a diverse landscape shaped by differences in climate, geology, soils and topography. The vast majority of this landscape is managed by farming to some extent. The biodiversity of our grassland, arable land, field boundaries, wetland and freshwater habitats, scrub, woodland, mires, heaths and coastal areas are influenced by management activities. This poses a significant challenge for conservation as to how to manage this diverse landscape to retain and enhance its biodiversity value.

Much of the current conservation management of these areas is based on traditional techniques. These did not originally develop to maximise biodiversity value but rather as a requirement to provide for the needs of people within the prevailing regional environmental constraints. The effectiveness of traditional management practices in conservation management needs urgent investigation before the traditional knowledge is lost. Where management practices for

conservation have been investigated in detail (e.g. BurrenLIFE), a marrying of science with traditional knowledge have proven very effective in the development of conservation techniques that meet both the socio-economic and biodiversity requirements of regions.

Drivers: Multiple legislative requirements under Birds and Habitats Directive, Water Framework Directive. Policy commitments of government to international biodiversity targets revised in wake of failure to meet 2010 targets. New EU headline target: Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss.

***Overarching research need*:** Research to improve the design and effectiveness of agri-environment schemes.

To facilitate research into appropriate habitat and species management through agri-environmental schemes, the following specific measures are required:

5.1 Research to develop farming for conservation systems to meet the needs of High Nature Value farmland areas in Ireland.

5.2 Research to investigate the environmental consequences of different habitat management techniques such as grazing, cutting, burning, targeted herbicide use in unwanted vegetation control.

5.3 Research to Investigate the environmental impacts of alternative landuses in marginal agricultural areas and its impact on biodiversity e.g. wind turbines, biofuels, recreation etc.

5.4 Research to better understand the socio-economics of biodiversity production e.g. support requirements, labour inputs, etc.

5.5 Research to establish methodologies for the objective identification of HNV farmland and the agricultural systems that support the maintenance of biodiversity in HNV areas.

5.6 Research on large-scale ecological restoration of the Irish uplands, with emphasis on quantifying sustainable grazing levels to maintain and enhance biodiversity.

5.7 A series of biodiversity management reviews required for key habitats starting with priority habitats and species under the EU Habitats and Birds Directive.

5.8 Initiate a programme of national habitat mapping, both within and outside designated areas to include habitat types, and classify these habitats into their soil, elevation, vegetation type and overall habitat rating. Such a mapping system needs to take

cognisance of mapping programmes already completed and underway to ensure best use of available data and a standardised approach.

5.9 Identify and prioritise specific agri-environment objectives for farmland wildlife, to ensure that agri-environmental schemes contribute to halting biodiversity loss.

5.10 Investigate innovative habitat restoration and conservation practices within landscapes affected by anthropogenic factors. This should be a support to the development of the High Nature Value model and should be underpinned by basic classification of HNV status, extent and condition.

5.11 The development of tailored, tested, prescriptions for roll-out through agri-environment schemes. In addition, baseline information needs to be collected to allow for monitoring at farm and scheme level, with a strong emphasis on use of indicators as a moniotring tool.

6: Long-term studies and the development of a network of long-term study sites

Long-term ecosystem research, including the establishment of a network of long-term study sites, is an essential mechanism to better understand ecosystem structure, function, and response to environmental, societal and economic drivers. While numerous long-term study sites (and others which could be established as such) exist in Ireland, largely because of previous research projects such as Ag-Biota and Biochange, there is no overall coherence between these sites or the research data being collected from them.

Drivers: The establishment of a network of long-term study sites related to agricultural ecosystems will greatly enhance our ability to understand ecological processes and favourable conservation status on a national scale. The study of these sites will help address many legislative requirements (under the Habitats, Birds, Water Framework, Agri-Environment Regulation, impending Soil Framework Directive, Nitrates Directive and other targeted agri-environmental schemes) through the evolution of monitoring guidelines, identification of indicators of change and definitions of thresholds.

***Overarching research need*:** The development of a co-operative, inter-institutional research programme to support the establishment of a long-term experimental infrastructure and the development of an integrated research model incorporating the conservation and utilisation of biological diversity in the development of sustainable grass-based agriculture.

To facilitate and optimise the establishment of a network of agricultural long-term study sites the following specific measures are required:

6.1 Establishment of a working group to identify a suitable network of sites. While taking into account existing long-term study sites and the research data gatered from them.

6.2 Within these study sites conduct a programme of research within agricultural and grassland ecosystems to better understand:

- The impacts of agricultural activities and practices (e.g. fertilizers, pesticides and disturbance) on habitat, species and soil biodiversity.
- The impacts on soil and surface-active invertebrates of poaching (trampling of flooded soil by livestock) and soil compaction at different stocking levels.
- The long-term impacts of depositing sewage sludge and other organic wastes on to agro-ecosystems.
- The consequences of biofuel production for biodiversity at field, landscape and regional levels.
- How soil carbon can be retained and and further carbon sequestered in the soil.
- Landscape analysis of the impact of the abandonment of traditional patterns of land use and farming systems biodiversity in economically marginal areas.
- The development of tools for monitoring the effects of changing farm practice, by development of an index-based method for the quantification of farmed landscape structure and quality and the development of indicators.

7. Functions and processes

There is a need to improve our basic understanding of how genetic, species and ecosystem ecology and processes influence the development and maintenance of biodiversity across a gradient of managed and natural ecosystems; this should include the processes underpinning the relationship between biodiversity and ecosystem services e.g. food production, maintenance of soil fertility, pollination and natural pest control. This will increase our understanding of the significance of biodiversity in agricultural and grassland systems and its relationship with ecosystem function and well-being. It will also allow predictions of the possible consequences of environmental change on biodiversity and the likely impacts on ecosystem function. The renewed policy target of halting biodiversity loss and degradation of ecosystem services (ES) by 2020 will be a significant challenge for Ireland. Research to identify and prioritise the ecosystem services that are provided, and the specific threats to them are urgently required to fulfil this target. Significant work remains for Ireland to adequately identify and implement policy to support (HNV) farmland.

Thus far, Ireland has failed to identify or implement policy to support High Nature Value (HNV) farmland.

Drivers: Better understanding the functions and processes that influence biodiversity and ecosystem goods and services will help address and better implement many legislative requirements (under Agri-Environment Regulation, impending Soil Framework Directive, Nitrates Directive and other targeted agri-environmental schemes) by understanding the relationship between biodiversity and ecosystem health and providing the knowledge required to allow the development of sustainable environmental policies and effective conservation strategies.

***Overarching research need*:** The development of a co-operative, inter-institutional research programme to investigate the relationship between biodiversity and ecosystem functions and processes.

To facilitate research into the relationship between biodversity and ecosystem function the following specific research is required:

7.1 Research to quantify the ecosystem services provided by land with different agricultural land use intensities and biodiversity levels, in particular pollination, C sequestration, water storage and purification.

7.2 Research to halt degradation of ecosystem services. Including the identification and prioritisation of ecosystem services, specific threats to them and the development of restorative measures to mitigate identified threats.

7.3 Research to understand the environmental consequences of farming patterns ranging between the extremes of widespread extensification vs. complete segregation of agricultural production and conservation areas.

7.4 Landscape analysis research on the extent and impact on biodiversity and ecosystem services due to abandonment of traditional patterns of land use and farming systems in economically marginal areas.

7.5 Reseach on the interaction of biodiversity effects across habitat and ecosystem boundaries through nature corridors. Including research to assess the effects of robust species-rich environments on the economic viability of farming in adjacent areas.

7.6 Research into species interactions (such as pollination, predation and competition).

7.7 Research on the extent of functional plasticity of species, in particular those species listed under Annex II of the Habitats Directive and the Annex I of the Birds Directive.

C. References

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Research recommendations of the Freshwater Working Group of the National Platform for Biodiversity Research

February 2012

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Summary

Biodiversity is essential for human life. It generates goods and services including the provision of food and medicines, the protection and regulation of water flow, the support of soil formation together with numerous social and cultural benefits. Without which, there would be no economies, no societies - and no human life.

Biodiversity loss is probably the greatest challenge human societies face today. Although the world's attention is almost exclusively focused on economic crises and climate change, a recent review on identifying planetary boundaries for human welfare identified biodiversity loss as the most critical.

Ireland, along with every other nation, faces enormous challenges in terms of halting biodiversity loss in the years ahead, not just in terms of implementing the many actions that are set down in the National Biodiversity Plan, but in many cases, in deciding what action is appropriate. The decisions we take in the next few years will have far-reaching consequences for biodiversity and therefore must be based on thorough knowledge of the problems, interactions and dependencies involved. This kind of knowledge will only be available by conducting appropriate and comprehensive scientific research.

There is currently a lack of understanding and knowledge regarding biological diversity (BioChange, 2011) and an urgent need to develop scientific, technical and institutional capacities to provide basic understanding upon which to plan and improve appropriate conservation measures. This lack of hard scientific data has been highlighted by the Convention on Biological Diversity (CBD) and by various other national, European and international regulations and by the National Biodiversity Plan.

