BioAtlantis

Nature Working Naturally™

Foreshore License Application:
Sustainable hand-harvesting of *Ascophyllum nodosum* at Clew Bay
(cSAC Site Code 1482)

Natura Impact Statement to inform Appropriate Assessment

Version: 4th November 2014

ecofact
Environmental Consultants

Tait Business Centre,
Dominic Street,
Limerick City, Ireland.

t. +353 61 419477,
f. +353 61 414315

e. info@ecofact.ie
w. www.ecofact.ie
f. www.facebook.com/ecofact

EXECUTIVE SUMMARY

BioAtlantis Ltd. is a biotechnology company which provides solutions to problems caused by stresses in plants, animals and humans. The company works with several of the leading universities in Ireland and across the world, isolating key functional molecules from natural resources and validating their functionality and effectiveness for use in solving problems facing modern agriculture and healthcare. As part of it's continued expansion, security of supply of raw material - the brown seaweed *Ascophyllum nodosum* - is essential to future development. It is proposed to source this raw material from Clew Bay using sustainable harvesting methods. The current proposal is therefore for BioAtlantis to undertake sustainable hand-harvesting of *Ascophyllum nodosum* at Clew Bay.

BioAtlantis Ltd. has a requirement of ~12,900 wet tonnes of *A. nodosum* per annum. A previous study entitled 'Mapping and assessment of the seaweed resources (*A. nodosum*, *Laminaria* spp.) off the west coast of Ireland' (Hession *et al*., 1998) indicates that the Clew Bay region has the potential to sustainably yield between 14,870 tonnes to 16,970 tonnes of *A. nodosum* seaweed per annum. BioAtlantis propose to incorporate known rates of *A. nodosum* recovery within Clew Bay into a broader system of harvesting, based primarily with sustainability in mind. Central to this approach will be a harvesting methodology which is minimally invasive and ensures rapid recovery and re-growth of *A. nodosum* post-harvest. By applying hand-harvesting techniques known to be environmentally friendly and incorporating their use within a sustainable best practise approach, BioAtlantis aims to implement a sustainable mode of seaweed harvesting in Clew Bay.

The preparation of this Natura Impact Statement (NIS) is to inform the Appropriate Assessment process as required under the Habitats Directive (92/43/EEC) in instances where a plan or project may give rise to significant effects upon a Natura 2000 site. This NIS has been prepared following the manual *'Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities'* published by (DoEHLG, 2009). The Screening Assessment identified Clew Bay Complex cSAC as the only Nature 2000 site potentially affected by the proposal and which is subject to assessment in the NIS. The qualifying interests of the cSAC are:

- Mudflats and sandflats not covered by seawater at low tide [1140];
- Coastal lagoons [1150];
- Large shallow inlets and bays [1160];
- Annual vegetation of drift lines [1210];
- Perennial vegetation of stony banks [1220];
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330];
- Embryonic shifting dunes [2110];
- Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120];
- Otter (*Lutra lutra*) [1355];
- Common seal (*Phoca vitulina*) [1365];
- *Vertigo geyeri* [1013].

The potential for significant impacts on the Clew Bay Complex cSAC resulting from the proposed Foreshore Licence application for the sustainable hand-harvesting of *Ascophyllum nodosum* within Clew Bay have been recognised.

The NIS has been informed by detailed coastal and marine baseline studies completed on behalf of NPWS and utilised in developing the conservation objectives of the Clew Bay

Complex cSAC. The key qualifying interests of the Clew Bay Complex cSAC identified as being potentially affected by the proposal and assessed in the NIS reporting include Annex I listed habitats (Large shallow inlets and bays) and Annex II listed mammals (Common seals and Otter). Specific mitigation measures have been set out in a detailed 'Code of Practice', developed by BioAtlantis and included in the Licence Application (BioAtlantis, 2014), in order to avoid significant direct, indirect and cumulative effects on these qualifying interests. These best practice guidelines have been developed on the basis of findings from the peer reviewed literature, best scientific knowledge and previous surveys carried out in the Clew Bay Complex. National Parks & Wildlife Service (NPWS) recommend that continuous disturbance of each community type should not exceed an approximate area of 15% (NPWS 2011A), covering Annex I community types such as shingle and reef. BioAtlantis will work within a 15% continuous disturbance limit thereby ensuring compliance with the European Commission Article 17 reporting framework which considers disturbances of >25% of an area in an Annex I habitat to represent an unfavourable conservation status. The only habitats to be impacted by hand harvesting of *A. nodosum* are reef and shingle, at levels of 4.9% and 12.7% respectively per annum, below the 15% limit. BioAtlantis are applying for an exclusive licence and have constructed the licence application on this basis. As sole licence holder, BioAtlantis will be responsible for all aspects of commercial harvesting in Clew Bay.

Appropriate conservation measures are identified for implementation to ensure the habitats and species for which this site has been designated are maintained at a favourable conservation status (compliance with Article 6(1) of the EU Habitats Directive). The proposed operational management plans will also avoid damaging activities that could significantly disturb these species or deteriorate the habitats of the protected species or habitat types (compliance with Article 6(2) of the EU Habitats Directive).

Taking account of the mitigation measures proposed for the avoidance and reduction of adverse effects on the qualifying interests and conservation objectives of the designated Natura 2000 sites within the area, it is concluded that the proposal will not result in direct, indirect or cumulative impacts which would have the potential to adversely affect the qualifying interests / special conservation interests of the Natura 2000 site within the study area with regard to the structure and function; range; population densities; or conservation status of the habitats and species for which the Clew Bay Complex cSAC is designated. The provisions of Article 6 of the 'Habitats' Directive 92/43/EC (2000) defines 'integrity' as the 'coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and / or population of species for which the site is or will be classified'. From the evidence presented in the current assessment, it is concluded, beyond reasonable scientific doubt, that the proposed project, with the implementation of the prescribed mitigation measures, will not give rise to direct, indirect or cumulative impacts that would adversely affect the integrity of any designated Natura 2000 site.

FOREWORD

BioAtlantis Ltd. submitted a Natura Impact Statement to the Department of the Environment, Heritage and Local Government with regard to a foreshore application to undertake hand harvesting of seaweed at Clew Bay, Co. Mayo. The National Parks and Wildlife Service (NPWS) identified a number of deficiencies in the proposal / NIS submitted for the proposal and requested significant additional information. The further information items from the NPWS are detailed in a response (reference: FS6269). These items of further information are listed hereunder and each item has been addressed via a response in this document as outlined below:

Further information item: Drawing from the principle outlined in the European Commission's Article 17 reporting framework that disturbance of greater than 25% of the area of an Annex I habitat represents unfavourable conservation status, this Department [NPWS] takes the view that licensing of activities likely to cause continuous disturbance of each community type should not exceed an approximate area of 15%.

Response: The only habitats to be impacted by hand harvesting of *A. nodosum* are reef and shingle, at levels of 4.9% and 12.7% respectively per annum, below the 15% limit for structure and function measures used for assessing conservation status. Working within the limit of 15% disturbance is achievable (see Section 4.3.1.1, Table 4) and critical to ensure compliance with the European Commission Article 17 reporting framework which considers disturbances of >25% of an area in an Annex I habitat to represent an unfavourable conservation status.

Further information item: Greater clarity is required in relation to the spatial extent of the harvesting techniques. This should make reference to the noted intention to manage expansive and prolonged operations. The potential interaction of seaweed harvesting may include impacts from targeted and non-targeted removal of species, disturbance and displacement of species (particularly benthic species), changes in community structure (the cited measure (Kelly *et. al*. 2001) of biodiversity stasis is deficient in respect of its short study duration, focus towards macro-invertebrates, and the lack of quantitative information on species prevalence), changes in hydrodynamics, and potential disturbance of marine fauna. It is encouraged that a more holistic examination is generated.

Response: Section 3.1.1.2 outlines management and implementation components of the harvesting system and includes activities relating to planning and scheduling of harvesting activities, numbers of personnel to be managed and harvest rates, exploitation levels, data recording and analysis, access and navigation at harvest sites, hand-harvest methodology and future planning. Levels of *A. nodosum* and site recovery will be assessed throughout the duration of the harvesting as in Section 3.1.1.3. Table 1 (Section 3.1.1.2) sets out the islands and shore-line areas identified as being within the proposed harvesting area for the BioAtlantis project, with *A. nodosum* densities and coverage included. The Resource Manager employed by BioAtlantis will be required to verify that each site has fully recovered prior to re-harvesting. The Resource Manager will visit each site and verify the data by means of direct measurements or visual assessments. The production plan will be updated as necessary with the results of this analysis. A maximum harvest of 20% of the total available *A. nodosum* biomass per site per annum is permitted to ensure sustainability.

Section 4.3.1.1 provides information on the potential impact of disturbance and displacement of non target species. Section 4.3.1.1 also gives potential impacts on macroinvertebrates. Section 4.3.2.1.1.1 gives potential impacts on hydrodynamics, erosion and water quality and 4.3.2.1.1.2 gives potential impacts on intertidal community structure and biodiversity stasis. Potential issues are addressed in the section on mitigation for habitats (Section 4.4.1) which gives comprehensive measures to minimise impacts on *A. nodosum* and other flora and fauna associated with *A. nodosum.* It is accepted that there are deficiencies in the Kelly *et al.,* 2001) report in respect of its short study duration. However, BioAtlantis will build on the findings of Kelly *et al*., (2001) and continually assess the potential impact of *A. nodosum* harvesting over the life-time of the licence (see Section 4.4.3).

Further information item: The potential interaction with coastal habitats is inadequately covered. It is recognised that primary production on the shore is critical in the formation of some coastal habitat types. The loss or removal of this source has not been recognised in the accompanying documentation and is critical in examining the conservation interaction with those features.

Response: The importance of sediment supply for coastal habitats is outlined in Section 4.2.1. Impacts on Annex I habitats are given in Section 4.3.2.1.1.1 under hydrodynamics, erosion and water quality. The role of *A. nodosum* as a contributor of organic matter in the complex is recognised. It is pointed out in the section on mitigation and in Appendix 4 (Code of Practice) that harvest rates will be in the order of 20%. The figure of 20% refers to the percentage of the total available *A. nodosum* biomass harvested per site per annum. Based on Kelly *et al.,* (2001), the removal of *A. nodosum*, at sustainable levels from the intertidal zone has been found to not affect the distribution or density of growth of this species. Moreover, there are strict mitigation measures in place to ensure that *A. nodosum* mortality due to removal of holdfast material will not be tolerated, hence preventing further losses in biomass, and in turn, organic matter.

Further information item: The interaction of other operations within the Bay which act in-combination requires further detail. In terms of unlicensed or traditional harvesting of seaweed the current estimation is unresolved. Further information will be required in relation to the interaction of planned and casual harvesting of seaweed to ensure compliance with the conservation objectives of the site.

Response: Section 4.3.3 details in-combination effects on the Clew Bay Complex cSAC. Information on existing harvesting of *A. nodosum* within the Clew Bay Complex is provided in Section 4.3.3.1. Interactions with aquaculture and fisheries are given in Section 4.3.3.2 while natural mortality of *Ascophyllum nodosum* is provided in Section 4.3.3.4. Impacts via functionality changes & sediment supply, and non native species are given in Sections 4.3.3.5 and 4.3.3.6 respectively.

BioAtlantis have a mitigation measure in place to ensure that large-scale unlicensed harvesting will be reported to the Department of Environment, Heritage and Local Government Department. This is to ensure compliance with the conservation objectives for the site and to ensure adequate record keeping, monitoring of the resource and access to sensitive sites and particular times of the year. In terms of casual harvesting, BioAtlantis will permit low scale removal of <0.5 tonnes for personal usage only. Any large-scale commercial usage must be managed by BioAtlantis to ensure the SAC objectives are met. Any commercial user having low requirements of >0.5 tonnes per annum (e.g. hotels, health

Spas), will be approached by BioAtlantis to discuss their requirements and assess the potential for in combination effects. Appropriate action will be taken on a case-by-case basis.

Further information item: In relation to invasive species, such as *Didemnum vexillum*, the proponent must include information to demonstrate the potential interaction of the proposed activities and if necessary derived mitigation or management measures to ensure that harvesting of seaweed is not a vector for spread within Clew Bay Complex SAC.

Response: Non-native invasive species including *D. vexillum* have been discussed under Section 4.3.3.6. Specific control and mitigation measures have been included in the current proposal (Section 4.4.1), integrated into the Harvest Management Plan and the 'Code of Practice for *A. nodosum* harvest activities in Clew Bay cSAC', to avoid the potential for hand harvesting activities from acting as a vector for the spread of *D. vexillum* within the Clew Bay complex SAC.