The initiation, development and delivery of appropriate policy to meet national and EU obligations must be based on relevant and rigorous research knowledge by both collating existing knowledge and conducting appropriate new research where knowledge gaps are shown to exist. Since the conservation, enhancement and sustainable utilisation of biodiversity and biological resources must underpin all areas of environmentally based legislation; there is a clear necessity for the integration of scientific advice into policy-making and delivery.

In July 2010, a working group of scientists (see list in Section D) drawn from the National Platform for Biodiversity (NPBR) was formed. The purpose of this working group was to examine the Biodiversity Knowledge Programme for Ireland (EPA, 2006) with a view to revising this document, prioritising research needs to help inform policy and to further establish knowledge gaps that hinder Ireland in meeting national biodiversity objectives in relation to freshwater habitats. This review identified six priority areas essential to implement our legislative requirements and to meet the challenge of halting the loss of our national biodiversity in this area. Section A of this document deals with enabling actions necessary to facilitate biodiversity research, while Section B deals with the most urgent research priorities required in the area of Freshwater; specifically rivers, streams and lakes, rather than wetland habitats.

A. Enabling Actions

1. Integration of the policy environment

A number of EU Directives and national legislation dictate how we manage our national biodiversity. While responsibility for the implementation of these Directives falls into the brief of different government departments, the reality is that the majority of these issues are cross cutting and simply cannot be implemented by any one department, without the co-operation of other related departments.

Currently biodiversity research support across different government departments is fragmented, scattered and largely uncoordinated. This has led to a lack of coherence between departments attempting to implement the various nature conservation directives and conduct the necessary research required for their implementation. This lack of coherence is a hindrance to fulfilling our legislative requirements and is an extremely inefficient use of government funding. It has resulted in an overlap of research projects and a lack of awareness across departments of where the knowledge gaps actually lie.

Policies are often developed without sound scientific evidence. This is a direct result of a lack of communication between policy makers and scientists. There is a lack of awareness among scientists of the policy timeframes and a lack of coordination of research efforts to meet needs of policy makers.

At local authority level Biodiversity Action Plans are being developed. While the formulation of these plans follows guidelines laid down by the Department of the Environment, Community and Local Government there is no coordination between the various local authorities while developing these plans. This is particularly relevant to developing actions for freshwater ecosystems where freshwater catchments may span a number of local authority areas.

Drivers: Maximum value for money for the funding of biodiversity research relating to freshwater ecosystems to deliver maximum impact of the research results. Multiple legislative drivers in this regard include: The Water Framework Directive, Floods Directive, Birds and Habitats Directives, The Planning and Development (Amendment) Regulations 2011 and the EIA (Agriculture) Regulations 2011.

Overarching need: A clear and coordinated inter-departmental system to facilitate targeted biodiversity research programmes, designed to facilitate the implementation of legislative requirements.

To facilitate the coordination of inter-departmental systems the following specific measures are required:

The establishment of an inter-departmental working group, including the relevant key technical experts to:

1.1 Conduct a formal review of existing national environmental legislation (including enforcement) and the related policy, and assess the effectiveness of both. This review should include an assessment the environmental, economic and social effectiveness of current policy and legislation.

1.2 Ensure coordinated research effort and knowledge sharing between departments and agencies to maximise efficiencies and research effort of direct relevance to the implementation of legislative requirements.

1.3 Evaluate impacts, compatibilities and conflicts between government policies and biodiversity objectives and economic practice. This review should be based around the relevant sectors.

1.4 Identify policy blind spots and suggest methods that might be used to resolve policy conflicts. This should also include developing the actions required from research recommendations e.g. responsibility for dealing with invasive non-native species.

1.5 Identify more effective ways of integrating existing knowledge from both fundamental and applied research thereby facilitating evidence-based policy making.

1.6 Identify, develop and demonstrate appropriate policy implementation tools (e.g. recommend methodologies for habitat identification, prioritisation and assessment, monitoring, use of indicators and evaluation tools).

1.7 Identify how Government policies can be used as opportunities for biodiversity enhancement.

1.8 Identify effective measures for the policing of derogations.

1.9 Identify effective measures to assess the implementation of Biodiversity Action Plans within each Local Authority.

2: The coordination and dissemination of biodiversity data (including metadata)

The work of both policy and scientists is frequently hindered by the lack of access to, or knowledge of, previously generated national biodiversity research. The National Biodiversity Data Centre has assisted greatly in providing access to biodiversity datasets on species. However biodiversity research data is still housed in a disparate manner. There should be a co-ordination of research funding agencies to ensure that data arising from such projects are available in a central location. A working group drawn from the National Platform for Biodiversity Research and the National Biodiversity Data Centre should work together to develop a framework for the collation of all data and metadata and the establishment of a user friendly and fully comprehensive portal for access to this data. In addition, a standardisation of the approach to metadata entry needs to be agreed and disseminated.

Drivers: It is essential that the results of nationally funded biodiversity research are publicly available to assist in both the formulation of biodiversity policy, delivering legislative requirements and on-going research needs. Previously conducted biodiversity research will provide "added value" if accessible.

Overarching need: The coordination and dissemination of biodiversity data (including metadata).

To facilitate the coordination and dissemination of biodiversity data the following specific measures need to be undertaken:

2.1 All existing biodiversity data resources need to be collated and centralised.

2.2 Protocols for data exchange & data sharing need to be developed.

2.3 National biodiversity metadata entry should be agreed and standardised.

2.4 National database standards need to be developed and co-ordinated.

2.5 Dissemination of information is a two-way process. Both policy makers and scientists should disseminate biodiversity research outputs in the most effective format to facilitate key recommendations.

3: Funding of biodiversity research

Biodiversity research relating to freshwater is currently funded through two separate mechanisms. These are:
(1) Priority targeted research identified by government departments and agencies (e.g. Teagasc, Department of Agriculture, Food and the Marine, National Parks and Wildlife Service, the Environmental Protection Agency and the Heritage Council) that is necessary to implement legislative requirements.
(2) Open-call, competitive, peer-reviewed funding for biodiversity research in the University and NGO sectors, generally funded by the Department of Agriculture, Food and the Marine (Research Stimulus Fund) and the Environmental Protection Agency (STRIVE). Additionally EU funding programmes have contributed large research grants in this area.

The funding of freshwater related biodiversity research is largely uncoordinated amongst the various funding agencies and departments that fund biodiversity research. Often departments are unaware of projects being funded by other departments leading to inefficiencies, overlap and a lack of prioritised research funding. There is a need to establish a mechanism for coordinated research funding. The McCarthy Report (McCarthy, 2009) indicates coordination and efficiencies in research funding might be best achieved through a single stream of funding. However, it would be more appropriate if funding for targeted research remained with the relevant department to ensure research needs for legislative requirements will be delivered. The development of an interdepartmental/agency group is necessary to ensure that research referred to in (1) and (2) above is targeted at previously agreed research priorities.

Drivers: Maximum value for money and efficiency for the funding of freshwater biodiversity research to deliver maximum impact of the research results through coordinated funding mechanisms.

Overarching need: A clear and coordinated funding mechanism to ensure the most urgent research needs are delivered.

To facilitate coordination of the funding of biodiversity research, the following specific measures are required:

Establish an interdepartmental/agency group (referred to in section A. 1) to coordinate freshwater biodiversity research to:

3.1 Maximise efficiencies and ensure research is targeted in a prioritised manner

3.2 Identify a funding mechanism that has the capacity to manage competitive research calls on the themes identified in section B.

3.3 Establish a mechanism to ensure funders discuss proposed research funding with policy experts, for example through a funding referral officer available to assist in devising and evaluating research proposals.

B. Urgent research priorities

4. Functions and processes

The anthropogenic alteration of river corridors and floodplains can significantly modify the structure and function of rivers, particularly floodplains, lead to an extensive loss of wetlands and have significant adverse impacts on aquatic ecosystems as a result of excessive sedimentation and turbidity. Floodplain hydrology is intrinsically linked to streams and rivers in the context of a watershed. The economic consequences of the loss of floodplain structure and function have been clearly demonstrated in recent flood events in Ireland.

Rivers provide the floodplain with nutrients and sediment, whilst the floodplain provides a habitat for many species and improves water quality through settlement of sediment, and absorption and re-cycling of nutrients and pollutants. In recent times, urban and agricultural development has taken priority on many floodplains leading to their protection from flooding.

Freshwater resources, such as rivers, streams and lakes, play a major role in the provision of ecosystem goods and services. They also support a range of habitats and species, many of which are important contributors to the overall health of freshwater ecosystems.

Major threats to freshwater biodiversity include runoff from agricultural and urban areas, the invasion of exotic species, overexploitation and pollution. These threats have already significantly impacted the biodiversity within these ecosystems. Aquatic areas that have been damaged or suffered habitat loss or degradation can be rehabilitated. Even species populations that have suffered a decline can be targeted for restoration (e.g., Freshwater Pearl Mussel). The restoration of floodplains can be an important part of a catchment's flood management strategy in addition to restoring and enhancing its ecological structure and function.

Drivers: Multiple legislative requirements under the Habitats Directive, Water Framework Directive, Floods Directive. Policy commitments of government to international biodiversity targets revised in wake of failure to meet 2010 targets. New EU headline target: Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss. Local Authority Biodiversity Action Plans.

***Overarching research need*:** The development of a co-operative, inter-institutional research programme to investigate the relationship between biodiversity and ecosystem functions and processes in freshwater ecosystems.

To facilitate research to understand watershed management and the restoration of floodplains the following specific measures are required:

Research to understand the relationships between diversity and ecosystem functioning in major freshwater systems.

4.1 Research on the impact of sedimentation on biodiversity, including modelling of sediment movements.

4.2 Biodiversity-production studies, the importance of species complementarities and extent of species redundancy in freshwater ecosystems.

4.3 Research on the impact of sedimentation on biodiversity, including modelling of sediment movements.

4.4 Research to investigate innovative habitat restoration and conservation practices within floodplain habitats affected by anthropogenic factors.

4.5 Research to halt degradation of freshwater ecosystem services. Including the identification and prioritisation of ecosystem services, specific threats to them and the development of restorative measures to mitigate identified threats.

4.6 Research to investigate the effects of drainage maintenance and sedimentation processes on freshwater ecosystems, including those resulting from forestry, agricultural and peatland management practices.

4.7 Research to develop biological metrics for watershed hydrology, sediment delivery, and sediment composition.

4.8 Research to understand the effects of water abstraction in major freshwater ecosystems.

4.9 Research to develop appropriate agri-environment programmes to address the favourable conservation status of key habitats and species (e.g. freshwater pearl mussel).

4.10. Research to develop practical tools to (a) provide a workable classification of Irish Rivers, lakes and streams and (b) assess the conservation status of Irish Rivers, lakes and streams.

5: Inventory, distribution and taxonomic expertise

Knowledge of species distributions and ecology is fundamental to conservation, sustainable development and supporting policy needs. Virtually all policy instruments contain obligations where knowledge of species distributions is required to implement policy. To support policy needs, it will be necessary to focus existing knowledge, and where necessary, to acquire new knowledge and baseline biodiversity information that is specifically targeted at policy issues.

Acknowledging the key role played by taxonomy in safeguarding freshwater biodiversity and ensuring its sustainable use is crucial to implementing successful programmes of inventory and distribution and the monitoring of these species in the future. Without a concerted effort to develop taxonomic skills and capacity it will be impossible to conduct successful programmes of inventory and distribution and to fulfil Ireland's legislative obligations under a number of EU Directives (Habitats Directive and Water Framework Directive in particular).

***Drivers*:** Water Framework Directive, Habitats Directive.

***Overarching research need**:*

To increase the availability and interpretative value of basic information and improve the value of baseline data, it will be necessary to support:

5.1 Strengthening the capacity of State institutions to undertake taxonomy of freshwater species to include specialist training of taxonomists in this area.

5.2 The production of interactive web-based keys for the taxonomic identification of freshwater species.

5.3 Research on the status and distribution of rare or threatened freshwater species.

5.4 Identification of hotspots that have a high biodiversity value in Ireland, with particular reference to regional/catchment level studies.

5.5 Production of national inventories for less well-known freshwater taxa (e.g. freshwater mites and sponges) and their distribution.

5.6 Research on indicators of freshwater biodiversity and ecosystem health.

5.7 Early warning systems for the identification and detection of non-native species in freshwater ecosystems.

5.8 Establishment of networks of long-term study sites for larger-scale (spatial and temporal) monitoring and evaluation of biodiversity in freshwater habitats to help integrate research and provide long-term baseline data.

5.9 National surveys of freshwater habitats listed under Annex I, and species listed in Annex II of the EU Habitats Directive.

6. Biodiversity and economic values

Freshwater ecosystems interlink a myriad of users, economic and natural systems dependent on them. The agriculture, tourism, fisheries, forestry and construction industries (to name but a few) all benefit both directly and indirectly from freshwater ecosystems. Goods derived from freshwater ecosystems include fish, timber and fuel, wildlife, fertile land and, of course, water itself. These, along with services such as transport, recreation and scientific study are examples of direct uses of freshwater ecosystems. Indirect uses include storm protection, sediment and pollution retention, nutrient retention and evaporation. Through these goods and services freshwater ecosystems provide people with enumerable benefits that are valued at local, national, regional and global levels. In addition to the benefits and related values associated with the goods and services, people also intrinsically value freshwater ecosystems.

Freshwater ecosystems are among the most severely impacted as a direct result of anthropogenic activity and yet one of the most crucial in terms of human livelihoods. Understanding how human activities impact on freshwater biodiversity, and developing effective methods to mitigate these impacts and to enhance biodiversity forms an essential basis for delivering major international policy objectives of reducing the rate of biodiversity loss and maintaining ecosystem goods and services.

Drivers**:** Water Framework Directive, Habitats Directive. TEEB Report on the economics of biodiversity and ecosystem health, which highlights the stark reality of further impacting on freshwater resources.

Overarching research need*:* A fully integrated, multidisciplinary approach to examine the ecosystem goods and services delivered through freshwater ecosystems to include all sectors.

Research is required to:

6.1 Quantify the economic importance and relevance of freshwater resources and biodiversity in all sectors of the Irish economy. A baseline review and projections for the future (over the next 10 years and longer) are required.

6.2 Assess the relationship between the payment of subsidies to farmers, fisherman and other sectors and its impact on protecting and enhancing freshwater biodiversity.

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NPBR

Research recommendations of the Marine Working Group of the National Platform for Biodiversity Research

February 2012

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Summary

Biodiversity is essential for human life. It generates goods and services including the provision of food and medicines, the protection and regulation of water flow, the support of soil formation together with numerous social and cultural benefits. Without which, there would be no economies, no societies - and no human life.

Biodiversity loss is probably the greatest challenge human societies face today. Although the world's attention is almost exclusively focused on economic crises and climate change, a recent review on identifying planetary boundaries for human welfare identified biodiversity loss as the most critical.

Ireland, along with every other nation, faces enormous challenges in terms of halting biodiversity loss in the years ahead, not just in terms of implementing the many actions that are set down in the National Biodiversity Plan, but in many cases, in deciding what action is appropriate. The decisions we take in the next few years will have far-reaching consequences for biodiversity and therefore must be based on thorough knowledge of the problems, interactions and dependencies involved. This kind of knowledge will only be available by conducting appropriate and comprehensive scientific research.

There is currently a lack of understanding and knowledge regarding biological diversity (BioChange, 2011) and an urgent need to develop scientific, technical and institutional capacities to provide basic understanding upon which to plan and improve appropriate conservation measures. This lack of hard scientific data has been highlighted by the Convention on Biological Diversity (CBD) and by various other national, European and international regulations and by the National Biodiversity Plan.

The initiation, development and delivery of appropriate policy to meet national and EU obligations must be based on relevant and rigorous research knowledge by both collating existing knowledge and conducting appropriate new research where knowledge gaps are shown to exist. Since the conservation, enhancement and sustainable utilisation of biodiversity and biological resources must underpin all areas of environmentally based legislation; there is a clear necessity for the integration of scientific advice into policy-making and delivery.

In October 2009, a working group of marine scientists (see Section D) that included senior policy representatives drawn from the NPBR was formed. The purpose of this working group was to examine the Biodiversity Knowledge Programme for Ireland (EPA, 2006) with a view to revising this document, prioritising research needs to help inform policy and to further establish knowledge gaps in relation to marine biodiversity research in Ireland. This review identified six priority areas essential to implement our legislative requirements and to meet the challenge of halting the loss of our national marine biodiversity. Section A of this document deals with enabling actions necessary to facilitate biodiversity research, while Section B deals with the most urgent research priorities.

A. Enabling Actions

1. Integration of the policy environment

A number of EU Directives and national legislation dictate how we manage our national biodiversity. While responsibility for the implementation of these Directives falls into the brief of different government departments, the reality is that the majority of these issues are cross cutting and simply cannot be implemented by any one department without the cooperation of other related departments.

Currently biodiversity research support across different government departments is fragmented, scattered and largely uncoordinated. This has led to a lack of coherence between departments attempting to implement the various Nature Conservation Directives and conduct the necessary research required for their implementation. This lack of coherence is a hindrance to fulfilling our legislative requirements and is an extremely inefficient use of government funding. It has resulted in an overlap of research projects and a lack of awareness across departments of where the knowledge gaps actually lie.

Drivers: Maximum value for money for the funding of marine biodiversity research to deliver maximum impact of the research results.

Overarching need: A clear and coordinated inter-departmental system to facilitate targeted biodiversity research programmes, designed to facilitate the implementation of legislative requirements.

To facilitate the coordination of inter-departmental systems the following specific measures are required:
The establishment of an interdepartmental working group, including the relevant key technical experts to:

1.1 Ensure coordinated research effort and knowledge sharing between departments and agencies to maximise efficiencies and research effort of direct relevance to the implementation of legislative requirements.

1.2 Evaluate impacts, compatibilities and conflicts between government policies and biodiversity objectives and economic practice. This review should be based around the relevant sectors.

1.3 Identify policy blind spots and suggest methods that might be used to resolve policy conflicts. This should also include developing the actions required from research recommendations e.g. responsibility for dealing with invasive non-native species.