TABLE OF CONTENTS

1 INTRODUCTION 9

1.1 LEGISLATIVE CONTEXT 11
1.2 APPROPRIATE ASSESSMENT GUIDANCE DOCUMENTS 12
1.3 CONSULTATION 12
1.4 STATEMENT OF AUTHORITY 13

2 METHODOLOGY 15

2.1 DESK STUDY 15
2.2 SITE SURVEY TO INFORM THE NIS 16
2.3 CALCULATION OF COMMUNITY AREAS WITHIN CLEW BAY 16
2.4 APPROPRIATE ASSESSMENT METHODOLOGY 16
2.4.1 Screening to Inform Appropriate Assessment 17
2.4.2 Natura Impact Assessment 17

3 SCREENING FOR APPROPRIATE ASSESSMENT 19

3.1 DESCRIPTION OF THE PROPOSED PROJECT 19
3.1.1 Operational phase of the proposal 19
3.2 DESCRIPTION OF THE RECEIVING ENVIRONMENT 30
3.3 IDENTIFICATION OF RELEVANT NATURA 2000 SITES 31
3.3.1 Screening of Natura 2000 sites within the study area 31
3.4 SCREENING ASSESSMENT OF LIKELY EFFECTS 38
3.4.1 Assessment of potential direct impacts affecting the Clew Bay Complex cSAC 38
3.4.2 Assessment of potential indirect impacts affecting the Clew Bay Complex cSAC 39
3.4.3 Assessment of potential cumulative impacts affecting the Clew Bay Complex cSAC 40
3.5 SCREENING STATEMENT WITH CONCLUSIONS 41

4 NATURA IMPACT ASSESSMENT (NIS) 42

4.1 OVERVIEW OF NIS OBJECTIVES 42
4.2 DESCRIPTION OF THE CLEW BAY COMPLEX CSAC NATURA 2000 SITE 42
4.2.1 Annex I habitats: Large shallow inlets and bays 43
4.2.2 Annex II species: Common (or harbour) seal and Otter 45
4.3 ASSESSMENT OF THE QUALIFYING INTERESTS OF THE CLEW BAY CSAC SITE POTENTIALLY AFFECTED BY THE PROPOSAL 46
4.3.1 Potential for direct impacts 46
4.3.2 Potential indirect impacts 51
4.3.3 Potential for cumulative or in-combination effects 56
4.4 MITIGATION MEASURES FOR THE PROPOSED PROJECT 63
4.4.1 Mitigation measures for the protection of Annex I habitats 63
4.4.2 Mitigation measures for the protection of Annex II species 75
4.4.3 Mitigation measures for changes in community structure 76
4.5 IMPLICATIONS FOR THE CONSERVATION OBJECTIVES OF THE NATURA 2000 SITES WITHIN THE STUDY AREA 77
4.5.1 Large shallow inlets and bays [1160] 78
4.5.2 Common seal Phoca vitulina 79
4.5.3 Otter Lutra lutra 80
4.6 CONCLUSIONS 81

REFERENCES 84

PLATES 88

APPENDIX 1 CLEW BAY COMPLEX CSAC SITE SYNOPSIS.....93

APPENDIX 2 CLEW BAY COMPLEX CONSERVATION OBJECTIVES.....97

APPENDIX 3 BIOATLANTIS COMPLIANCE AND RECORD FORMS 131

APPENDIX 4 BIOATLANTIS CODE OF PRACTICE.....136

1 INTRODUCTION

ECOFACT Environmental Consultants Ltd. have been commissioned by BioAtlantis Ltd. to prepare a Natura Impact Statement (NIS) to inform the Appropriate Assessment process for the proposed hand-harvesting of the seaweed *Ascophyllum nodosum* in a sustainable manner from Clew Bay, Co. Mayo. The proposed licensing area within Clew Bay is presented in Figure 1 and is located within the Clew bay Complex candidate Special Area of Conservation (cSAC code 001482). The site synopsis for the Clew Bay Complex cSAC is presented as Appendix 1 and the conservation objectives are provided in Appendix 2.

BioAtlantis Ltd. is a biotechnology company which provides solutions to problems caused by stresses in plants, animals and humans. The company works with several of the leading universities in Ireland and across the world, isolating key functional molecules from natural resources and validating their functionality and effectiveness for use in solving problems facing modern agriculture and healthcare. As part of continued expansion, security of supply of raw material, *A. nodosum* is essential to future development.

A study completed by Hession C. *et al*. (1998) indicates that the Clew Bay region has the potential to sustainably yield between 14,870 to 16,970 wet tonnes of *A. nodosum* seaweed per annum. BioAtlantis Ltd. has a requirement of ~12,900 wet tonnes per annum. BioAtlantis will work within the 15% disturbance limit assigned for Annex I habitats within the SAC. The only habitats to be impacted by hand harvesting of *A. nodosum* are reef and shingle, at levels of 4.9% and 12.7% respectively per annum, below the 25% limit for structure and function measures used for assessing conservation status and below the NPWS recommendation that continuous disturbance of each community type within Clew Bay Complex cSAC should not exceed an approximate area of 15%. BioAtlantis will incorporate known rates of *A. nodosum* recovery within Clew Bay into a broader system of harvesting, based primarily with sustainability in mind. Central to this approach will be a harvesting methodology which is minimally invasive and ensures rapid recovery and re-growth of *A. nodosum* post-harvest. By applying hand-harvesting techniques known to be environmentally friendly and incorporating their use within a sustainable best practise approach, BioAtlantis aims to implement a sustainable mode of seaweed harvesting in Clew Bay. The proposed harvesting activities are subject to significant management oversight and protocols to limit disturbance to sensitive qualifying interests and ecological receptors within the Clew Bay Complex cSAC. These protocols have been developed taking account of the existing fishing and aquaculture industry within the Clew Bay Complex. BioAtlantis are applying for an exclusive licence and have constructed the licence application on this basis. As sole licence holder, BioAtlantis will be responsible for all aspects of commercial harvesting in Clew Bay.

The preparation of this NIS is to inform the Appropriate Assessment process as required under the Habitats Directive (92/43/EEC) in instances where a plan or project may give rise to significant effects upon a Natura 2000 site. Natura 2000 sites are of European Importance and have been designated in accordance with the requirements of the EC Habitats Directive (1992) and EC Birds Directive (2009/147/EC); transposed into Irish legislation as the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011). The Habitats Directive, in combination with the Birds Directive (2009), establishes a network of internationally important sites designated for their ecological status; identified as Special Areas of Conservation (SACs) designated under the Habitats Directive for the protection of flora, fauna and habitats and as Special Protection Areas (SPAs) designated under the Birds Directive to protect rare, vulnerable and migratory birds. These sites together form a Europe-wide ‘Natura 2000’ network of designated sites, referred to in this report as Natura 2000 sites.

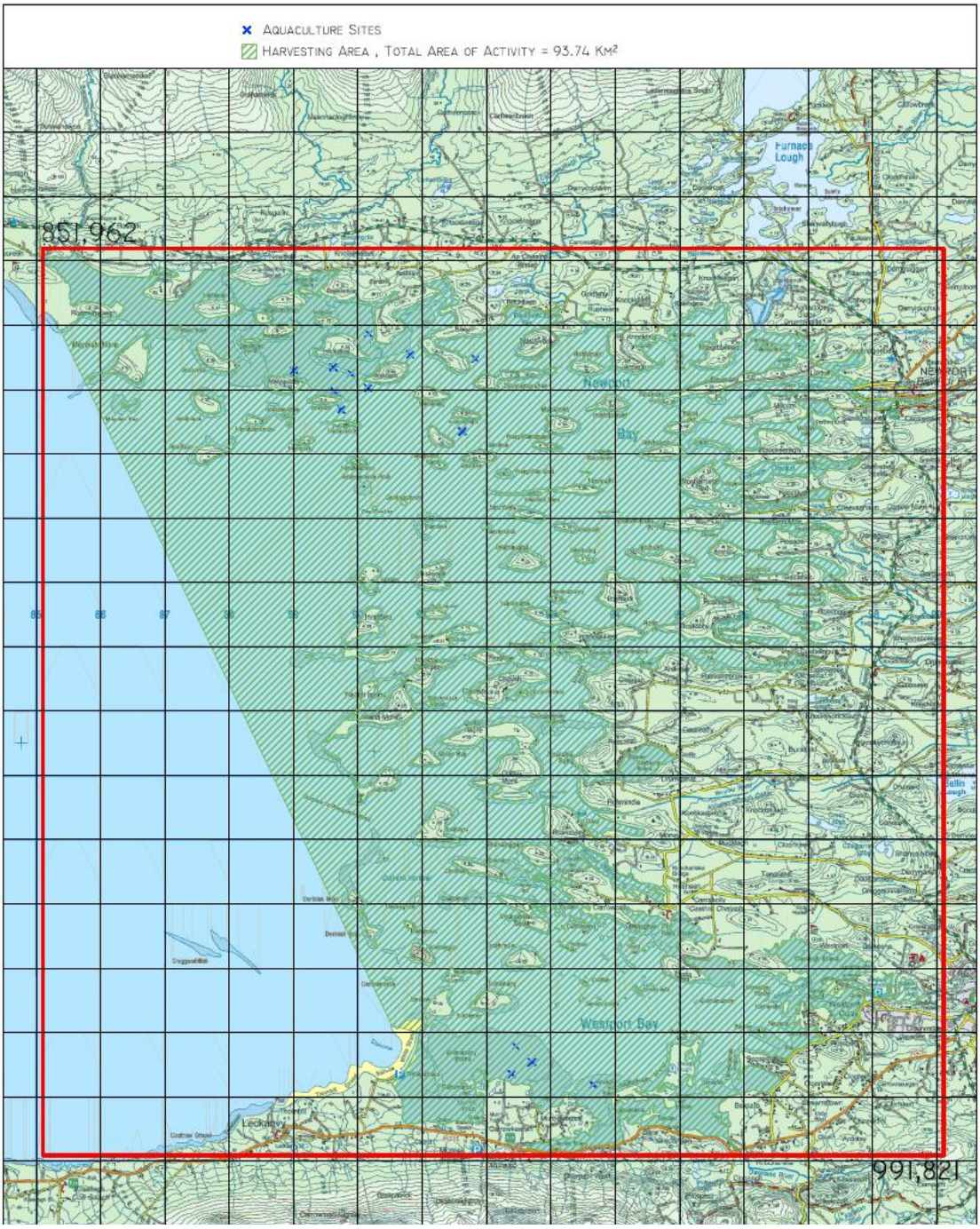


Figure 1 Map showing the proposed harvesting area within the licence application, Clew Bay, Co. Mayo.

This NIS provides a focused and detailed impact assessment of the implications of the proposed hand harvesting of *A. nodosum* from Clew Bay, alone and in combination with other plans and projects, on the integrity of the Natura 2000 site network in view of the conservation objectives of these sites. This assessment takes account of the best scientific evidence and methods available. This NIS has been updated following an NPWS appraisal of an earlier version and more consultation with NPWS. This updated NIS contains additional information on the proposal, a response to an NPWS request for further information (see foreword), a broad examination of the nature, extent and impact of harvesting and more detailed mitigation. This report also includes an assessment of the percentage area of specific marine

community types affected by the annual harvest of *A. nodosum*, and takes cognisance of the NPWS recommendation that continuous disturbance of each community type within Clew Bay Complex cSAC should not exceed an approximate area of 15%. Working within the limit of 15% disturbance is critical to ensure compliance with the European Commission Article 17 reporting framework which considers disturbances of >25% of an area in an Annex I habitat to represent an unfavourable conservation status.

It is the obligation of the appropriate Competent Authority to make a determination for the Appropriate Assessment on the basis of information provided, taking account of the findings of the NIS. The assessment follows the requirements of the Habitats Directive 92/43/EEC, Article 6(3) and the guidance published by NPWS (DoEHLG, 2009) '*Appropriate Assessment of Plans and Projects in Ireland, Guidance for Planning Authorities*'. Mitigation measures are set out in detail to avoid / reduce any potential impacts.

1.1 Legislative context

The current assessment takes account of Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora - '*The Habitats Directive'* which was transposed into Irish law by the '*European Community (Natural Habitats) Regulations 1997*' (S.I. No. 94/1997). The most recent transposition of this legislation in Ireland is the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). The Birds Directive (2009/147/EC) which is now included in the former Regulations seeks to protect birds of special importance by the designation of Special Protection Areas (SPAs) whereas the Habitats Directive does the same for habitats and other species groups within Special Areas of Conservation (SACs), which are designated or proposed as candidate Special Areas of Conservation (cSACs). It is the responsibility of each member state to designate SPAs and SACs, both of which will form part of Natura 2000, a network of protected areas throughout the European Community. Article 6, paragraphs 3 and 4 of the EC 'Habitats' Directive (1992) state that:

6(3) 'Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.'

6(4) 'If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted. Where the site concerned hosts a priority natural habitat type and / or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest.'

In addition, the European Court of Justice in Case C-127/02 (the "Waddenzee Ruling") has made a relevant ruling in relation to Appropriate Assessment and this is reflected in the current assessment:

'Any plan or project not directly connected with or necessary to the management of the site is to be subject to an appropriate assessment of its implications for the site in view of the site's conservation objectives if it cannot be excluded, on the basis of objective information, that it will have a significant effect on that site, either individually or in combination with other plans or projects" and that the plan or project may only be authorised "where no reasonable scientific doubt remains as to the absence of such effects.'

1.2 Appropriate Assessment guidance documents

- DoEHLG (2009) Appropriate Assessment of Plans and Projects in Ireland, Guidance for Planning Authorities;
- NPWS (2012) Marine Natura Impact Statements in Irish Special Areas of Conservation: A Working Document. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht;
- European Commission (2001) Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC. European Commission;
- English Nature (2001) Habitats Regulations Guidance Note (No. 4): Alone or in combination.

1.3 Consultation

During preparation of this document consultation was undertaken, both directly and indirectly (via publically available information / websites) with relevant statutory bodies and stakeholders. Additional consultation undertaken by BioAtlantis Ltd. informed the assessment including early stage discussions and scoping with the Department of the Environment, Community and Local Government. Direct consultation of relevance to the current NIS was also undertaken with Inland Fisheries Ireland (IFI) and with NPWS.

A consultation meeting with the regional staff of NPWS was held on the 13th of November 2013, in order to inform the Appropriate Assessment and to highlight ecological constraints and sensitivities at a local level. This meeting was also attended by a representative Marine Ecologist from the Science and Biodiversity section of the NPWS. Key constraints and sensitivities with regard to the Clew Bay Complex cSAC and wider ecological issues, outside the remit of the Appropriate Assessment process were identified, with requirements for the avoidance of significant adverse effects clearly specified at this meeting.

BioAtlantis Ltd. submitted a Natura Impact Statement to the Department of the Environment, Heritage and Local Government. NPWS identified a number of deficiencies in the Natura Impact Statement submitted for the proposed development and requested significant additional information. The observations from the NPWS are detailed in a response (reference: FS6269). These items of further information are listed hereunder:

- Greater clarity is required in relation to the spatial extent of the harvesting techniques this should make reference to the noted intention to manage expansive and prolonged operations. The potential interaction of seaweed harvesting may include impacts from targeted and non-targeted removal of species, disturbance and

displacement of species (particularly benthic species), changes in community structure (the cited measure (Kelly *et. al*. 2001) of biodiversity stasis is deficient in respect of its short study duration, focus towards macro-invertebrates, and the lack of quantitative information on species prevalence), changes in hydrodynamics, and potential disturbance of marine fauna. It is encouraged that a more holistic examination is generated.

- The potential interaction with coastal habitats is inadequately covered. It is recognised that primary production on the shore is critical in the formation of some coastal habitat types. The loss or removal of this source has not been recognised in the accompanying documentation and is critical in examining the conservation interaction with those features.

- The interaction of other operations within the Bay which act in-combination requires further detail. In terms of unlicensed or traditional harvesting of seaweed the current estimation is unresolved. Further information will be required in relation to the interaction of planned and casual harvesting of seaweed to ensure compliance with the conservation objectives of the site.

- In relation to invasive species, such as *Didemnum vexillum*, the proponent must include information to demonstrate the potential interaction of the proposed activities and if necessary derived mitigation or management measures to ensure that harvesting of seaweed is not a vector for its spread within Clew Bay Complex SAC.

Consultations between NPWS and BioAtlantis took place between 26/08/14 and 30/10/14, thus providing clarity on obligations for ensuring that four key measures of conservation status are adhered to. These are: area, range, structure and function. Future prospects are also required when considering effects in SAC and SPA areas. As hand harvesting of *A. nodosum* does not give rise to permanent dam age to the shore, it does not interact with the parameters of area or range (NPWS, personal correspondence). However, targeted removal of species has potential to result in alterations to structure and function.

1.4 Statement of authority

The current report was prepared by the following senior ecologists whom have a combined experience of over 30 years working on ecological impact assessments. They are considered to be suitably qualified for preparing the current Natura Impact Statement:

- Daireann McDonnell MSc, BSc, MSB, CIEEM;
- Dr. William O'Connor, PhD, MSc, BSc, CEnv, CBiol, FSB, CIEEM, MIFM;
- Gerard Hayes BSc, MCIEEM.

Daireann McDonnell is a senior ecologist who has been working in the environmental consultancy industry for over ten years. He is a graduate of the University of Limerick where he was awarded an MSc (Research) in Environmental Science. Daireann also holds a BSc (Hons) in Environmental Management from University College Dublin. He is a full member of both the Chartered Institute of Ecology and Environmental Management and the Society of Biology. He has previously acted as Principal Ecologist for the Irish operation of large multinational engineering firm, and has been the Senior Ecologist at ECOFACT since 2008. Daireann has completed a large number of Natura Impact Statements for marine projects

including offshore wind farms, coastal road projects, wastewater discharges and aquaculture projects.

Dr. William O' Connor is a senior ecologist with over 20 professional experience. He is a graduate of the University of Wales, Cardiff where he was awarded an MSc degree in Applied Hydrobiology, and the National University of Ireland, Galway where he received a PhD degree in Zoology for research on the Shannon estuary. He is a Fellow of the Society of Biology, a Chartered Environmentalist, a Chartered Biologist and a full member of both the Chartered Institute of Ecology and Environmental Management and the Institute of Fisheries Management. Dr. O'Connor is the Managing Director and Principal Ecologist of ECOFACT Environmental Consultants Ltd. and has prepared Natura Impact Statements and Environmental Impact Statements for numerous major commercial and infrastructural developments affecting marine, estuarine and coastal habitats. He has also worked as a scientific advisor for a number of state bodies, including the NPWS, BIM, OPW, EPA, ESB and numerous local authorities.

Gerard Hayes has eight years professional experience in ecological field study and environmental consultancy. Gerard graduated from the University of Limerick with a Bachelor of Environmental Science (Hons) degree. He is a full member of the Chartered Institute of Ecology and Environmental Management. Gerard is competent in the preparation of EIA, EIS, and AA (Stage I and II). Gerard is responsible for detailed macroinvertebrate surveys for protected aquatic fauna and fish species, which are followed up by laboratory identification. His faunal identification skills extend across freshwater, terrestrial and marine habitats. Gerard also has extensive experience of mammal surveying.

2 METHODOLOGY

2.1 Desk study

A desktop study was undertaken to identify the extent and scope of the potentially affected designated Natura 2000 sites within the current study area in relation to the proposed hand-harvesting of *A. nodosum* within Clew Bay. The desktop study identified the designated Natura 2000 sites within the zone of influence of the project and identified this as the study area for consideration in the current NIS. Following the DoEHLG (2009) guidance publication a distance of 15km is presented as a suitable radius for sites potentially affected, in the absence of pathways identified where Natura 2000 sites outside of this radius could potentially be affected. The desk study undertaken for the current NIS included a review of the baseline survey data undertaken to inform the Conservation Objectives for Clew Bay Complex, including marine and intertidal surveys commissioned by the NPWS:

- Aqua-Fact (1999) A survey of selected littoral and sublittoral sites in Clew Bay, Co. Mayo. Duchas, The Heritage Service, Dublin;
- Falvey, *et al*. (1997) Survey of intertidal sediment biotopes in estuaries in Ireland. Unpublished report to the National Parks and Wildlife Service;
- McCorry (2007) Saltmarsh Monitoring Project 2006: Summary Report. Research Branch, National Parks and Wildlife Service, Dublin;
- McCorry & Ryle (2009) Saltmarsh Monitoring Project 2007-2008: Volume 4. Research Branch, National Parks and Wildlife Service, Dublin;
- MERC Consultants (2006) Surveys of sensitive subtidal benthic communities in Slyne Head Peninsula SAC, Clew Bay Complex SAC and Galway Bay Complex SAC. Project Report on behalf of the National Parks and Wildlife Service;
- NPWS (2011a) Conservation Objectives: Clew Bay Complex SAC 001482. Version 1.0 (July 2011). National Parks and Wildlife Service, Dublin;
- NPWS (2011b) Clew Bay SAC (site code 1482) Conservation objectives supporting document - coastal habitats. Version 1. National Parks and Wildlife Service, Dublin;
- NPWS (2011c) Clew Bay Complex SAC (site code 1482) Conservation objectives supporting document- marine habitats and species. Version 1. National Parks and Wildlife Service, Dublin;
- Ryle, *et al.* (2009) Coastal Monitoring Project 2004-2006. National Parks and Wildlife Service, Dublin.

Additional reporting prepared by BioAtlantis was also reviewed with regard to field survey observations within the study area and the assessments undertaken with regard to sustainable harvest management, potential impacts and interactions, as set out in the Foreshore Licence Application (BioAtlantis, 2014). To assess cumulative effects, data was also taken from online resources to measure the extent of existing activities. Information on aquaculture activities other harvesting activities or harvesting of invertebrates, and information for tourism, recreation, was also taken from online sources. Some information was derived through word-of-mouth or as ‘common knowledge’.

2.2 Site survey to inform the NIS

A site walkover survey and visual assessment was undertaken to inform the NIS with regard to the qualifying interests and conservation features of the Natura 2000 sites within the study area of the proposed project. The findings of this broad-scale survey are included in the current assessment. The study area, comprising the islands and shoreline of Clew Bay, were visited by boat during November 2013 and an overview assessment was carried out to establish the presence and sensitivity of Annex I habitats and suitable habitat availability for Annex II species, with regard to the Natura 2000 designations within the study area.

2.3 Calculation of community areas within Clew Bay

Taking cognisance of the NPWS recommendation that continuous disturbance of each community type within Clew Bay Complex cSAC should not exceed an approximate area of 15%, there was a requirement to perform calculations. To measure the potential impact on structure and function in Clew Bay, BioAtlantis requested marine community type datasets for Clew Bay. A shapefile of relevant community types was provided by NPWS in ESRI format (18/08/2014). Using this data, BioAtlantis calculated the total area (m^2) in Clew Bay SAC of each marine community type, the area affected by harvest activities/annum (m^2 and percentage).

2.4 Appropriate Assessment Methodology

The preparation of this NIS to inform the Appropriate Assessment process follows the guidance published by NPWS (DoEHLG, 2009) '*Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities'*. According to these guidelines, the Appropriate Assessment process is a four staged approach, as described below:

- *Stage One: Screening / Test of Significance* - The process which identifies the likely impacts upon a Natura 2000 site of a project or plan, either alone or in combination with other projects or plans, and considers whether these impacts are likely to be significant;
- *Stage Two: Natura Impact Statement* - The consideration of the impact of the project or plan on the integrity of the Natura 2000 site, either alone or in combination with other projects or plans, with respect to the site's structure and function and its conservation objectives. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts;
- *Stage Three: Assessment of Alternative Solutions* - The process which examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site; and
- *Stage Four: Assessment Where Adverse Impacts Remain* - An assessment of compensatory measures where, in the light of an assessment of Imperative Reasons of Overriding Public Interest (IROPI), it is deemed that the project or plan should proceed.

The safeguards set out in Article 6(3) and (4) of the Habitats Directive are triggered not by certainty but by the possibility of significant effects. Thus, in line with the precautionary principle, it is unacceptable to fail to undertake an appropriate assessment on the basis that it is not certain that there are significant effects.

2.4.1 Screening to Inform Appropriate Assessment

Following the guidelines set out by DoEHLG (2009), Screening is the process that addresses and records the reasoning and conclusions in relation to the first two tests of Article 6(3); i.e. whether a plan or project can be excluded from Appropriate Assessment requirements because it is directly connected with or necessary to the management of the site; and the potential effects of a project or plan, either alone or in combination with other projects or plans, on a Natura 2000 site in view of its conservation objectives, and considering whether these effects will be significant. According to the DoEHLG (2009) guidance, screening is the process that addresses and records the reasoning and conclusions in relation to the first two tests of Article 6(3) of the EU Habitats Directive, that is: whether a plan or project is directly connected to or necessary for the management of the site; and whether a plan or project, alone or in combination with other plans and projects, is likely to have significant effects on a Natura 2000 site or sites in view of its conservation objectives.

The BioAtlantis proposal for the hand-harvesting of *A. nodosum* within Clew Bay does not comply with the first screening test (i.e. the proposed works are not directly connected to or necessary for the management of any Natura 2000 site). The Screening assessment therefore aims to inform the Appropriate Assessment process in determining whether the proposed project, alone or in combination with other plans and projects, is likely to have significant effects on the Natura 2000 sites within the study area. If the effects are deemed to be significant, potentially significant, or uncertain, or if the screening process becomes overly complicated, then the Appropriate Assessment process must proceed to the preparation of a Natura Impact Statement (NIS). The required elements of a Screening Report included in the current report are as follows:

- Description of plan or project - Identification of relevant Natura 2000 sites and compilation of information on their qualifying interests and conservation objectives. Include the potential for a plan or project, whether it is within or outside a Natura 2000 site, to have direct, indirect or cumulative effects. Desk study information for the conservation interests is available from the NPWS.
- Assessment of likely effects – direct, indirect and cumulative – undertaken on the basis of available information as a desk study or field survey or primary research as necessary. A precautionary approach is fundamental and, in cases of uncertainty, it should be assumed the effects could be significant. As a guide, any element of a plan or project that has the potential to affect the conservation objectives of a Natura 2000 site, including its structure and function, should be considered significant.

2.4.2 Natura Impact Assessment

A Natura Impact Statement (NIS) considers whether the plan or project, alone or in combination with other projects or plans, will have adverse effects on the integrity of a Natura 2000 site, and includes any mitigation measures necessary to avoid, reduce or offset negative effects. The current report is set out in the format of a NIS and comprises a scientific examination of the plan / project and the relevant Natura 2000 sites; to identify and characterise any possible implications for the site in view of the site's conservation objectives, structure and function, taking account of in combination effects. The requirements for Appropriate Assessment derive directly from Article 6(3) of the EU Habitats Directive (1992).

Direct and indirect impacts in isolation or in combination with other plans and projects on the identified Natura 2000 sites in view of the sites' conservation objectives have been examined. Case law of the European Court of Justice (ECJ) has established that Appropriate Assessment must be based on best scientific knowledge in the field. These are the qualifying interests i.e. Annex I habitats, Annex I bird species (EU Birds Directive, incorporated into the EU Habitats Directive) and Annex II species hosted by a site and for which that site has been selected. The conservation objectives for Natura sites (SACs and SPAs) are determined under Article 4 of the Habitats Directive and are intended to ensure that the relevant qualifying interests i.e. Annex I habitats, Annex I bird species and Annex II species present within the designated sites are maintained in a favourable condition. The current assessment of the proposal for hand-harvesting of *A. nodosum* at sustainable levels within Clew Bay provides a description of the project and the receiving environment. The conservation objectives of Natura 2000 sites potentially affected by the proposal are listed and potential impacts outlined with respect to the integrity of the Natura 2000 site. Mitigation measures have been proposed for the protection of the conservation interests and the avoidance of impacts to Natura 2000 sites occurring within the study area.

3 SCREENING FOR APPROPRIATE ASSESSMENT

3.1 Description of the proposed project

Clew Bay has in excess of 90 islands and 100km of coastline that contain harvestable quantities of *A. nodosum*. Given the ecological sensitivities identified within the Clew Bay works area, harvesting must be carried out in a manner which does not negatively affect the biological environs. Utilising sustainable hand-harvesting techniques (Kelly et al., 2001; Guiry & Morrison, 2013) and incorporating their use within a best practise approach, BioAtlantis have developed a sustainable model of seaweed harvesting in Clew Bay. Subject to obtaining a licence to harvest in Clew Bay, BioAtlantis will employ up to 20 full-time staff in Clew Bay to service both the existing and future production requirements, with 12,900 tonnes per annum harvested. This will include 16 full time or 32 part-time hand harvesters from the region. A full time Resource Manager and person involved in transport will also be required. BioAtlantis will recruit harvesters with previous experience or whose families have farms or fishing interests in the area and will work with the harvesters to apply sustainable methods of harvesting, collection and conservation of the resource.