1.4 Identify more effective ways of integrating existing knowledge from both fundamental and applied research thereby facilitating evidence-based policy making.

2: The coordination and dissemination of biodiversity data (including metadata).

The work of both policy and scientists is frequently hindered by the lack of access to, or knowledge of, previously generated national biodiversity research. The National Biodiversity Data Centre has assisted greatly in providing access to biodiversity datasets on species. However biodiversity research data is still housed in a disparate manner. There should be a co-ordination of research funding agencies to ensure that data arising from such projects are available in a central location. A working group drawn from the National Platform for Biodiversity Research and the National Biodiversity Data Centre should work together to develop a framework for the collation of all data and metadata and the establishment of a user friendly and fully comprehensive portal for access to these data. In addition, a standardisation of the approach to metadata entry needs to be agreed and disseminated.

Drivers: It is essential that the results of nationally funded biodiversity research are publicly available to assist in both the formulation of biodiversity policy, delivering legislative requirements and on-going research needs. Previously conducted biodiversity research will provide "added value" if accessible.

Overarching need: The coordination and dissemination of biodiversity research data (including metadata).

To facilitate the coordination and dissemination of biodiversity research data the following specific measures need to be undertaken:

2.1 All existing biodiversity research data resources need to be collated and centralised.

2.2 Protocols for data exchange & data sharing need to be developed.

2.3 National biodiversity metadata entry should be agreed and standardised.

2.4 National database standards should be developed and co-ordinated.

2.5 Biodiversity research outputs should be disseminated in the most appropriate format to facilitate both research and policy.

3: Funding of marine biodiversity research

Marine biodiversity research is currently funded through two separate mechanisms. These are:
(1) Priority targeted research identified by government departments and agencies (e.g. the National Parks and Wildlife Service, the Environmental Protection Agency, the Marine Institute and the Heritage Council) that is necessary to implement legislative requirements.
(2) Open-call, competitive, peer-reviewed funding for biodiversity research in the University and NGO sectors, generally funded by the Marine Institute, the Environmental Protection Agency, Science Foundation Ireland and the Irish Research Council for Science, Engineering and Technology (IRCSET). Additionally EU funding programmes have contributed large research grants in this area.

The funding of marine biodiversity research is largely uncoordinated amongst the various funding agencies and departments that fund marine biodiversity research. Often departments are unaware of projects being funded by other departments leading to inefficiencies, overlap and a lack of prioritised research funding. There is a need to establish a mechanism for coordinated research funding. The McCarthy Report (McCarthy, 2009) indicates coordination and efficiencies in research funding might be best achieved through a single stream of funding. However, it would be more appropriate if funding for targeted research remained with the relevant department to ensure research needs for legislative requirements will be delivered. The development of an interdepartmental/agency group is necessary to ensure that research referred to in (1) and (2) above is targeted at previously agreed research priorities.

Drivers: Maximum value for money and efficiency for the funding of marine biodiversity research to deliver maximum impact of the research results through coordinated funding mechanisms.

Overarching need: A clear and coordinated funding mechanism to ensure the most urgent marine research needs are delivered.

To facilitate coordination of the funding of biodiversity research, the following specific measures are required:

3.1 An interdepartmental/agency group (referred to in section A. 1) to coordinate marine biodiversity research needs to be established to:

- Maximise efficiencies and ensure research is targeted in a prioritised manner.
- Identify a funding mechanism that has the capacity to manage competitive research calls on the themes identified in section B.
- Establish a mechanism to ensure funders discuss proposed research funding with policy experts, for example through a funding referral officer available to assist in devising and evaluating research proposals.

B. Urgent research priorities

4: The identification and conservation of areas of high biodiversity value

Areas of high biodiversity value are areas that contain a high number of endemic and threatened species. As the natural values of such areas are assumed to be largely intact, undertaking action now to identify these areas and to maintain conservation status within them has the potential to provide value-for-money by optimising resources for conservation and maximising current research effort. The current, planned or potential anthropogenic activities of areas of high biodiversity value place their natural values at risk and it is likely this risk will increase in the future in the absence of active conservation management.

The protection of areas of high biodiversity value is a cross cutting issue that will require the engagement and commitment of a number of government departments and can only be achieved by the implementation of the measures listed in Section A.

Drivers: The identification and conservation of biodiversity hotspots will facilitate Ireland's legal requirements under numerous EU Directives (Habitats Directive, Birds Directive, Marine Strategy Framework Directive, Water Framework Directive, etc).

***Overarching research need*:** The identification of areas of high biodiversity value, the evaluation of threats to these areas and the production of effective conservation management strategies to protect their conservation interests.

To facilitate the identification of national marine areas of high biodiversity value the following specific measures are required:

4.1 The development of the criteria necessary to classify an area as an area of high biodiversity value and to allow these areas to be then prioritised for future research, monitoring, management and protection.

4.2 The production of national inventories of marine species.

4.3 The production of national inventories for less well-known taxonomic groups of marine algae and invertebrates and their distribution.

4.4 The establishment of the status and distribution of rare or threatened species in marine

ecosystems.

4.5 The undertaking of nationwide surveys of those habitats of national and European importance that have not been the subject of previous surveys or where such surveys have delivered insufficient information.

4.6 The undertaking of nationwide surveys of those species of national and European importance that have not been the subject of previous surveys or where such surveys have delivered insufficient information.

4.7 Account should also be taken of biodiversity and the potential for marine research associated with deep-water environments, which may be required to fulfill the requirements under the Marine Strategy Framework Directive.

4.8 The identification of key species and their potential effects on targeted species loss in nationally important marine ecosystems.

4.9 The production of red data books for marine species (algae, invertebrates and fish) should be commenced and will be facilitated by the supporting actions in 4.2-4.6.

5: The establishment of long-term study sites

Long-term ecosystem research, through the establishment of a network of long-term study sites, is an essential mechanism to better understand ecosystem structure, function, and response to environmental, societal and economic drivers. While numerous long-term marine study sites exist in Ireland, there is no programme of coherence between these sites or the research data being collected from them.

Drivers: The establishment of a network of long-term marine study sites will greatly enhance our ability to understand ecological processes and favourable conservation status on a national scale. The study of these sites will help address many legislative requirements (under the Habitats, Birds, Water Framework and Marine Strategy Framework Directives) through the evolution of monitoring guidelines, identification of indicators of change and definitions of thresholds.

Overarching research need**:** The establishment of a network of long-term marine study sites and a programme of research to be conducted within these sites.

To facilitate and optimise the establishment of a network of marine long-term study sites the following specific measures are required:

- The establishment of a working group to identify a suitable network of sites, while taking into account existing long-term study sites and the research data gathered from them. Particular attention should be paid to the establishment of sites in the offshore marine environment.

Within these study sites conduct a programme of research to better understand:

5.1 Patterns of spatial and temporal variation at a range of scales, particularly for Annex I habitats and Annex II species.

5.2 The interactions between fisheries and fish predators (mammals and birds).

5.3 The impacts of fisheries and aquaculture on ecosystems, habitats and species. Particularly Annex I habitats and Annex II species and methods of mitigation.

5.4 Variation in ecological patterns.

5.5 Minimum viable areas of species of conservation importance.

5.6 Ecological changes associated with long-term environmental change, e.g. climate change, ocean acidification and shorter-term impacts, e.g. nutrient pollution and harmful algal blooms.

5.7 Ground truthing of biomonitoring tools by sampling and experimentation.

5.8 Natural and anthropogenic variation in biodiversity and its relationship with ecosystem functioning and provision of ecosystem services.

5.9 The functional importance of interactions within and between habitats and species, in particular those species listed under Annex II of the Habitats Directive and the Annex I of the Birds Directive.

6: Non-native invasive species

Invasive non-native (alien) species are important drivers of environmental change and can have profound consequences for native biodiversity. The impact of non-native species on ecosystem goods and services is well documented. They are known to have an increasing negative impact on our native biodiversity and a direct impact on the economic value we derive from our natural environment.

Drivers: The "do-nothing approach" is not an option. Urgent action is required to detect and manage invasive non-native marine species that have the potential to drive the loss of economic goods and services and impact upon our native biodiversity. Under Annex III of the Marine Strategy Framework Directive, member states are obligated to create "*an inventory of the temporal occurrence, abundance and spatial distribution of non-indigenous, exotic species or, where relevant, genetically distinct forms of native species, which are present in the marine region or subregion"*

Overarching research need**:** Develop an early warning system for the identification and detection of non-native invasive marine species.

To facilitate the development of an early warning system for the identification and detection of non-native invasive marine species the following specific measures are required:

6.1 Establishment of a permanent working group to assist in the coordination of efforts to deal with the issues of non-native invasive species and to enable a rapid response.

6.2 The production of inventories, including spatial distribution and temporal occurrence, of non-native marine species.

6.3 Research to understand the dispersal mechanisms of non-native species needs urgent attention since the capability of such mechanisms could exceed the ability of management measures employed.

6.4 Research to enable risk-assessments on impacting (target) species likely to arrive based on current and future trade, likely entry points and subsequent spread.

6.5 Research to assess likely hubs of inoculation and the development of *a priori* plans for dealing with specific invasions likely to be of impact.