BioAtlantis will employ a site-specific management approach throughout the expanse of the Clew Bay SAC and throughout the entire year. This ensures that activities take place at appropriate locations and at appropriate times. Specifically, this allows for robust mitigation measures to be employed to ensure that sites designated as unavailable for harvest at a particular time due to presence of sensitive seal and bird species, are not visited. Thus, while the total area of coastline in Clew Bay is quite large, the approach of selecting environmentally-appropriate sites, effectively narrows the focus to a small number of discrete locations at any given time. The use of the collection vessel also ensures ease of access of the Resource Manager to sites in use. It also brings full traceability to the process, as quality of harvest for each location will be monitored and biomass will be weighed on the boat prior to issuing the harvesters with a Goods Received Note (GRN). This technique also frees up harvesters to spend less time, money and effort on hauling cut seaweed ashore, whilst avoiding the otherwise negative consequences associated with bringing cut seaweed ashore at inappropriate locations.

Hand-harvested *A. nodosum* will be transported to production facilities in Kanturk, Co. Cork for further processing.

3.1.1 Operational phase of the proposal

The BioAtlantis proposal for sustainable hand-harvesting of *A. nodosum* from Clew Bay will include an area extending from Rosmurrevagh point on the north of Clew Bay to Leckanvy Pier in the south, including the islands within the Bay. Through use of data obtained from the field studies and evaluations by BioAtlantis Ltd. in 2014 (see main application document) and Hession *et al*. (1998) and maps and aerial photographs of the region, it is calculated that the current maximum yield of *A. nodosum* from Clew Bay to be of the order of 64,759 tonnes. This equates to an annual sustainable harvest of ~12,900 tonnes, based on harvesting a maximum of 20% of the total available *A. nodosum* biomass per site per annum. BioAtlantis will employ a site-specific management approach to the Clew Bay SAC, throughout the entire year. This ensures that activities take place at appropriate locations and at appropriate times. Specifically, this allows for robust mitigation measures to be employed to ensure that sites designated as unavailable for harvest at a particular time due to presence of sensitive

harbour seal and bird species, are not visited. BioAtlantis Ltd. will employ a Resource Manager or Project Manager to operate on site, preferably with relevant environmental qualifications and/or experience in the fishing / marine resources industry. This individual will be responsible for managing activities within the harvesting area and in ensuring sustainability of these activities. They will report directly to the company CEO and work as part of the resource management team. Thus, while the total area of coastline in Clew Bay is quite large, the approach of selecting environmentally-appropriate sites, effectively narrows the focus to a small number of discrete locations at any given time. The use of a collection vessel ensures ease of access by the Resource Manager to the sites. This brings full traceability to the process, as the quality of harvest from each location is monitored and biomass is weighed on collection and recorded on a Goods Received Note (GRN). The benefits of this technique is that harvester's times is no longer spent hauling seaweed ashore and coastal damage that could be caused by bringing in large quantities of seaweed ashore at inappropriate locations is avoided.

A key requirement in implementing and securing a functioning system for sustainably hand harvesting *A. nodosum*, are effective control measures, reporting and monitoring systems. These are set out in this Code of Practice document and form a key framework for managing and ensuring that the system is being adhered to in a precise, correct, seamless and traceable manner. A key component to ensuring that the systems are being adhered to, and at the levels set out in the Code of Practice, will be a strong and robust auditing system. BioAtlantis will conduct quarterly and annual audits covering the areas below:

(a) Quarterly Audit:

- Audit Part A: Records, Forms & Documents
  Step 1: Forms: receipt of training & verification of understanding
  Step 2: Completed Training Certs & Permits (obtained through training above.)
  Step 3: Records, forms & documents (general)

- Audit Part B: Quality Assessment (documentation)
  Step 1. GRNs (Clew Bay)
  Step 2. Production logsheets (Production Facilities)
  Step 3. Incident Reports
  Step 4. Non-conformance Reports
  Step 5. Software Systems

(b) Annual Audit (on-site):
  Step 1. Site Quality (inspection of harvested sites)
  Step 2. Harvest methods (inspection of techniques)
  Step 3.Collection vessel

For more information on the auditing system and its contents, please consult Appendix 4 and Appendix 8 (Clew Bay Audit template) of the main BioAtlantis licence application document. All control measures, action limits/non-conformance, analytical procedures, monitoring schedule, (frequency), corrective actions and verification are detailed in the licence application main text document. In addition, the harvesting system will be reviewed annually to assess and verify the control measures and determine areas in need of improvement.

3.1.1.1 Overview of the proposed operational phase

In carrying out the operational stage of the proposal, harvest will be recorded using BioAtlantis Compliance and Record Forms (see Appendix 3). BioAtlantis has developed a management plan set out in the 'Code of Practice for *A. nodosum* harvest activities in Clew Bay cSAC', included as Appendix 4 in the current NIS. This includes the development of a database, to take account of the study area of Clew Bay including over 90 islands and 100km of coastline that contain harvestable quantities of *A. nodosum*. This database will be used to:

(a) Determine and manage sites which require a fallowing period to allow for adequate recovery from recent activities;
(b) Determine and manage rotation requirements (i.e. extrapolation and calculation of the duration or fallowing period required prior to a particular areas being fit for re-harvest);
(c) Prevent harvest activities that would lead to a decline in yield;
(d) Record the details of each harvest, how much, by whom and when.

Moreover, this database represents a central, working component of the BioAtlantis best practice guidelines for harvesting *A. nodosum*, requiring:

(a) Development of pre-harvest plans in advance of harvest activities;
(b) A cap of 20% on the level of available biomass which can be harvested from a given site per annum;
(c) Limitations of a 200-300mm (8-12 inches) cutting height of *A. nodosum* above the holdfast.

Table 1 below sets out the islands and shore-line areas identified as being within the proposed harvesting area for the BioAtlantis project, with *A. nodosum* densities and coverage included. There are four main types of activities associated with the operational phase include:

Operation/Activity No. 1: Management & implementation;
Operation/Activity No. 2: Monitoring, recording & reporting;
Operation/Activity No. 3: Verification & analysis.
Operation/Activity No. 4: Long term assessment of biomass and community structure

All operations/activities are described in detail in the Code of Practice prepared by BioAtlantis, included in the Licence Application (BioAtlantis, 2014) and presented in Appendix 4 of this NIS. When planning future harvests some Islands will be marked as unavailable for certain times of the year, in order to ensure that known seal breeding, moulting and resting and bird breeding and wintering sites are avoided. The Resource Manager will be responsible for ensuring that these sites are avoided. The list of restricted sites is set out in the Code of Practice (Appendix 4); this will be updated to reflect ongoing consultation and data available from NPWS into the future; taking account of time of year and the presence of Common seals and breeding and wintering bird populations.

The BioAtlantis Resource Manager will be required to verify that each site has fully recovered prior to re-harvesting. This will be done by visiting each site and performing an assessment of the growth and density of *A. nodosum* on each, and updating the production plan as necessary with the results of this analysis.

3.1.1.2 Management and implementation during operations

Management and implementation components include activities relating to:

1. *Planning and scheduling of harvesting activities*: In the initial stages, it is necessary to establish details of when each area was last harvested. This will be done by working closely with the existing local harvesters, and through analysis of derived data, BioAtlantis can establish the dates and quantities of the most recent harvests for each island and coastal zone. This data can then be used to derive when a region will be next available for harvest. The nominal recovery time is generally accepted to be 3-5 years from a complete harvest; a maximum harvest of 20% of the total available biomass of seaweed is permitted per site per annum to ensure sustainability.

2. *Numbers of personnel to be managed and harvest rates:* Approximately 16 full time people, or 32 part-time, will work for an average of 230 days/year, harvesting approximately 3.5 tonnes per day (rate of ~10.4Kg/M^2). The area harvested will be 26,923m^2 per day per 16 harvesters. This reflects a harvest rate of 20% of *A. nodosum* biomass per site per annum. This corresponds to an area occupied of 1,683m^2 per person/day or 0.4acres per person per day, for approximately 6-8 hours per day. Approximately 2-4 harvesters are permitted on small-medium sized sites. Medium to large islands may require between 4-6, while larger islands will likely require approximately 6-10 harvesters. Thus, the low number of people over a wide area reduces the potential for anthropogenic impacts (e.g. intensity of trampling) on the biotope. In fact, given that the BioAtlantis plan targets specific areas at specific times of the year, the low levels of trampling events will also be largely episodic in nature. It is unlikely therefore, that any significant change in the structure of *A. nodosum* assemblages will occur. Furthermore, as BioAtlantis will implement a strict policy against holdfast removal, the incidence of *A. nodosum* mortality will be reduced considerably (see 'Code of Practice', Appendix 4). As such, the harvest level of 20% of the total available biomass per site per annum represents a relatively constant figure and will not be exacerbated due to significant levels of *A. nodosum* mortality due to partial or complete holdfast removal;

3. *Exploitation Levels*: As BioAtlantis will implement a strict policy against holdfast removal, *A. nodosum* mortality and whole plant removal will therefore be prevented. Hence, the harvest rate figure of 20% of the total available biomass will remain largely constant and will not be breached due to increased mortality rates.

4. Once the re-harvesting date for each island is established, this information will be used to plan the next seasons harvesting. The Resource Manager will be required to verify that each site has fully recovered prior to re-harvesting. This will be done by visiting each site and performing an assessment of the growth and density of *A. nodosum* on each, and updating the production plan as necessary with the results of this analysis;

5. *Data recording and analysis*: BioAtlantis will provide a boat to be used for the collection of harvested *A. nodosum*. The boat will be piloted by the Resource Manager. The seaweed collected from each point will be weighed and the details of the harvest recorded, at each collection point. The Resource Manager will complete a 'Goods Received Note' to accompany the harvest from each site. This also includes measurement of quality standards with respect to the harvested seaweed and the sustainability of the methods employed. After receipt of the harvest by BioAtlantis, these details will be uploaded into the main database. The quality of the supplied *A. nodosum*

will be assessed by the quality control and/or production team and details of any deviations from the specified requirements recorded on the harvest record. Computerised data will be maintained of all harvest records and non-conformances;

6. *Access and Navigation at harvest sites*: The harvesters shall use their own vessels to navigate to and from the island sites. In the case of coastal sites, the harvesters shall be responsible for access to and from the sites via existing access routes. The size of the shore area covered by an individual net will be approximately 8m^2. Tied nets will typically cover an area of approximately 2m^2. Harvest will occur at islands and shorelines as described in the harvest management plan. Nets will then be picked up at each location in which harvest took place. Final pick-up points will be at established piers and harbours, particularly in Westport and Newport. Access to the northern coastal area will be via the roads at Knockmanus road, Roskeen south Road, Carrowsallagh Rd, Keeloges Rd, and via boat. Access to the Milcum harvesting site will be via the Teevmore Road. The coast roads on Knockeeragh and Rosclave provide good access to the harvesting sites in this area. The harvesting site at Rosanrubble can be accessed by boat and from the road to Rosanrubble Point. The harvesting area between Bleanrosdooaun Strand and Monkelly can be accessed by road to Roslaher, Rostoohy Pier, Moyna Strand, Ardkeen Quay, Roscahil Rd, Rosmindle Rd, Castleaffy, Rosmoney, Rusheen, Carrowcally, Bawn Strand, & Monkelly Strand. BioAtlantis will provide a boat that will be approved by the Marine survey office (MSO) for use on the open waters of Clew Bay. This vessel will be used to collect the harvested *A. nodosum* from the designated sites. The harvesters will be made aware that all harvested *A. nodosum* must be collected by BioAtlantis for weighing and processing, and the seaweed will only be collected from the sites identified on the harvesting schedule or at sites which are approved by BioAtlantis.

7. *Communication*: The number of harvesters involved in harvesting the requirements of BioAtlantis will be below ten initially and will rise to 16 in subsequent years. Communication of the harvesting plan will be done in advance each month/quarter via email or post. This will include information on sites that are to be harvested and the quantity and dates for each harvest site. Sites will be identified on a map and the anticipated quantities for each site indicated. Communications with the harvesters during harvesting activities will be either via a mobile phone or 2 way radios, as deemed appropriate and will be managed by BioAtlantis and the BioAtlantis Resource Manager;

8. *Hand-harvest methodology*: Harvesters must undergo training in order to be certified as having the skills required to harvest *A. nodosum* in an environmentally friendly and sustainable manner. Activities will be carried out in accordance with a clearly defined protocol which will prevent any damage to the environment or underlying growth substrate, whilst also facilitating sufficient re-growth and re-generation of the vegetation post-harvest. The 'Code of Practice for *A. nodosum* harvest activities in Clew Bay cSAC' is set out in the Licence Application (BioAtlantis 2014) and is included in Appendix 4 of the current report;

9. *Health and safety measures*: All harvesters will receive appropriate and certified Health & Safety Training. BioAtlantis will run regular training days for the harvesters. The seaweed collection vessel will be equipped with all necessary safety equipment as required by the marine survey office.

Table 1 Harvesting locations and quantity estimates within the Clew Bay study area.