6.6 The development of strategies for the effective control of species identified as high risk in 6.4 at the first sign of their arrival.

6.7 Development of indicators of the impacts of non-native species and assessment of the possible ecological and economic impact of current and potential invasives to help prioritise management responses towards the most damaging species.

6.8 Research to reduce the impact of Ireland as a donor to other countries and biogeographical provinces.

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F. Definitions

The definitions given below are general and their objective is to guide the reader as to their meaning rather than provide a scientific definition.

Ecological patterns: The variation within habitats and species found across different ecological gradients whether caused by natural or anthropogenic effects.

Deep water: Depths encountered off the continental shelf.

Long term: Generally decades.

National and European importance: Species listed in Annex I of the habitats Directive and Birds Directive and habitats listed in Annex II of the Habitats Directive.

Native species: In general a species is defined as indigenous or native to a given region or ecosystem if its presence in that region is the result of only natural resources, with no human intervention. It also refers to species that have become naturalised in Ireland over long periods of time.

Non-native invasive species: An introduced, alien, exotic or non-indigenous species**.**

Threatened: Any species vulnerable to extinction in the near future. The World Conservation Union (IUCN) is the foremost authority on threatened species, and treats threatened species not as a single category, but as a group of three categories: vulnerable, endangered, and critically endangered, depending on the degree to which they are threatened.

Targeted species loss: In this context is taken to mean species that are intentionally removed from the ecosystem.

Research recommendations of the uplands, wetlands and peatlands working group of the National Platform for Biodiversity Research

February 2012

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Summary

Biodiversity is essential for human life. It generates goods and services including the provision of food and medicines, the protection and regulation of water flow, the support of soil formation together with numerous social and cultural benefits. Without which, there would be no economies, no societies - and no human life.

Biodiversity loss is probably the greatest challenge human societies face today. Although the world's attention is almost exclusively focused on economic crises and climate change, a recent review on identifying planetary boundaries for human welfare identified biodiversity loss as the most critical.

Ireland, along with every other nation, faces enormous challenges in terms of halting biodiversity loss in the years ahead, not just in terms of implementing the many actions that are set down in the National Biodiversity Plan, but in many cases, in deciding what action is appropriate. The decisions we take in the next few years will have far-reaching consequences for biodiversity and therefore must be based on thorough knowledge of the problems, interactions and dependencies involved. This kind of knowledge will only be available by conducting appropriate and comprehensive scientific research.

There is currently a lack of understanding and knowledge regarding biological diversity (BioChange, 2011) and an urgent need to develop scientific, technical and institutional capacities to provide basic understanding upon which to plan and improve appropriate conservation measures. This lack of hard scientific data has been highlighted by the Convention on Biological Diversity (CBD) and by various other national, European and international regulations and by the National Biodiversity Plan.

The initiation, development and delivery of appropriate policy to meet national and EU obligations must be based on relevant and rigorous research knowledge by both collating existing knowledge and conducting appropriate new research where knowledge gaps are shown to exist. Since the conservation, enhancement and sustainable utilisation of biodiversity and biological resources must underpin all areas of environmentally based legislation; there is a clear necessity for the integration of scientific advice into policy-making and delivery.

In January 2011, a working group of scientists (see section E) and policy representatives drawn from the NPBR was formed. The purpose of this working group was to examine the Biodiversity Knowledge Programme for Ireland (EPA, 2006) with a view to revising this document, prioritising research needs to help inform policy and to further establish knowledge gaps that hinder Ireland in meeting national biodiversity objectives in relation to uplands, wetlands and peatlands. This review identified seven priority areas essential to implement our legislative requirments and to meet the challenge of halting the loss of our national biodiversity in this sector of the landscape. section A of this document deals with enabling actions necessary to facilitate biodiversity research, while section B deals with the most urgent research priorities required in the area of uplands, wetlands and peatlands. In this context, section C of this document details the habitats covered under the broad classification of uplands, wetlands and peatlands.

A. Enabling Actions

1. Integration of the policy environment

A number of EU Directives and acts of national legislation dictate how we manage our national biodiversity. While responsibility for the implementation of these directives falls into the brief of different government departments, the reality is that the majority of these issues are cross cutting and simply cannot be implemented by any one department without the cooperation of other related departments.

Currently biodiversity research support across different government departments is fragmented, scattered and largely uncoordinated. This has led to a lack of coherence between departments attempting to implement the various nature conservation directives and conduct the necessary research required for their implementation. This lack of coherence is a hindrance to fulfilling our legislative requirements and is an extremely inefficient use of government funding. It has resulted in an overlap of research projects and a lack of awareness across departments of where the knowledge gaps actually lie.

Policies are often developed without sound scientific evidence. This is a direct result of a lack of communication between policy makers and scientists. There is a lack of awareness among scientists of the policy timeframes and a lack of coordination of research efforts to meet needs of policy makers.

Drivers: Maximum value for money for the funding of biodiversity research relating to uplands, peatlands and wetlands to deliver maximum impact of the research results. Multiple legislative drivers in this regard include: the EIA (Agriculture) Regulations 2011, Birds and Habitats Directives, Water Framework Directive and the Planning and Development (Amendment) Regulations 2011.

Overarching need: A clear and coordinated inter-departmental system to facilitate targeted biodiversity research programmes, designed to facilitate the implemention of legislative requirements.

To facilitate the coordination of inter-departmental systems the following specific measures are required:

The establishment of an inter-departmental working group, including the relevant key technical experts to:

1.1 Ensure coordinated research effort and knowledge sharing between departments and agencies to maximise efficiencies and research effort of direct relevance to the implementation of legislative requirements.

1.2 Evaluate impacts, compatibilities and conflicts between government policies and biodiversity objectives and economic practice. This review should be based around the relevant sectors.

1.3 Identify policy blind spots and suggest methods that might be used to resolve policy conflicts. This should also include developing the required actions from existing research recommendations e.g. responsibility for dealing with invasive non-native species.

1.4 Identify more effective ways of integrating existing knowledge from both fundamental and applied research thereby facilitating evidence-based policy making.

1.5 Identify, develop and demonstrate appropriate policy implementation tools (e.g. recommend methodologies for habitat identification, prioritisation of measures and assessment of efficacy, monitoring of implementation and effect, use of indicators and evaluation tools for schemes and initiatives).

1.6 Identify how Government policies can be used as opportunities for biodiversity enhancement.

2: The coordination and dissemination of biodiversity data (including metadata)

The work of both policy and scientists is frequently hindered by the lack of access to, or knowledge of, previously generated national biodiversity research. The National Biodiversity Data Centre has assisted greatly in providing access to biodiversity datasets on species. However biodiversity research data is still housed in a disparate manner. There should be a co-ordination of research funding agencies to ensure that data arising from such projects are available in a central location. A working group drawn from the National Platform for Biodiversity Research and the National Biodiversity Data Centre should work together to develop a framework for the collation of all data and metadata and the establishment of a user-friendly and fully comprehensive portal for access to this data. In addition, a standardisation of the approach to metadata entry needs to be agreed and disseminated.

Drivers: It is essential that the results of nationally funded biodiversity research is publically available to assist in both the formulation of biodiversity policy, delivering legislative requirements and on-going research needs. Previously conducted biodiversity research will provide "added value" if accessible.

Overarching need: The coordination and dissemination of biodiversity data (including metadata).

To facilitate the coordination and dissemination of biodiversity data the following specific measures need to be undertaken:

2.1 All existing biodiversity data resources need to be collated and centralised.

2.2 Protocols for data exchange and data sharing need to be developed.

2.3 National biodiversity metadata entry should to be agreed and standardised.

2.4 A system of national database standards should be developed and co-ordinated.

2.5 Both policy makers and scientists should disseminate biodiversity research outputs in the most effective format to facilitate key recommendations.

2.6 Integrated analysis of available biodiversity datasets relating to uplands, peatlands and wetlands that have been collated by the National Biodiversity Data Centre and other organisations should be conducted. Targeted analysis of these data will assist in addressing specific policy needs and research questions.

3. Conservation policy: stakeholder attitudes and social compliance.

The Irish landscape is largely semi-natural, shaped by thousands of years of agricultural practices. Historically, we know that at a time when the population of Ireland was almost double of what it is today, hardly a corner of the country was left untouched by agricultural practice of some type. Generally the only fragments of land left untouched by human hand were those in areas not suitable for agriculture, many of which occur in upland, wetland and peatland habitats. Improved technology, and the utilisation of land unsuitable for agriculture for other purposes (e.g. wind farms, peat extraction) have increased the anthropogenic impacts in these areas.

Conservation policy seldom succeeds without the active engagement of those whose livelihoods depend on the land from which they derive their income. To a great extent these are the custodians of the natural environment and without their willingness and active participation in conservation management, plans and policies are unlikely to fully succeed. Previous research e.g.

the EPA funded Biochange project has already borne out these facts; however, active stakeholder engagement in the formulation of policy rarely engages stakeholders and their attitudes.

In a similar manner to subsection A1 where it is stated that policies are often developed without sound scientific evidence, policy is also often developed without full stakeholder engagement. This lack of communication between policy makers and stakeholders creates a further obstacle to the effective management of our biodiversity. Similarly, a lack of engagement between scientists and stakeholders frequently leads to research recommendations that fail to take stakeholder attitudes and the practicalities of sustainability into account.

Drivers: Improved compliance with numerous legislative requirments including the Habitats Directive, Birds Directive and Water Framework Directive. Improved adherence to good practice under agri-environment schemes and cross-compliance. Better advice to policy makers from the scientific community and vice versa.

Overarching need: A clear and coordinated inter-departmental infrastructure to facilitate stakeholder engagement in biodiversity policy as part of a two way process, designed to facilitate the implemention of legislative requirements.

4: Funding of biodiversity research

Biodiversity research in relation to uplands, wetlands and peatlands is currently funded through two separate mechanisms. These are:
(1) Priority targeted research identified by government departments and agencies (e.g. Teagasc, Department of Agriculture, Food and the Marine, National Parks and Wildlife Service, the Environmental Protection Agency and the Heritage Council) that is necessary to implement legislative requirments and
(2) Open-call, competitive, peer-reviewed funding for biodiversity research in the University and NGO sectors, generally funded by the Department of Agriculture, Food and the Marine (Research Stimulus Fund), the Environmental Protection Agency (STRIVE), Science Foundation Ireland and the Irish Research Council for Science, Engineering and Technology (IRCSET). Additionally EU funding programmes have contributed large research grants in this area.

The funding of upland, wetlands and peatland related biodiversity research is largely uncoordinated amongst the various funding agencies and departments that fund biodiversity

research. Often departments are unaware of projects and their outputs that are being funded by other departments, which can lead to inefficiencies, overlap and a lack of prioritised research funding. There is a need to establish a mechanism for coordinated research funding and dissemination of research results. The McCarthy Report (McCarthy, 2009) indicates coordination and efficiencies in research funding might be best achieved through a single stream of funding. However, it would be more appropriate if funding for targeted research remained with the relevant department to ensure research needs for legislative requirements will be delivered. The development of an interdepartmental/agency group is necessary to ensure that research referred to in (1) and (2) above is targeted at previously agreed research priorities.

Drivers: Maximum value for money and efficiency for the funding of biodiversity research to deliver maximum impact of the research results through coordinated funding mechanisms.

Overarching need: A clear and coordinated funding mechanism to ensure the most urgent research needs are delivered.

To facilitate coordination of the funding of biodiversity research, the following specific measures are required:

Establish an interdepartmental/agency group (referred to in subsection A1) to coordinate upland, wetland and peatland biodiversity research to:

4.1 Maximise efficiencies and ensure research is targeted in a prioritised manner.

4.2 Identify a funding mechanism that has the capacity to manage competitive research calls on the themes identified in section B.

4.3 Establish a mechanism to ensure funders discuss proposed research funding with policy and scientific experts, for example through a funding referral officer, who should also be a member of the NPBR, available to assist in devising and evaluating research proposals

B. Urgent research priorities

5. Mapping, inventory and analysis

Many areas of biodiversity value occur in upland, wetlands and peatland habitats both within and outside areas currently designated for nature conservation (Special Areas of Conservation, Special Protection Areas, and Natural Heritage Areas). The current, planned or potential anthropogenic activities in such habitats place their natural values at risk. It is likely this risk will increase in the future in the absence of a comprehensive inventory of these habitats and their component species to aid effective conservation management. Research is required to identify and describe the biodiversity value of these areas. This has the potential to provide value-for-money by optimising resources for conservation (to maintain or enhance their favourable conservation status) and to focus current research effort.

The recently completed Irish BOGLAND project funded by the EPA stated "Research should be aimed at a better understanding of the distribution and composition of the biodiversity of peatlands beyond the more obvious plants, animals and bird species. Also, the investigation of less studied habitats, such as blanket bogs and fens should be a priority. In particular, the improved mapping and monitoring of blanket bog habitats is required in order to quantify the extent and condition of the resource and for prioritising conservation efforts".

While the topic of data collation, integration and dissemination is discussed under subsection A2 it has been included here as it goes beyond the task of collating and disseminating data to include the targeted analysis of these data to address specific policy needs and research questions.

A large volume of data already exists in relation to upland, wetland and peatland biodiversity. These data are seriously under-utilised, largely due to the disparate manner in which they have been collected and stored, as outlined in section A2. As a first step, there is an urgent need to collate and integrate all data relevant to uplands, wetlands and peatlands and to analyse this data in a manner appropriate to identifying gaps where further mapping and inventory are required to use this data to its full potential.

Analysis of already existing datasets will also provide a mechanism to identify areas of high biodiversity value, assess land use practices, assess the effectiveness of agri-environment

schemes, indicate areas where targeted mapping and inventory are required and identify the drivers of change.

The identification, collation, integration and analysis of datasets will require the active engagement across a number of government departments, agencies and the scientific community.

Drivers: The identification, mapping and collation of data of upland, wetland and peatland habitats will facilitate Ireland's legal requirements under numerous EU Directives and national legislation (Habitats Directive, Birds Directive, Flora Protection Orders, the Convention on Biological Diversity, Water Framework and Landscape Directives). The analysis of these data will also provide a mechanism to enhance the implementation of other national programmes such as the Commonage Framework Plans and other agri-environmental schemes. It will also provide the information required for numerous related policy requirements such as the identification of High Nature Value (HNV) Farmland and the Ecosystem Goods and Services (EGS) provided by these habitats.

Overarching research need**:** The collation, mapping and analysis of all data relating to upland, wetland and peatland habitats to provide a mechanism for the evaluation of the effectiveness of current agri-environment schemes in these habitats and to identify areas where gaps exist in these datasets to facilitate targeted mapping and inventory to allow effective conservation management.

To fully realise the value of already existing data on upland, wetland and peatland habitats the following specific measures are required:

Collate all existing data on upland, wetland and peatland habitats including maps on stocking levels, condition, population and other socio-economic data and use this data to:

5.1 Construct a national habitat map of all Annex I upland, peatland and wetlands habitats (see list of these habitats in section C).

5.2 Construct a national vegetation map at Fossitt level 2.

5.3 Quantify the actual extent of domestic peat cutting, especially on blanket bogs.

5.4 Identify indicator species.

5.5 Identify indicators of change.

5.6 Identify biodiversity hotspots.

5.7 Identify HNV farmland systems that support biodiversity.

5.8 Assess the conservation status of Annex I habitats and Annex II species listed by the Habitats Directive.

Assess where gaps exist in our current knowledge of the location and distribution of these habitats and their component species to facilitate targeted surveys likely to include:

5.9 The completion of national inventories of all upland, wetland and peatland Annex I habitats.

5.10 The production of national inventories for less well-known taxa (including lichens, fungi and bryophytes) and their distribution.

5.11 The creation a national vegetation classification system for all Irish habitats; including uplands, peatlands and wetlands.

6. Protection of biological resources

The protection of our national biological resources and successful implementation of biodiversity legislation is strongly dependent upon our knowledge of current management practices and use of its natural resources, impacts on biological diversity and ecosystem health, and how we can best protect core ecological services vital for the sustainable utilisation of biological resources and implementation of nature conservation legislation.

The longer-term impacts of major environmental change brought about by resource management practices are a key area of uncertainty. Knowledge is also needed concerning the development of alternative production systems that maximise environmental protection and make wider use of genetic resources that best match local conditions in agricultural, forestry and other commercial systems in uplands, wetland and peatlands, and protect and utilise natural ecosystem processes.

Drivers: The better understanding of systems and processes affeacting upland, wetland and peatland habitats will facilitate compliance with Ireland's legal requirements under numerous EU Directives and national legislation (Habitats Directive, Birds Directive, Flora Protection Orders, the CBD, Water Framework and Landscape Directives).

Overarching research need: To further our understanding of systems and processes affecting the protection, restoration and utilisation of biodiversity within upland, wetland and peatland habitats, the following priority measures are required:

6.1 Research to investigate innovative habitat restoration and conservation techniques within landscapes affected by anthropogenic factors to assess their effectiveness in terms of hydrology, carbon storage and sequestration potential and biodiversity at all levels.

6.2 Costed and targeted prescriptions that can be delivered through agri-environmental schemes, which can address undergrazing and overgrazing.

6.3 Analysis of various habitat prescriptions implemented to date through agri-environmental schemes in upland and peatland habitats.

6.4 Research into the re-creation requirements for raised bog communities/habitats on industrial cutaway/cutover bog areas, as opposed to creation of non-peat forming wetlands.

6.5 Research to enhance our understanding of restoration and conservation of the remaining raised bogs, which is critical to preventing further degradation due to past drainage and cutting.

6.6 Research to investigate the effectiveness of specific environmental measures and schemes such as agri-environmental, forestry and transport schemes to ensure these schemes protect and enhance biodiversity in accordance with best scientific knowledge for protecting biodiversity.

6.7 Research into possible “greening measures” that could be delivered in extensive landscapes and supported through direct payments to farmers.

6.8 Research to investigate greenhouse gas emissions from peat soils under various managements (to be used towards Tier 3 reporting of Kyoto protocol).