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m^2)	Typical Density (Kg / m^2)	Coverage§	Harvest levels (Tonne)†	
						Available Seaweed	Maximum Annual Harvest
	Bartraw - Westport	CZ 1.1	226318	0	46%	0.0 T	0.0 T
		CZ 1.2	83288	0.7	100%	58.3 T	11.7 T
		CZ 1.3	57560	0.7	98%	39.4 T	7.9 T
		CZ 1.4	46890	0.7	100%	32.8 T	6.6 T
		CZ 1.5	59466	0.7	70%	29.3 T	5.9 T
		CZ 1.6	32360	1.25	100%	40.4 T	8.1 T
		CZ 1.7	47684	0.7	100%	33.4 T	6.7 T
		CZ 1.8	77259	0	54%	0.0 T	0.0 T
		CZ 1.9	7961	0.7	100%	5.6 T	1.1 T
		CZ 1.10	5559	1.25	100%	6.9 T	1.4 T
		CZ 1.11	11271	1.25	100%	14.1 T	2.8 T
		CZ 1.12	4254	1.25	100%	5.3 T	1.1 T
		CZ 1.13	136927	10.5	94%	1354.0 T	270.8 T
		CZ 1.14	76090	10.5	94%	751.9 T	150.4 T
		CZ 1.15	37232	0.5	100%	18.6 T	3.7 T
		CZ 1.16	35400	0.5	100%	17.7 T	3.5 T
		CZ 1.17	35419	0.5	100%	17.7 T	3.5 T
		CZ 1.18	6633	0.5	100%	3.3 T	0.7 T
	Westport - Rosmoney	CZ 2.1	38658	0	82%	0.0 T	0.0 T
		CZ 2.2	5199	0	100%	0.0 T	0.0 T
		CZ 2.3	8889	0	100%	0.0 T	0.0 T
		CZ 2.4	35324	0	94%	0.0 T	0.0 T
		CZ 2.5	74945	0.55	98%	40.4 T	8.1 T
		CZ 2.6	30076	0.8	100%	24.1 T	4.8 T
		CZ 2.7	7831	0	57%	0.0 T	0.0 T
		CZ 2.8	6710	0	100%	0.0 T	0.0 T
		CZ 2.9	125537	0.8	100%	100.4 T	20.1 T
		CZ 2.10	109815	0.8	97%	85.0 T	17.0 T
		CZ 2.11	9303	0	100%	0.0 T	0.0 T
		CZ 2.12	27612	0	91%	0.0 T	0.0 T
		CZ 2.13	328	0	100%	0.0 T	0.0 T
		CZ 2.14	22527	0	100%	0.0 T	0.0 T
		CZ 2.15	3842	0	94%	0.0 T	0.0 T
		CZ 2.16	6082	0	100%	0.0 T	0.0 T
		CZ 2.17	3636	0	0%	0.0 T	0.0 T
	Rosmoney - Moyna Strand	CZ 3.1	18865	0	50%	0.0 T	0.0 T
		CZ 3.2	40641	4.35	100%	176.8 T	35.4 T
		CZ 3.3	97095	4.35	100%	422.4 T	84.5 T
		CZ 3.4	12914	4.35	100%	56.2 T	11.2 T
		CZ 3.5	9650	4.35	100%	42.0 T	8.4 T

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m^2)	Typical Density (Kg / m^2)	Coverage§	Harvest levels (Tonne)†	
						Available Seaweed	Maximum Annual Harvest
		CZ 3.6	78317	4.35	95%	323.9 T	64.8 T
		CZ 3.7	117114	4.35	100%	509.4 T	101.9 T
		CZ 3.8	8398	4.35	100%	36.5 T	7.3 T
	Rostoohy Pt - Newport	CZ 4.1	84464	4.35	92%	339.0 T	67.8 T
		CZ 4.2	27181	4.35	100%	118.2 T	23.6 T
		CZ 4.3	150517	4.35	100%	654.8 T	131.0 T
		CZ 4.4	38351	4.35	99%	164.9 T	33.0 T
		CZ 4.5	26354	0	96%	0.0 T	0.0 T
		CZ 4.6	6397	0	83%	0.0 T	0.0 T
		CZ 4.7	5572	0	100%	0.0 T	0.0 T
		CZ 4.8	6703	0	100%	0.0 T	0.0 T
		CZ 4.9	9671	0	100%	0.0 T	0.0 T
		CZ 4.10	24594	0	64%	0.0 T	0.0 T
		CZ 4.11	117165	0.85	81%	80.2 T	16.0 T
		CZ 4.12	77555	0.85	100%	65.9 T	13.2 T
		CZ 4.13	278265	0.85	79%	187.7 T	37.5 T
		CZ 4.14	110969	0.85	100%	94.3 T	18.9 T
	Newport - Mallaranny Pier	CZ 5.1	61157	0	100%	0.0 T	0.0 T
		CZ 5.2	58948	3.5	79%	163.3 T	32.7 T
		CZ 5.3	105121	3.5	84%	310.9 T	62.2 T
		CZ 5.4	258002	3.5	92%	833.8 T	166.8 T
		CZ 5.5	82278	3.5	83%	240.2 T	48.0 T
		CZ 5.6	41272	3.5	100%	144.5 T	28.9 T
		CZ 5.7	145329	3.5	89%	454.2 T	90.8 T
		CZ 5.8	84126	3.5	100%	294.4 T	58.9 T
		CZ 5.9	8260	3.5	100%	28.9 T	5.8 T
		CZ 5.10	17114	3.5	100%	59.9 T	12.0 T
		CZ 5.11	4451	3.5	100%	15.6 T	3.1 T
		CZ 5.12	1689	3.5	100%	5.9 T	1.2 T
		CZ 5.13	29666	3.5	100%	103.8 T	20.8 T
		CZ 5.14	3900	1.75	100%	6.8 T	1.4 T
		CZ 5.15	30450	1.75	100%	53.3 T	10.7 T
		CZ 5.16	11735	1.75	100%	20.5 T	4.1 T
		CZ 5.17	47890	1.75	79%	65.8 T	13.2 T
1	Forillan, Illanavrick	IS 11.1	40653	6	100%	243.9 T	48.8 T
1		IS 11.2	13763	10	100%	137.6 T	27.5 T
2	Kid Isd East		3966	14	100%	55.5 T	11.1 T
3	Roslynagh		7990	0	0%	0.0 T	0.0 T
4	Illannambraher		57901	19	96%	1053.2 T	210.6 T
5	Inishdasky		14818	18	100%	266.7 T	53.3 T
6	Inishquirk		25206	15	82%	308.9 T	61.8 T

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m^2)	Typical Density (Kg / m^2)	Coverage§	Harvest levels (Tonne)†	
						Available Seaweed	Maximum Annual Harvest
7	Inishtubrid		45540	18	100%	819.7 T	163.9 T
8	Inishlim		13308	16	100%	212.9 T	42.6 T
9			41752	18	100%	75.1 T	15.0 T
9	Beetle Isd North						
9	Inishbobunnan						
10			566589	16	27%	246.1 T	49.2 T
10	Inishgowla						
10	Beetle Isd South						
11	InishKeel	IS 11.1	16036	12.5	100%	200.5 T	40.1 T
11		IS 11.2	2083	16.75	100%	34.9 T	7.0 T
11		IS 11.3	300	17.5	100%	5.3 T	1.1 T
11		IS 11.4	5876	17.5	100%	102.8 T	20.6 T
12	Black Rock		24348	2.5	100%	60.9 T	12.2 T
13	Moynish More		0	0	0%	0.0 T	0.0 T
14	Moynish Beg		0	0	0%	0.0 T	0.0 T
15	Inisherkin		53097	18	41%	387.7 T	77.5 T
16	Inishnacross		46888	18.5	61%	525.0 T	105.0 T
17	Inishilra		36300	18	78%	507.0 T	101.4 T
18	Inishcooa		70929	12	57%	486.2 T	97.2 T
19	Roeillaun		77113	5	100%	385.6 T	77.1 T
20	Inishdeashbeag		62555	0	100%	0.0 T	0.0 T
20							
20	Inishdeashmore						
21	Inishcorky		17912	18.75	100%	335.8 T	67.2 T
22	Inishcarrick		34846	19	60%	397.3 T	79.5 T
23	Inishcoragh		24041	15	100%	360.6 T	72.1 T
24	Muckinish		33800	19.25	100%	650.6 T	130.1 T
25	Inishdaweel		22175	20	77%	342.8 T	68.6 T
26	Rabbit Isd		52391	8	58%	242.1 T	48.4 T
26							
27	Illanascrraw		10411	18	100%	187.4 T	37.5 T
28	Freaghillanluggagh		23358	20	100%	467.2 T	93.4 T
29	Inishkee		16398	19	100%	311.6 T	62.3 T
30			15889	18	100%	286.0 T	57.2 T
31	Freaghillan West		20456	19	50%	194.8 T	39.0 T
32	Innishcannon		8656	16	100%	138.5 T	27.7 T
33	Carricklahan		0	0	0%	0.0 T	0.0 T
34	Carrickachorra		0	0	0%	0.0 T	0.0 T
35	Illanmaw		74045	0	66%	0.0 T	0.0 T
36	Freaghillan East		6422	18	100%	115.6 T	23.1 T
37			1476	16	100%	23.6 T	4.7 T

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m^2)	Typical Density (Kg / m^2)	Coverage§	Harvest levels (Tonne)†	
						Available Seaweed	Maximum Annual Harvest
38	Inishcuill West		82042	20.75	79%	1348.2 T	269.6 T
39	Mauherillan		14262	16.75	91%	217.5 T	43.5 T
40	Inishfesh		54236	18	70%	685.8 T	137.2 T
41	Inishmolt		23618	18	100%	425.1 T	85.0 T
42	Inishloy		36182	18.5	100%	669.4 T	133.9 T
43	Inishdaff		70875	20.5	100%	1452.9 T	290.6 T
44	Inishbollog		13201	20.75	100%	273.9 T	54.8 T
45	Inishlaughil		55888	0	100%	0.0 T	0.0 T
46	Inishgowla		67983	16	22%	243.7 T	48.7 T
47	Inishoo		23072	0	13%	0.0 T	0.0 T
48	InishTurk	IS 48.1	56134	21	100%	1178.8 T	235.8 T
48		IS 48.2	10755	21	100%	225.9 T	45.2 T
49	Illannaconney		17437	15	77%	201.6 T	40.3 T
50	Inishakillew	IS 50.1	69800	21.75	100%	1518.1 T	303.6 T
50		IS 50.2	18583	21.75	100%	404.2 T	80.8 T
51	Trawbaun		256815	19.5	89%	4468.7 T	893.7 T
51	Carrigeenglass North						
51	Moneybeg						
51	Inishcottle						
52	Calf Island		30778	19.75	81%	490.3 T	98.1 T
53	Inishbee, Derrinish & Dernish West		200836	17.5	58%	2021.6 T	404.3 T
54	Freaghillan	IS 54.1	27454	19.75	66%	357.1 T	71.4 T
54		IS 54.2	55101	20	90%	989.7 T	197.9 T
54		IS 54.3	5995	21	100%	125.9 T	25.2 T
55	Clynish		102154	18.5	77%	1463.2 T	292.6 T
56	llaunnamona		25370	16	95%	384.3 T	76.9 T
57	Rabbit Island, Island More &Quinnsheen Island	IS 57.1	14757	19.5	100%	287.8 T	57.6 T
57		IS 57.2	92903	16	88%	1307.4 T	261.5 T
57		IS 57.3	7894	17.5	100%	138.1 T	27.6 T
57		IS 57.4	9330	18	100%	167.9 T	33.6 T
58	Collan More, Carrigeenglass South & Collan Beg	IS 58.1	501217	16.75	100%	8395.4 T	1679.1 T
58		IS 58.2	55220	18.75	100%	1035.4 T	207.1 T
58		IS 58.3	29858	19.5	100%	582.2 T	116.4 T
59	Inishgort		64954	15.5	57%	571.7 T	114.3 T
60	Inishlyre		121285	5	57%	347.3 T	69.5 T
61	Illanataggart & Crovinish		442259	14	99%	6133.0 T	1226.6 T

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m^2)	Typical Density (Kg / m^2)	Coverage§	Harvest levels (Tonne)†	
						Available Seaweed	Maximum Annual Harvest
62	Ininhgowla South + Carrickwee		183389	15	100%	2750.8 T	550.2 T
63	Forilan		30569	9.75	100%	298.0 T	59.6 T
64	Carrickawart	IS 64.1	26696	16	100%	427.1 T	85.4 T
64		IS 64.2	1276	14.25	100%	18.2 T	3.6 T
65	Inishlaghan		32314	14.5	83%	388.4 T	77.7 T
66	Dorinish More & Dornish Beag		27107	12.5	100%	338.8 T	67.8 T
67	Inishimmel		0	0	0%	0.0 T	0.0 T
68	Inishleauge		54366	8	77%	334.3 T	66.9 T
69	Inishdaugh		22949	6.5	72%	108.0 T	21.6 T
70	Inishraher		81224	14.7	85%	1014.1 T	202.8 T
71	Inisheeney		53625	16	85%	725.4 T	145.1 T
72	Finnaun Island		0	0	0%	0.0 T	0.0 T
73	Corillan	IS 73.1	6787	6.5	100%	44.1 T	8.8 T
73		IS 73.2	1016	6.5	100%	6.6 T	1.3 T
73		IS 73.3	1737	6.5	100%	11.3 T	2.3 T
73		IS 73.4	3001	6.5	100%	19.5 T	3.9 T
74	Carricknamore	IS 74.1	2436	6.75	100%	16.4 T	3.3 T
74		IS 74.2	1393	6.75	100%	9.4 T	1.9 T
74		IS 74.3	2640	6.75	100%	17.8 T	3.6 T
75		IS 75.1	6494	6.75	100%	43.8 T	0.0 T
75		IS 75.2	1107	6.75	100%	7.5 T	0.0 T
75		IS 75.3	5463	6.75	100%	36.9 T	0.0 T
75	Stony Island	IS 75.4	7984	0	100%	0.0 T	0.0 T
75		IS 75.5	5822	5	100%	29.1 T	0.0 T
75		IS 75.6	10649	6.5	100%	69.2 T	0.0 T
75		IS 75.7	1649	6.5	100%	10.7 T	0.0 T
75		IS 75.8	9495	6.5	100%	61.7 T	0.0 T
76	Green Islands	IS 76.1	11054	0	100%	0.0 T	0.0 T
76		IS 76.2	3460	0	100%	0.0 T	0.0 T
76		IS 76.3	6690	0	100%	0.0 T	0.0 T
77	Carricknacally		2860	6.5	100%	18.6 T	3.7 T
78	Monkellys Rock		4425	8.75	100%	38.7 T	7.7 T
79	Inishweela		24604	10	97%	238.7 T	47.7 T
80	Illanroe		28522	14	100%	399.3 T	79.9 T
81	Roeillan		16126	15	100%	241.9 T	48.4 T
	Totals						**12900 T**

***** Harvesting Zone ID's were assigned by BioAtlantis as part of establishing the management system.

† Maximum Annual Harvest (Tonnes) is calculated as 20% of the total available biomass per site. The figure of 20% refers to the % of the total available *A. nodosum* biomass harvested per site, per annum.

‡ Area in use per year was calculated using shapefile data obtained courtesy of NPWS.

§ Denotes the percentage of coastline which can support *A. nodosum* growth.

3.1.1.3 Monitoring of the *A. nodosum* resource: initial and continual assessments

The Resource Manager must perform an initial assessment to verify the levels of biomass at each site in Clew Bay prior to conducting harvest. To do this, the Resource Manager will visit each site and verify the data by means of direct measurements and/or visual assessments. It is also necessary to determine which sites have been recently harvested and if necessary, assign sufficient fallowing periods to allow for biomass recovery at such sites. The Resource Manager will monitor *A. nodosum* harvest sites on a continual basis as required to ensure that sites have sufficiently recovered prior to harvest taking place. This information will be recorded in the database to ensure that harvest activities are planned to ensure that harvest is limited exclusively to sites where *A. nodosum* density has recovered.

Immediately following harvest, *A. nodosum* will be bagged and weighed automatically on the navigation vessel. Details will be recorded on the GRN on arrival at the pier, thus allowing for accurate recording of the locations and quantities of *A. nodosum* harvested per unit area. The Resource Manager will be responsible for uploading the data from the GRN forms to the harvest database. The maintenance of the database will be the responsibility of the Engineering manager. Scientific, production and quality personnel will have access to the database as required for the correct implementation of their duties.

Locations and periods of harvest must be planned in a manner which ensures that (a) there is no damage incurred to the environs of this cSAC region, (b) there is sufficient *A. nodosum* biomass available for harvest and (c) sufficient time has passed to allow for recovery. The most accurate means of ensuring that each of these goals are met is through analysis of data as it emerges. In this way, staff at BioAtlantis will make decisions which are informed by knowledge of the rates of *A. nodosum* re-growth and site recovery. This data will be incorporated into the harvest management database for use in planning harvest periods.

In terms of quality control, BioAtlantis, as a GMP+ certified company, must ensure full traceability to end users of the origin and location of the raw material used in the products manufactures. Therefore, the Quality Control system in BioAtlantis will play a key role in the management and monitoring of work relating to harvest of *A. nodosum* in Clew Bay. In brief, this will involve:

- Assessment of quality control checks on harvesting activities in Clew Bay to ensure conformance with quality and other requirements for the cSAC;
- Assessment of quality control checks to ensure recording is conducted appropriately (Goods Received Notes (GRN), etc);
- Implementation of corrective actions where necessary. Liaise with BioAtlantis GMP+ Team on non-conformance issues should they arise;
- Utilisation of this knowledge in the preparation, scheduling and allocation of resources for harvesting;
- Assist in the implementation and training of all personnel & contractors involved in hand harvesting activities in the Clew Bay area;
- Liaise with BioAtlantis R&D Department regarding interpretation of data and on research and development related issues;
- Ensure customers have full traceability from point of harvest to the end product.
- Audits: assist in quarterly and annual audits on the harvesting system.

The quota for each island is a sustainable harvest of 20% of *A. nodosum.* The figure of 20% refers to the percentage of the total available *A. nodosum* biomass harvested per site per annum. If quota is exceeded, a Non-Conformance Report (NRC) will be issued. Harvesters

will undergo re-training if required. In the event of continual non-compliance, the contract with any such individual will be terminated. In the event that harvesters employed by BioAtlantis cut excess amounts of *A. nodosum* and/or sell material to other companies, BioAtlantis will investigate and if necessary take disciplinary procedures. The Resource Manager will routinely inspect sites post-harvest to ensure compliance of harvesters with sustainable hand harvest methods. Harvest will be recorded using BioAtlantis Compliance and Record Forms (see Appendix 3).

3.2 Description of the receiving environment

Clew Bay is a wide, west-facing bay on the west coast of Co. Mayo. It is open to the westerly swells and winds from the Atlantic with Clare Island giving only a small amount of protection. The drumlin landscape was formed during the last glacial period when sediments were laid down and smoothed over by advancing ice - the sea has subsequently inundated this area, creating a multitude of islands. These glacial features vary considerably in size from large islands supporting dwellings and pastures to little more than raised features on the sea floor. The numerous islands give rise to shallow straits and lagoons between which flow deep channels. This, together with the erosion of existing and submerged drumlins with their coarse glacial deposits, gives rise to a heterogeneous sediment environment. The presence of coarse material may therefore be an artefact of the glacial deposits rather than simply reflecting the level of energy present.

The geomorphology of the bay has resulted in a complex series of interlocking bays creating a wide variety of marine and terrestrial habitats, including several listed on Annex I of the E.U. Habitats Directive: large shallow bay, lagoon, Atlantic salt meadows, drift lines, perennial vegetation of stony banks, embryonic shifting dunes, Marram dunes, dune slacks and old Oak woodland. Around the edges of the inner part of the bay are shores of mixed boulders, cobbles, gravel with some sand and mud. They have a typical zonation of intertidal communities found on sheltered shores of mixed substratum. The Rosmurrevagh area in the north of Clew Bay displays a high diversity of habitats, from seashore to dunes and coastal grassland, as well as saltmarsh, bog and fen. A further dune system occurs at Bartraw in the south-west of the site. The Clew Bay Complex is identified as being important with regard to the populations of Otter and Common seal within the bay, listed as qualifying interests of the Clew Bay Complex cSAC.

A number of intertidal and marine communities/community complexes have been identified in the bay. The development of a community complex arises when an area possesses similar abiotic features but records a number of biological communities that are not regarded as being sufficiently stable and/or distinct temporally or spatially to become the focus of conservation efforts. In this case, examination of the available data from Clew Bay identified a number of biological communities whose species composition overlapped significantly. Such biological communities are grouped together into what experts consider are sufficiently stable units (i.e. a complex) for the purposes of setting conservation targets with respect to the designated Natura 2000 status of the Clew Bay Complex cSAC as a whole.

3.3 Identification of relevant Natura 2000 sites

3.3.1 Screening of Natura 2000 sites within the study area

The screening assessment to inform the Appropriate Assessment has identified Natura 2000 sites within a 15km radius of the proposed project, following the guidance published by DoEHLG (2009). It has been evaluated that a wider radius was not required in the absence of pathways identified by which sites outside of this radius could potentially be affected. Designated candidate Special Areas of Conservation (cSAC) sites and Special Protection Area (SPA) sites within the study area are presented in Table 2. The conservation interests of these sites and the potential for interactions leading to significant adverse effects arising from the proposed project are identified for each site. The locations of the cSAC and SPA Natura 2000 sites within the study area are presented in Figures 2 and 3.

Table 2 Designated Natura 2000 sites which are located within a 15km radius of the BioAtlantis study area at Clew Bay, Co. Mayo. The qualifying interests and the potential for impacts affecting these individual features are identified.

Natura site	Distance	Qualifying Interests	Potential for impacts identified	Further assessment required
Clew Bay Complex cSAC 001482	0km	*Vertigo geyeri* [1013] Mudflats and sandflats [1140] Coastal lagoons [1150] Large shallow inlets and bays [1160] Annual vegetation of drift lines [1210] Perennial vegetation of stony banks [1220] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Otter (*Lutra lutra*) [1355] Common seal (*Phoca vitulina*) [1365] Embryonic shifting dunes [2110] Marram dunes (white dunes) [2120]	There will be no interactions or pathways for impacts arising from the proposal which may affect the terrestrial / upper shore habitats of this designated site. Works are required within habitats that interact with the intertidal zone and within the bay itself. The Otter and Common seal have been recorded from within the project area and cSAC populations are known to be mobile.	No further assessment is required with regard to the terrestrial and upper shore Annex I habitats of this site. The potential for significant impacts affecting Annex I intertidal / marine habitats requires assessment. Further assessment is required to determine the significance of potential impacts affecting the cSAC populations of Common seal and Otter, with regard to disturbance and habitat displacement.
Owenduff/Nephin Complex cSAC (000534)	1.8km northwest	Salmon (*Salmo salar*) [1106] Otter (*Lutra lutra*) [1355] Shining sickle moss (*Drepanocladus vernicosus*) [1393] Marsh saxifrage (*Saxifraga hirculus*) [1528] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3110] Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoto-Nanojuncetea* [3130] Natural dystrophic lakes and ponds [3160] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] Northern Atlantic wet heaths with *Erica tetralix* [4010] Alpine and Boreal heaths [4060]	There will be no interactions or pathways for impacts arising from the proposed project which may affect the terrestrial and freshwater Annex I habitats and Annex II flora listed as qualifying interests of this site. The proposed works along the intertidal zone on the northern shore of Clew Bay has the potential to give rise to interactions affecting mobile otter populations from the adjacent Owenduff / Nephin cSAC with respect to the lower reaches of the Owengarve and Carrowsallagh Rivers. However, due to	No further assessment is required with regard to the Annex I habitats and Annex II species of this site. There is no potential for significant impacts affecting the conservation interests, with regard to the conservation objectives of this site.

Natura site	Distance	Qualifying Interests	Potential for impacts identified	Further assessment required
		Juniperus communis formations on heaths or calcareous grasslands [5130] Blanket bog (*active only) [7130] Transition mires and quaking bogs [7140]	distance and the absence of interactions with the freshwater environment within the cSAC boundary, no significant impacts are identified.	
Corraun Plateau cSAC (000485)	1km northwest	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3110] Northern Atlantic wet heaths with *Erica tetralix* [4010] European dry heaths [4030] Alpine and Boreal heaths [4060] *Juniperus communis* formations on heaths or calcareous grasslands [5130] Blanket bog (*active only) [7130]	There will be no interactions or pathways for impacts arising from the proposed works which may affect the terrestrial and freshwater habitats listed as qualifying interests of this site.	No further assessment is required with regard to the Annex I habitats listed as qualifying interests of this site.
Newport River cSAC 002144	1.3km east	Freshwater pearl mussel (*Margaritifera margaritifera*) [1029] Salmon (*Salmo salar*) [1106] Northern Atlantic wet heaths with *Erica tetralix* [4010] Blanket bog (*active only) [7130]	Taking account of distance and the character of these qualifying features there will be no interactions or pathways for impacts arising from the proposed works which may affect the habitats or species for which this site is designated.	No further assessment is required with regard to the Annex I habitats and Annex II species listed as qualifying interests of this site.
Brackloon Woods cSAC (000471)	2km south	Old sessile oak woods with *Ilex* and *Blechnum* in British Isles [91A0]	Taking account of distance and the character of the proposal, there will be no interactions or pathways for impacts arising from the works which may affect the Annex I habitat for which this site is designated.	No further assessment is required with regard to the Annex I habitats of this site.
Mweelrea / Sheeffry / Erriff Complex cSAC 001932	5.5km south	*Vertigo geyeri* [1013] *Vertigo angustior* [1014] Freshwater pearl mussel (*Margaritifera margaritifera*) [1029] Salmon (*Salmo salar*) [1106] Coastal lagoons [1150] Annual vegetation of drift lines [1210] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Otter (*Lutra lutra*) [1355] Petalwort (*Petalophyllum ralfsii*) [1395] Mediterranean salt meadows (*Juncetalia maritimi*) [1410] Slender naiad (*Najas flexilis*) [1833] Embryonic shifting dunes [2110] Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120]	Taking account of distance and the hydrological separation of this designation from the proposed works; there will be no interactions or pathways for impacts arising from the proposal which may affect the Annex I habitats or Annex II species for which this site is designated.	No further assessment required with regard to the Annex I habitats or Annex II species of this site.

Natura site	Distance	Qualifying Interests	Potential for impacts identified	Further assessment required
		Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) [2150] Dunes with *Salix repens ssp.argentea* (*Salix arenariae*) [2170] Machairs [21A0] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3110] Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoto-Nanojuncetea* [3130] Natural dystrophic lakes and ponds [3160] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] Northern Atlantic wet heaths with *Erica tetralix* [4010] European dry heaths [4030] Alpine and Boreal heaths [4060] *Juniperus communis* formations on heaths or calcareous grasslands [5130] Blanket bog (*active only) [7130] Transition mires and quaking bogs [7140] Depressions on peat substrates of the *Rhynchosporion* [7150] Petrifying springs with tufa formation (*Cratoneurion*) [7220] Alkaline fens [7230] Calcareous rocky slopes with chasmophytic vegetation [8210] Siliceous rocky slopes with chasmophytic vegetation [8220]		
Lough Gall Bog cSAC (000522)	6.5km northwest	Blanket bog (*active only) [7130] Depressions on peat substrates of the *Rhynchosporion* [7150]	Taking account of distance and the character of these qualifying features there will be no interactions or pathways for impacts arising from the proposed works which may affect the habitats for which this site is designated.	No further assessment is required with regard to the Annex I habitats of this site.
Bellacragher Saltmarsh cSAC (002005)	7km northwest	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Mediterranean salt meadows (*Juncetalia maritimi*) [1410]	Taking account of distance and the hydrological separation between the proposed works and the Annex I habitats listed as qualifying features of this designation, there will be no interactions or pathways for impacts arising which may affect the habitats for which this site is designated.	No further assessment is required with regard to the Annex I habitats of this site.
Oldhead Wood cSAC 000532	7km west	European dry heaths [4030] Old sessile oak woods with *Ilex* and *Blechnum* in British Isles [91A0]	Taking account of distance and the character of these qualifying features there will be no	No further assessment is required with regard