6.9 Mechanisms to ensure that all policy drivers of change (schemes, initiatives etc) are compliant with the requirements of the Habitats and Birds Directives in relation to the protection of Natura 2000 sites and respect the Wildlife Acts and other national legislation.

6.10 Classification and identification of all peatlands along a degradation scale.

6.11 Research and development into alternative material to replace peat in horticulture and other products.

6.12 Research to investigate the cultivation of *Sphagnum* moss for use in growing media.

6.13 Research into paludiculture on degraded peatlands should be developed.

6.14 Wet heaths are often associated with blanket bogs and are listed in the Annex 1 of the Habitats Directive as important habitat to protect. An assessment of the disturbance to these habitats is required as they have serious consequences in terms of carbon loss and water quality

7. Strategic Environmental Assessment of plans and programmes

Strategic Environmental Assessment (SEA) is the process by which environmental considerations are required to be fully integrated into the preparation of plans and programmes and prior to their final adoption. The objectives of the SEA process are to provide for a high level of protection of the environment and to promote sustainable development by contributing to the integration of environmental considerations into the preparation and adoption of specified Plans and Programmes (including protocols and schemes).

Plans or programmes (eg highlighted areas for windfarm expansion) in extensive habitats such as upland and peatlands have the potential to create significant environmental damage if due consideration is not given to possible impacts they might have on the conservation status of these habitats.

Drivers: Impacts from the introduction of new plans and programmes could have significant implications under the Habitats Directive, Birds Directive, Water Framework Directive and Landscape Directives unless adeqautely assessed under SEA. The requirement for SEA derives from the SEA Directive.

Overarching research need**:** There is a need to identify a process through which SEA is triggered for plans, programmes, schemes, initiatives and protocols in extensive landscapes.

As a priority research is required to:

7.1 Assess past and potential future impacts of plans and programmes (such as windfarms and single farm payment eligibility) on upland and peatland habitats.

7.2 Develop a framework to mitigate possible future impacts on upland and peatland habitats and prescriptions for accelerating habitat recovery.

C. Working definition of uplands, peatlands and wetlands

For defining the habitats under consideration in the broad heading of uplands, peatlands and wetlands the following habitats are considered:

Upland habitats

(This definition is taken from Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland available at:
http://www.npws.ie/en/media/NPWS/Publications/IrishWildlifeManuals/IWM48.pdf

Upland habitats are defined as unenclosed areas of land over 150 m altitude, and contiguous lowland areas of related habitats. The principal upland habitats comprise blanket bog, heaths, flushes, dense bracken, exposed rock and scree and semi-natural grasslands. Several of these regularly occur together as mosaics, with transitions resulting from changes in topography, edaphic conditions, drainage, management or microclimate. Unenclosed lands are defined as those outside man-made boundaries that are semi-improved or unimproved – they tend to be used primarily for rough grazing. Semi-improved or unimproved lands demarcated by ineffective boundaries are also regarded as 'unenclosed' and thus within the remit of the national survey and conservation assessment of upland vegetation and habitats in Ireland. Fencing to denote property boundaries is a relatively recent phenomenon in the uplands and may contain significant areas of unimproved or semi-improved lands that are considered within the remit of proposed survey.
EU Annex 1 habitats that occur in Irish uplands

Upland habitats	EU habitat name and code
Wet heath	Northern Atlantic wet heaths with *Erica tetralix* (4010)
Dry heath	European dry heaths (4030)
Alpine and subalpine scrub	Alpine and Boreal heaths (4060)
Apecies-rich nardus upland grasslands	Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) (6230)
Blanket bog (active)	Blanket bog (*active only) (7130)
Rhynchosporion depressions	Depressions on peat substrates of the Rhynchosporion (7150)
Siliceous scree	Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) (8110)

Calcareous scree	Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*) (8120)
Calcareous rocky slopes	Calcareous rocky slopes with chasmophytic vegetation (8210)
Siliceous rocky slopes	Siliceous rocky slopes with chasmophytic vegetation (8220)

Peatlands habitats	EU habitat name and code
Raised bog	Active raised bogs (7110) Degraded raised bogs still capable of natural regeneration (7120) Depressions on peat substrate of the Rhynchosporion (7150)
Upland blanket bog	Blanket bog (7130)
Lowland blanket bog	Depressions on peat substrate of the Rhynchosporion (7150)
Cutover bog	Depressions on peat substrate of the Rhynchosporion (7150)
Eroding blanket bog	N/A
Rich fen and flush	Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae (7210) Alkaline fens
Poor fen and flush	N/A
Transition mire and quaking bog	Transition mire and quaking bogs (7140)

Wetland habitats	EU habitat name and code
Tall herb swamps	Hydrophilous tall herb fringe communities of plains and of the Montane to alpine levels (6430)
Turloughs	Turloughs 3180
Marsh	Hydrophilous tall herb fringe communities of plains and of the Montane to alpine levels (6430)
Wet grassland	Molina meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) (6410)
Dune slacks	Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*) (2170)

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Research recommendations of the Invasive Alien Species Working Group of the National Platform for Biodiversity Research

February 2012

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Summary

Biodiversity is essential for human life. It generates goods and services including the provision of food and medicines, the protection and regulation of water flow, the support of soil formation together with numerous social and cultural benefits. Without which, there would be no economies, no societies - and no human life.

Biodiversity loss is probably the greatest challenge human societies face today. Although the world's attention is almost exclusively focused on economic crises and climate change, a recent review on identifying planetary boundaries for human welfare identified biodiversity loss as the most critical. Globally, invasive alien species (IAS) are one of the five major threats to ecosystems and human health [1], and biodiversity [2].

The annual global economic impact of IAS has been estimated to be 1.4 trillion USD [3], although this may be an under-estimate. For Europe one of the key findings of a recent study was the overall negative impacts of IAS, including widespread ecological degradation to ecosystem services that are vital for economic development, production processes, tourism and human health [4]. The economic impact of IAS in Europe is estimated to be 12 billion Euros / year. The incidence of IAS and their impact are also increasing: the rate of arrival of alien species is increasing [6] as there continues to be deliberate and accidental introductions of alien species [1] probably due to increased globalisation [7].

There is currently no EU-wide legislative framework to deal with IAS [8], despite a clear need for such an action [9]. Policy and commercial activity are however responding to this crisis to include forthcoming EU legislation. These will lead to an increase in the need for IAS management and associated expertise in the coming decades.

The issue of IAS impacts on a number of different sectors with responsibility for the protection of our national biodiversity and has been included in all other thematic areas addressed by the NPBR. It is included here, however, as a separate issue due to its crosscutting nature and the urgency with which IAS control and impacts need to be addressed.

In March 2011, a working group of scientists (see Section D) that included policy representatives drawn from the NPBR was formed. The purpose of this working group was to examine the Biodiversity Knowledge Programme for Ireland [11] with a view to revising this document,

prioritising research needs to help inform policy and to further establish knowledge gaps and enabling actions required to address the issue of IAS in Ireland. This review identified six priority areas that are essential for implementing our legislative requirements and to meet the challenge of addressing the impact of IAS on our national biodiversity. Section A of this document deals with enabling actions necessary to facilitate biodiversity research and the utilisation of the research knowledge already available, while Section B deals with the most urgent research priorities that need to be addressed in relation to IAS.

A. Enabling Actions

1. Integration of the policy environment

A number of EU Directives and national legislation dictate how we manage our national biodiversity. While responsibility for the implementation of these Directives falls into the brief of different government departments, the reality is that the majority of these issues are cross cutting and cannot be implemented by any one department without the cooperation of other related departments.

Currently, biodiversity research support is fragmented, scattered and largely uncoordinated as it is spread across different government departments. This has led to a lack of coherence between departments attempting to implement the various Nature Conservation Directives and a failure to always conduct the necessary research required for their implementation. This lack of coherence is a hindrance to fulfilling our legislative requirements and is an extremely inefficient use of government funding. It has resulted in an overlap of research projects and a lack of awareness across departments of where the knowledge gaps actually lie.

Drivers: Maximum value for money for the funding of IAS research to deliver maximum impact of the research results.

Overarching need: A clear and coordinated inter-departmental system to facilitate targeted biodiverstiy research programmes, designed to facilitate the implemention of legislative requirements.

To facilitate the coordination of inter-departmental systems the following specific measures are required:

The establishment of an inter-departmental working group, including the relevant key technical experts to:

1.1 Ensure coordinated research effort and knowledge sharing between departments and agencies to maximise efficiencies and research effort of direct relevance to the implementation of legislative requirements.

1.2 Evaluate impacts, compatibilities and conflicts between government policies and biodiversity objectives and economic practice. This review should be based around the relevant sectors.

1.3 Identify policy blind spots and suggest methods that might be used to resolve policy conflicts. This should also include developing the actions required from research recommendations and identifying who has the responsibility for dealing with IAS.

1.4 Identify more effective ways of integrating existing knowledge from both fundamental and applied research thereby facilitating evidence-based policy making.