Natura site	Distance	Qualifying Interests	Potential for impacts identified	Further assessment required
			interactions or pathways for impacts arising from the proposed works which may affect the habitats for which this site is designated.	to the Annex I habitats of this site.
West Connacht Coast cSAC (2998)	8km west	Bottlenose dolphin *Tursiops truncates* [1349]	Taking account of distance and the character of the Annex II species listed as qualifying interests of this designation, i.e. not significantly sensitive to low-level disturbance at the shoreline, there are no pathways for impacts or interactions arising from the proposed works which may affect the species for which this site is designated.	No further assessment is required with regard to the Annex II species listed as a qualifying interest of this site.
River Moy cSAC 002298	10km north	White-clawed crayfish (*Austropotamobius pallipes*) [1092] Sea lamprey (*Petromyzon marinus*) [1095] Brook lamprey (*Lampetra planeri*) [1096] Salmon (Salmo salar) [1106] Otter (*Lutra lutra*) [1355] Active raised bogs [7110] Degraded raised bogs still capable of natural regeneration [7120] Depressions on peat substrates of the *Rhynchosporion* [7150] Old sessile oak woods with *Ilex* and *Blechnum* in British Isles [91A0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]	Taking account of distance and the hydrological separation of this designation from the proposed works; there will be no interactions or pathways for impacts arising from the proposal which may affect the Annex I habitats or Annex II species for which this site is designated.	No further assessment required with regard to the Annex I habitats or Annex II species of this site.
Owenduff/Nephin Complex SPA 004098	1.8km northwest	Merlin (*Falco columbarius*) [A098] Golden Plover (*Pluvialis apricaria*) [A140] Greenland White-fronted Goose (*Anser albifrons flavirostris*) [A395]	Taking account of distance and the character of these qualifying features, with regard to the proposal, there will be no interactions or pathways for impacts arising from the proposed works which may affect the species for which this site is designated.	No further assessment is required with regard to the Annex I bird species listed as special conservation interests of this site.
Clare Island SPA 004136	15km west	Fulmar (*Fulmarus glacialis*) [A009] Shag (*Phalacrocorax aristotelis*) [A018] Common Gull (*Larus canus*) [A182] Kittiwake (*Rissa tridactyla*) [A188] Guillemot (*Uria aalge*) [A199] Razorbill (*Alca torda*) [A200] Chough (*Pyrrhocorax pyrrhocorax*) [A346]	Taking account of distance and the character of these qualifying features, with regard to the proposal, there will be no interactions or pathways for impacts arising from the proposed works which may affect the species for which this site is designated.	No further assessment is required with regard to the Annex I bird species listed as special conservation interests of this site.

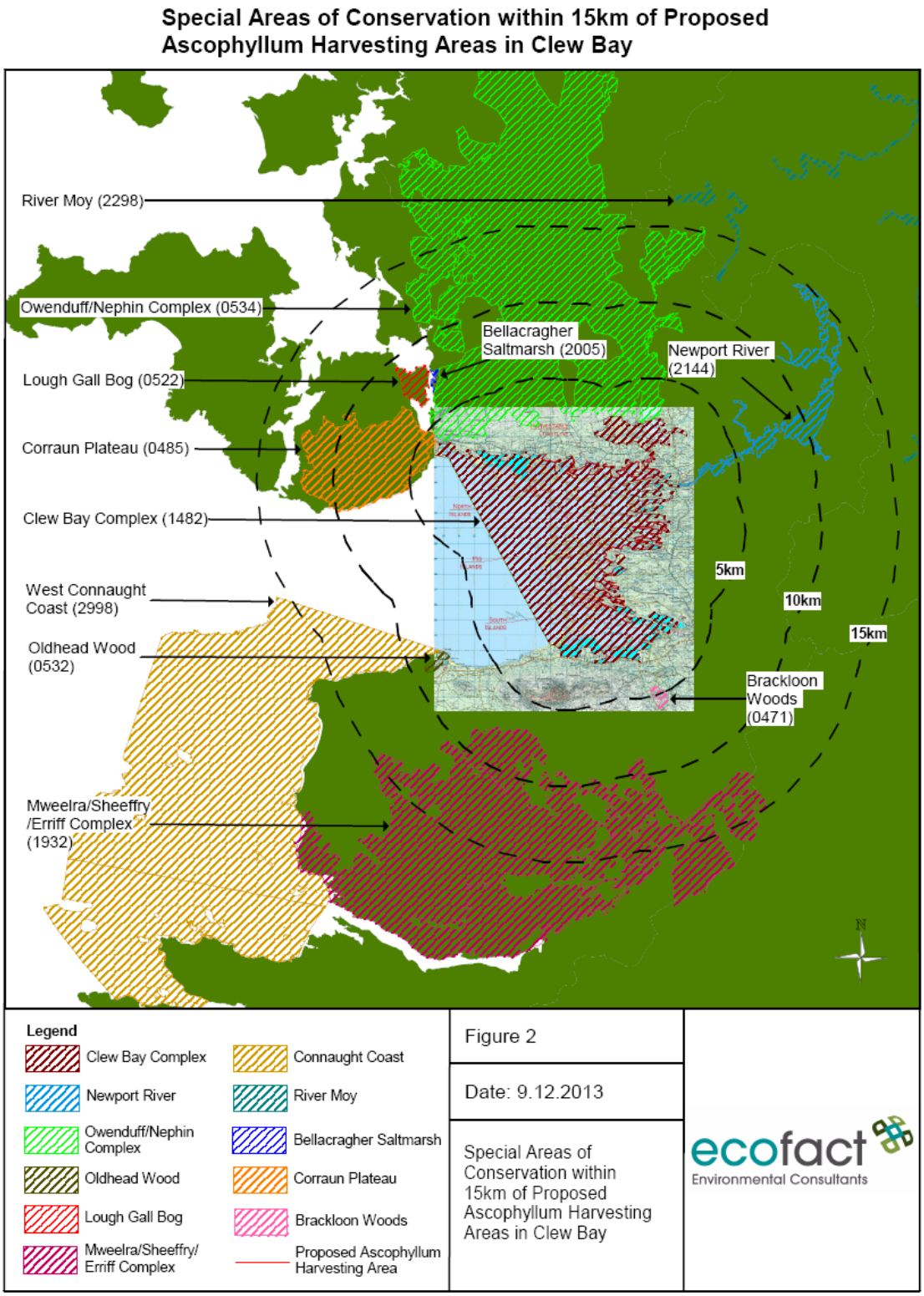


Figure 2 Map showing the locations of designated candidate SAC sites within the study area, relative to the BioAtlantis proposal for hand-harvesting of *A. nodosum* from Clew Bay.

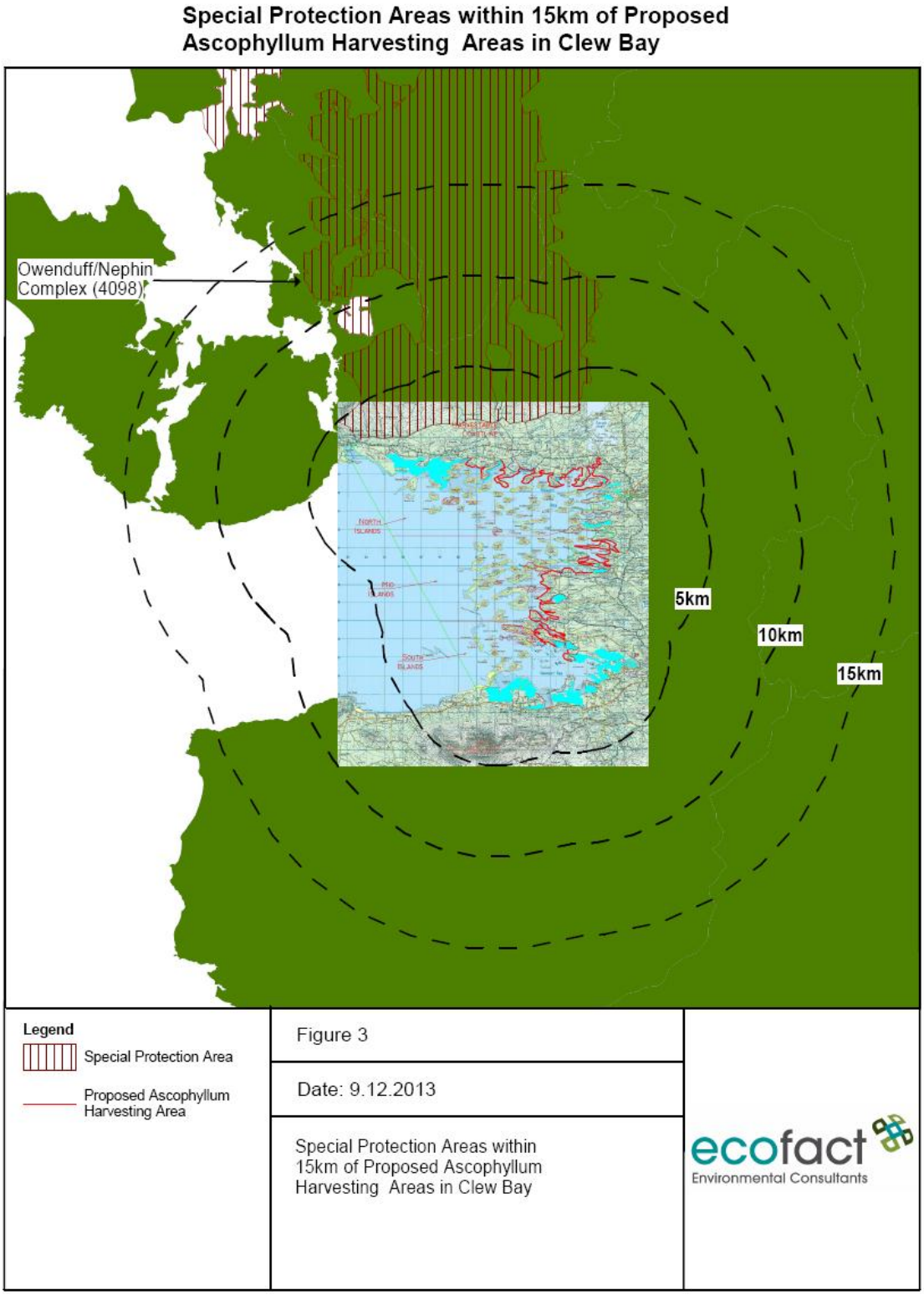


Figure 3 Map showing the locations of designated SPA sites within the study area, relative to the BioAtlantis proposal for hand-harvesting of *A. nodosum* at Clew Bay, Co. Mayo.

3.4 Screening assessment of likely effects

The current Screening assessment takes account of the potential for adverse effects on the qualifying interests and conservation objectives of the Natura 2000 sites potentially affected by the proposed project. Direct, indirect and cumulative impacts arising from the proposal for the sustainable hand-harvesting of *Ascophyllum nodosum* within the intertidal zone of Clew Bay are identified with regard to potential impacts affecting designated Natura 2000 sites as follows:

- disturbance / fragmentation of Annex I habitats;
- disturbance to Annex II species;
- impacts affecting the structure and function of the designated site;
- hydrological changes / water quality impacts.

From the initial screening of Natura 2000 sites within the study area only the Clew Bay Complex cSAC is identified with regard to the potential for significant adverse effects, with regard to the conservation objectives of this site. The site synopsis for the Clew Bay Complex cSAC is presented as Appendix 1 and the conservation objectives are provided in Appendix 2. The main potential risks affecting sensitive ecological receptors, i.e. the qualifying interests of this site are primarily due to human disturbance; trampling and removal of *A. nodosum* material potentially affecting the community structure within the Annex I habitats of the intertidal zone and further human disturbance due to increased activity potentially affecting Annex II species: Otter and Common seal.

3.4.1 Assessment of potential direct impacts affecting the Clew Bay Complex cSAC

Ecological impacts are the effects on natural resources and on the components, structures, and functioning of affected ecosystems. Effects may include those resulting from actions which may have both beneficial and detrimental effects. Direct impacts are caused by the action and occur at the same time and place.

3.4.1.1 Potential direct impacts affecting Annex I habitats

The proposal for the sustainable hand-harvesting of *A. nodosum* will require the transport of individual harvesters to the shoreline of Clew Bay and islands by small boat. Harvesters will work within the Bay and islands throughout the year. This work will require access to the shore and islands via existing routes or boats in order to harvest at low tide. There will be no interactions between the proposed works and the following habitats that would give rise to the potential for direct impacts likely to cause significant adverse effects:

- Mudflats and sandflats not covered by seawater at low tide [1140];
- Coastal lagoons [1150];
- Large shallow inlets and bays [1160];
- Annual vegetation of drift lines [1210];
- Perennial vegetation of stony banks [1220];
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330];
- Embryonic shifting dunes [2110];
- Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120].

The entirety of the proposed works are within the Annex I habitat 'Large shallow inlets and bays [1160]'. These works do not require the removal or disturbance to the sensitive littoral reef habitat or to Maerl or *Zostera* communities identified as important community biotopes within the Clew Bay [1160] Annex I habitat type. However, as the proposal requires works within this habitat area, it is considered that the potential for significant effects requires further assessment, with scope for the mitigation and avoidance of potential adverse effects.

3.4.1.2 Potential direct impacts affecting Annex II species

Both the Common seal *Phoca vitulina* and the Otter *Lutra lutra* are listed as Annex II qualifying interests of the Clew Bay Complex cSAC. Both species utilise the shoreline of the bay, in addition to the islands within the area. A number of these islands have been identified as important haul-out, breeding and moulting sites for Common seal. This gives rise to the potential for disturbance impacts affecting both species which may result in direct impacts affecting the availability of habitat and the range of these species within the cSAC. It is therefore considered that the potential for disturbance impacts, potentially affecting both Common seal and Otter require further examination.

As the proposed harvesting works are limited to the intertidal zone where *A. nodosum* will be collected, there are no pathways for impacts whereby the proposal would have the potential to give rise to significant direct impacts affecting the Annex II listed whorl snail *Vertigo geyeri*; as the habitats supporting this species above the shoreline will not be affected by the proposal.