2: The coordination and dissemination of biodiversity data (including metadata)

The work of both policy and scientists is frequently hindered by the lack of access to, or knowledge of, previously generated national biodiversity research. The National Biodiversity Data Centre has assisted greatly in providing access to biodiversity datasets on species. However, biodiversity research data needs to be stored and subsequently accessed in a user-friendly way. There should be a co-ordination of research funding agencies to ensure that data arising from such projects are available in a central location. A working group drawn from the National Platform for Biodiversity Research and the National Biodiversity Data Centre should work together to develop a framework for the collation of all data and metadata and the establishment of a user friendly and fully comprehensive portal for access to these data. In addition, a standardisation of the approach to metadata entry needs to be agreed and disseminated.

Drivers: It is essential that the results of nationally funded biodiversity research are publically available to assist in both the formulation of biodiversity policy, delivering legislative requirements and on-going research needs. Previously conducted biodiversity research will provide "added value" if it is accessible.

Overarching need: The coordination and dissemination of biodiversity data (including metadata).

To facilitate the coordination and dissemination of biodiversity data the following specific measures need to be undertaken.

2.1 All existing biodiversity data resources need to be collated and centralised.

2.2 Develop protocols for data exchange & data sharing.

2.3 National biodiversity metadata entry should be agreed and standardised.

2.4 Development & co-ordination of national database standards.

2.5 Biodiversity research outputs should be disseminated in the most appropriate format to facilitate both research and policy.

3: Funding for IAS research

Biodiversity research, including the funding of research on invasive species, is currently funded through two separate mechanisms. These are:

(1) Priority targeted research identified by government departments and agencies (e.g. Teagasc, Department of Agriculture, Fisheries and Food, National Parks and Wildlife Service, the Environmental Protection Agency and the Heritage Council) that is necessary to implement legislative requirements.

(2) Open-call, competitive, peer-reviewed funding for biodiversity research in the University and NGO sectors, generally funded by the Department of Agriculture, Food and the Marine (Research Stimulus Fund) and the Environmental Protection Agency (STRIVE). Additionally EU funding programmes have contributed large research grants in this area.

The funding of biodiversity research is largely uncoordinated amongst the various funding agencies and departments that support initiatives related to this topic. Often departments are unaware of projects being funded by other deparments leading to inefficiencies, overlap and a lack of prioritised research funding. There is a need to establish a mechanism for coordinated research funding. The McCarthy Report [12] indicates coordination and efficiencies in research funding might be best achieved through a single stream of funding. However, it would be more appropriate if funding for targeted research remained with the relevant department to ensure research needs for meeting legislative requirements will be delivered. The development of an interdepartmental/agency group is necessary to ensure that research referred to in (1) and (2) above is targeted at previously agreed research priorities.

Drivers: Maximum value for money and efficiency for the funding of IAS research to deliver maximum impact of the outcomes through coordinated funding mechanisms.

Overarching need: A clear and coordinated funding mechanism to ensure the most urgent research needs are delivered.

To facilitate coordination of the funding of biodiversity research, the following specific measures are required:

Establish an interdepartmental/agency group (referred to in section A. 1) to coordinate IAS research to:

3.1 Maximise efficiencies and ensure research is targeted in a prioritised manner

3.2 Identify a funding mechanism that has the capacity to manage competitive research calls on the themes identified in section B.

3.3 Establish a mechanism to ensure funders discuss proposed research objectives with policy experts, for example through a funding referral officer available to assist in devising and evaluating research proposals.

B. Urgent research priorities

4: Risk Assessment: Species and pathways

Understanding the mechanisms by which invasions by alien species are either facilitated or limited are unanswered questions. For example, why some species are apparently more successful invaders than others or why some species are invasive in certain habitats and not in others is not fully known. Yet, answers to these questions are central to our ability to assess the risks that different species pose in different habitats and in different regions. They are also critical to the development of effective locally-based management plans. It is well established that each step in the invasion process is facilitated by species specific and habitat-related characteristics that enable introduced organisms to overcome particular environmental barriers. It is also recognised that different habitats are invaded to different degrees. However, understanding the link between these factors is not clear and ambiguous results are often found.

Drivers: Knowledge of which species have the potential to become invasive, the pathways by which they become established and the habitats most susceptible to invasion needs to be addressed to facilitate Ireland's legal requirements under numerous EU Directives (Habitats Directive, Birds Directive, Marine Strategy Framework Directive, Water Framework Directive, etc).

***Overarching research need*:** The identification of species traits, habitat characteristics and pathways for dispertion to facilitate the mananagment and control of IAS.

To facilitate the identification of species characteristics and pathways for dispertion the following specific measures are required:

4.1 Further research to understand the particular features - "invasive traits" that facilitate invasions by both plant and animal species; to include factors such as climate, propagule pressure, vectors of introduction etc.

4.2 Research to better understand "habitat traits" that facilitate invasions.

4.3 Research to understand the dispersal mechanisms contributing to the spread of non-native species; this needs particular attention since a capability for rapid and effective dispersal could counteract any management measures employed.

4.4 Research to enable risk-assessments on impacting (target) species likely to arrive based on current and future trade, likely entry points and subsequent spread.

4.5 Research to assess likely hubs of introduction and the development of *a priori* plans for dealing with specific invasions.

5: Impact

The imapct of alien invasive species on both our national biodiversty and the ecosystem goods and services it provides can not be over emhasised. Based on documented costs, IAS damage and control measures are estimated to cost at least €12 billion per annum in Europe alone. The estimated cost of damage across a number of sectors is shown in table 1.

Table 1. Cost of damage in Europe caused by IAS across a range of sectors.

Sector	**Cost per annum (Million EURO)**
Agriculture	5510.1
Fisheries/aquaculture	241.6
Forestry	150.7
Health*	82.5

* Costs of epidemic animal and human diseases excluded

Source: Shine, C., Kettunen, M., ten Brink, P., Genovesi, P. & Gollasch, S. 2009. Technical support to EU strategy on invasive species (IAS) – Recommendations on policy options to control the negative impacts of IAS on biodiversity in Europe and the EU. Final report for the European Commission. Institute for European Environmental Policy (IEEP), Brussels, Belgium. 35 pp.

The cost of IAS damage and control measures in Ireland alone has not yet been assessed and a cost benefit analysis of the impact of IAS against the control measures required in mitigating the impacts of IAS is needed. In order to do this a comprehensive understanding of the *actual* impacts on ecosystems and livelihoods is required. There can be multiple effects of species invasions that are site and species-specific, that precludes any generalisations [13].

Drivers: Further damage and associated costs across a number of economic sectors resulting from the impact of IAS together with further damage and loss of our native biodiversity.

Overarching research need**:** An assessment of the impact of IAS on our national biodiversity and the associated impacts across a range of economic sectors.

To facilitate our knowledge of the specific impacts of IAS the following measures are required:

5.1 Research to facilitate our understanding of the influence and impact of IAS within a range of habitats and sectors including biodiversty, hydrology, biogeochemistry, ecosystem goods and services, human health Plant invasions, in particular, represent a significant

land-use change, with likely impacts on national greenhouse gas emissions that have so far not been assessed.

5.2 Research to address control measures for IAS across a range of habitats, species and scales.

5.3 Research to reduce the impact of Ireland as a donor to other countries and biogeographical provinces.

5.4 Research to understand the impact of some alien invasive species on other alien invasive species.

6: Management

IAS are important drivers of environmental change and can have profound consequences for native biodiversity. The impact of IAS on ecosystem goods and services is well documented. Introduced species are known to be having an increasingly negative impact on our native biodiversity and a direct impact on the economic value we derive from our natural environment.

The need to address IAS within the European Union, as an integral part of halting biodiversity decline, was recognised in 2001. In 2006, Community institutions made a formal commitment to develop an EU Strategy on Invasive Alien Species to substantially reduce the impacts of IAS and alien genotypes in line with Guiding Principles adopted under the Convention on Biological Diversity and the European Strategy on IAS adopted under the Convention on the Conservation of European Wildlife and Habitats. The Community also undertook to establish an Early Warning System for the prompt exchange of information between neighbouring countries on the emergence of IAS and cooperation on control measures across national boundaries, taking into account different biogeographical regions.

Drivers: If no action is taken, new IAS will continue to become established in Ireland with increased ecological, economic and social consequences and related costs. The "do-nothing approach" is not an option. Urgent action is required to detect and manage IAS to reduce the loss of economic goods and services and their impact upon our native biodiversity. The EU Commission is currently developing a strategy to address the issue of IAS in Europe (COM(2008) 789 final), an EU Directive on the control of IAS is likely in the short to medium term and research to support the implementation of forthcoming EU Directives is essential.

***Overarching research need*:** Develop an early warning system for the identification and detection of IAS.

To facilitate the development of an early warning system for the identification and detection of IAS the following specific measures are required:

6.1 Establishment of a permenanent working group to assist in the coordination of efforts to deal with the issues of non-native invasive species and to enable a rapid response.

6.2 Detailed inventories, including their spatial distribution and temporal occurrence, of IAS.

6.3 The development of strategies for the effective control of species identified as high risk at the first sign of their arrival.

6.4 Development of indicators of the impacts of non-native species and assessment of the possible ecological and economic impact of current and potential invaders to help prioritise management responses towards the most damaging species.

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