3.4.2 Assessment of potential indirect impacts affecting the Clew Bay Complex cSAC

Indirect effects are caused by factor(s) occurring later in time or farther removed in distance, but are considered to be reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

3.4.2.1 Potential indirect impacts affecting Annex I habitats

The proposed works within the Clew Bay Complex will require works within the intertidal zone of the Annex I habitat 'Large shallow inlets and bays [1160]', the removal of *A. nodosum* biomass is considered to have the potential to give rise to an alteration in the intertidal biotope characterised as intertidal reef habitat; identified as an Annex I habitat within the Annex I [1160] habitat of the Clew Bay Complex cSAC as a whole. There are no other Annex I habitats identified that may be indirectly affected by the proposed harvesting activities.

3.4.2.2 Potential indirect impacts affecting Annex II species

Additional indirect impacts may potentially occur due to a reduction in foraging area and displacement of common seal populations within the wider works area leading to the requirement for further assessment within the context of the current NIS. Potential indirect disturbance arising from both human activity and wider noise impacts affecting both Common seal and Otter within the cSAC are identified. This may include impacts relating to foraging

and commuting in the wider context of the study area; in addition to indirect impacts affecting breeding success and energy expenditure resulting from disturbance. The significance of impacts potentially affecting Common seal and Otter populations designated within this cSAC requires further assessment.

3.4.3 Assessment of potential cumulative impacts affecting the Clew Bay Complex cSAC

Cumulative impacts or effects are changes in the environment that result from numerous human-induced, small-scale alterations. Cumulative impacts can be thought of as occurring through two main pathways: first, through persistent additions or losses of the same materials or resource, and second, through the compounding effects as a result of the coming together of two or more effects (Bowers-Marriott, 1997). As part of the Screening for an Appropriate Assessment, in addition to the proposed works, other relevant projects and plans in the region must also be considered at this stage. This step aims to identify at this early stage any possible significant in-combination or cumulative effects / impacts of the proposed project with other such plans and projects on the Natura 2000 sites.

Completed plans or projects, where they contribute to a potential cumulative effect are considered in that they have resulted in an impact upon the qualifying interests of a designated site and the continuing effect must be assessed in order to identify any pattern of continuing loss of integrity (English Nature, 2001). Potential cumulative impacts affecting species listed as conservation interests of designated Natura 2000 sites are identified with regard to the following:

- Disturbance and displacement effects of increased boat traffic;
- Disturbance and potential displacement due to noise and human disturbance at a background level during operation;
- Indirect effects through loss of, or changes to, habitat and prey species availability arising from an alteration to the intertidal biotope / community due to harvesting of *A. nodosum*.

The location of the proposal within the Clew Bay Complex cSAC gives rise to the potential for direct and indirect impacts affecting Common seal and Otter populations listed as qualifying interests of this Natura 2000 site. The potential for disturbance impacts affecting these species are also recognised with regard to existing fishing boat activity, tourism and recreational activity within the Clew Bay area and pre-existing and ongoing seaweed harvesting activities; all of which would have the potential for cumulative and in-combination impacts arising from human disturbance impacts.

3.5 Screening statement with conclusions

According to the guidance published by the DoEHLG (2009), the Screening Assessment to inform the Appropriate Assessment process can identify that a Natura Impact Statement (NIS) is not required in circumstances where a project / proposal is directly related to the management of the designated site. Alternatively the Screening Assessment has the potential to conclude that there is no potential for significant impacts affecting the Natura 2000 network; or that significant effects are certain, likely or uncertain i.e. the project must either proceed to a NIS or be rejected.

The Screening Statement prepared to inform the current NIS has identified that the proposed sustainable harvesting of *Ascophyllum nodosum* within the intertidal habitats of the Clew Bay Complex cSAC gives rise to the potential for direct, indirect and cumulative impacts which may be significant with regard to the qualifying interests of this Natura 2000 designation. Based on the information provided, the current Screening Assessment has therefore determined that a Natura Impact Statement (NIS) for the proposal is required. The Clew Bay Complex cSAC is identified as the only designated Natura 2000 site potentially affected by the proposal and which will be subject to further assessment in this NIS.

4 NATURA IMPACT ASSESSMENT (NIS)

4.1 Overview of NIS objectives

In line with the requirements of a Natura Impact Statement, this section considers whether the plan or project, alone or in combination with other projects or plans, will have adverse effects on the *integrity* of a Natura 2000 site, and includes any mitigation measures necessary to avoid, reduce or offset negative effects. The proposal has been subject to a scientific examination of the proposal and the relevant Natura 2000 sites with regard to any possible implications for the Natura 2000 sites in view of their conservation objectives, structure and function; taking account of in combination effects. From the Screening Assessment in Chapter 3 above it is concluded that the potential exists for adverse effects on the physical environment and biological communities designated within the Natura 2000 network arising from direct, indirect and cumulative impacts of the proposal, and therefore further assessment is required.

The overall aim of the Habitats Directive (1992) is to maintain or restore the favourable conservation status of habitats and species of Community interest. These habitats and species are afforded protection under the Birds and Natura Habitats Regulations (2011) with Special Areas of Conservation and Special Protection Areas designated to conserve the most vulnerable interests. The qualifying interests of the Clew Bay Complex cSAC within the study area of the BioAtlantis proposal, and the conservation objectives of this site, are assessed with regard to potential direct, indirect and cumulative impacts. It is noted that only the qualifying interests identified as being potentially affected by the proposal (from the Screening Assessment, Chapter 3) are included in this NIS.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites. The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level. Favourable conservation status of a habitat is achieved when its natural range, and area it covers within that range, are stable or increasing; when the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and when the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when the population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; when the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and when there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

4.2 Description of the Clew Bay Complex cSAC Natura 2000 site

A description of the Clew Bay Complex is set out in Section 3.1 and is further described in the NPWS SAC site synopsis included as Appendix 1. The current assessment takes account of the qualifying interests and conservation objectives of this large site, with regard to the

interaction of the proposal and the requirements to maintain and restore the qualifying interests of the site at favourable status. The Annex I habitats and Annex II species listed as qualifying interests of the Natura 2000 site and potentially affected by the proposed project are described in this section. The qualifying interests of the cSAC are:

- Mudflats and sandflats not covered by seawater at low tide [1140];
- Coastal lagoons [1150];
- Large shallow inlets and bays [1160];
- Annual vegetation of drift lines [1210];
- Perennial vegetation of stony banks [1220];
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330];
- Embryonic shifting dunes [2110];
- Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120];
- Otter (*Lutra lutra*) [1355];
- Common seal (*Phoca vitulina*) [1365];
- *Vertigo geyeri* [1013].

4.2.1 Annex I habitats: Large shallow inlets and bays

The 'Large shallow inlets and bays' Annex I habitat encompasses the Annex I habitat Mudflats and sandflats not covered by seawater at low tide (NPWS, 2011c). As well as the communities that occur within that habitat the following benthic communities also occur within large shallow inlets and bays:

- *Zostera* dominated communities;
- Maërl dominated communities;
- Sandy mud with polychaetes and bivalves community complex;
- Fine sand dominated by *Nephtys cirrosa* community;
- Shingle;
- Reef (intertidal and subtidal);
- Mudflats and sandflats not covered by seawater at low tide;
- Intertidal sandy mud with *Tubificoides benedii* and *Pygospio elgans* community complex.

Coastal Habitats within the cSAC have been mapped by NPWS (2011b) (See map 7 of Appendix 2). Table 3 gives an account of the coastal habitats for which the Clew Bay Complex cSAC has been selected as a designated site. Accretion and erosion are natural elements of saltmarsh systems. Maintaining the sediment supply is vital for the continued development and natural functioning of a saltmarsh system (NPWS, 2011b). The health and on-going development of perennial vegetation of stony banks habitat relies on a continuing supply of shingle sediment. This may occur sporadically as a response to storm events rather than continuously (NPWS, 2011b). This may occur sporadically as a response to storm events rather than continuously. With regard to functionality and sediment supply, the process outlined above for saltmarshes are also considered applicable to mudflats/sandflats as well as large shallow inlets and bays.

Table 3 Account of the coastal habitats for which the Clew Bay Complex cSAC has been selected. Description and ecological characteristics taken from NPWS (2011b) and JNCC website.

Habitat	Description and ecological characteristics
Mudflats and sandflats [1140]	Intertidal mudflats and sandflats are submerged at high tide and exposed at low tide. In areas of low energy, or sheltered shores, sediments are poorly sorted with high levels of organic matter and silt content. Extreme shelter favours the establishment of a predominantly sessile tube-dwelling community of polychaetes with often high numbers of bivalves also well represented. As in moderately exposed shores, some species characteristic of subtidal areas may also be present. In addition, beds of the seagrass *Zostera marina* may occur at the lower margins. A wide range of species, such as *Arenicola marina* lugworm, and other polychaete worms and bivalve molluscs can colonise these sediments.
Coastal lagoons [1150]	There are two lagoons within the cSAC: Lough Furnace and Claggan Lough. Lough Furnace is located at the north-eastern corner of Clew Bay. The lough is a good example of a deep, stratified, saline lake lagoon in a very natural state. Salinity levels can vary considerably here depending on rainfall and tides. The lake is one of the very few permanently stratified lakes known in Ireland and Britain.
Large shallow inlets and bays [1160]	Large shallow inlets and bays Annex I habitat encompasses the Annex I habitat Mudflats and sandflats not covered by seawater at low tide. As well as the communities that occur within that habitat the following benthic communities also occur within Large shallow inlets and bays: Zostera dominated community; maerl dominated communities; sandy mud with polychaetes and bivalves community complex, fine sand dominated by *Nephtys cirrosa* community, shingle, reef, mudflats and sandflats not covered by seawater at low tide, intertidal sandy mud with *tubificoides benedii* and *Pygospio elegans* community complex
Annual vegetation of drift lines [1210]	This habitat type occurs on deposits of shingle lying at or above mean high-water spring tides. The types of deposits involved are generally at the lower end of the size range of shingle (2-200 mm diameter), with varying amounts of sand interspersed in the shingle matrix. These shingle deposits occur as fringing beaches that are subject to periodic displacement or overtopping by high tides and storms. The distinctive vegetation, which may form only sparse cover, is therefore ephemeral and composed of annual or short-lived perennial species.
Perennial vegetation of stony banks [1220]	Perennial vegetation of stony banks is vegetation that is found at or above the mean high water spring tide mark on shingle beaches (i.e. beaches composed of cobbles and pebbles). It is dominated by perennial species (i.e. plants that continue to grow from year to year). The first species to colonise are annuals or short-lived perennials that are tolerant of periodic displacement or overtopping by high tides and storms. Level, or gently-sloping, high-level mobile beaches, with limited human disturbance, support the best examples of this vegetation. More permanent ridges are formed by storm waves. Several of these storm beaches may be piled against each other to form extensive structures.
Atlantic salt meadows	Saltmarshes are stands of vegetation that occur along sheltered coasts, mainly on mud or sand, and are flooded periodically by the sea. They are restricted to the area between mid neap tide level and high water spring tide level.
Embryonic shifting dunes [2110] & Marram dunes (white dunes) [2120]	Sand dunes are hills of wind blown sand that have become progressively more stabilised by a cover of vegetation. In general, most sites display a progression through strandline, foredunes, mobile dunes and fixed dunes. Dune systems are in a constant state of change and maintaining this natural dynamism is essential to ensure that all of the habitats present at a site achieve favourable conservation condition. Embryonic dunes are low accumulations of sand that form above the strandline. They are sometimes referred to as foredunes, pioneer dunes or embryo dunes, as they can represent the primary stage of dune formation.

Habitat	Description and ecological characteristics
	Where sand accumulation is more rapid, marram grass (*Ammophila arenaria*) invades, initiating the transition to mobile dunes (Shifting dunes along the shoreline with *Ammophila arenaria*). Marram growth is actively stimulated by sand accumulation. These unstable and mobile areas are sometimes referred to as 'yellow dunes' (or white dunes in some European countries), owing to the areas of bare sand visible between the tussocks of marram. Tidal litter contains the remains of marine algal and faunal material, as well as a quantity of seeds. Decaying detritus in the tidal litter releases.

4.2.2 Annex II species: Common (or harbour) seal and Otter

A description of the Common seal population and habitat requirements within the Clew Bay Complex cSAC is set out in the NPWS Conservation Objectives for the site (NPWS, 2011c). The Common seal occurs in estuarine, coastal and offshore waters but also utilises a range of intertidal and terrestrial habitats for important life history functions such as breeding, moulting, resting and social activity. When hauling out ashore, common seals tend to prefer comparatively sheltered locations where exposure to wind, wave action and precipitation, for example, are minimised. Common seals occupy both aquatic and terrestrial habitats in Clew Bay Complex SAC, including intertidal shorelines that become exposed during the tidal cycle. The species is present at the site throughout the year during all aspects of its annual life cycle which includes breeding (May-July approx.), moulting (August-September approx.) and non-breeding foraging and resting phases. In acknowledging the limited understanding of aquatic habitat use by the species within the site, it should be noted that all suitable aquatic habitat is considered relevant to the species' range and ecological requirements at the site and is therefore of potential use by harbour seals.

Common seals are vulnerable to disturbance during periods in which time is spent ashore, or in shallow waters, by individuals or groups of animals. This occurs immediately prior to and during the annual breeding season, which takes place predominantly during the months of May-July. The necessity for individual seals to undergo an annual moult (i.e., hair shedding and replacement), which generally results in seals spending more time ashore during a relatively discrete season, is considered an intensive, energetically-demanding process, which incurs further vulnerability for individuals during this period. Terrestrial or intertidal locations where seals can be found ashore are known as haul-out sites. The Common seal moult season takes place predominantly during the months of August-September.

The NPWS Conservation Objectives for the Clew Bay Complex cSAC do not include a detailed description of the occurrence and range of Otter within the cSAC (NPWS, 2011a; NPWS, 2011b; NPWS 2011c); however, specific conservation objectives for this species are provided and are addressed in the relevant section of the NIS.

4.3 Assessment of the qualifying interests of the Clew Bay cSAC site potentially affected by the proposal

In this section the qualifying interests, i.e. the Annex I habitats and Annex II species for which the Clew Bay Complex cSAC is designated, are described for further assessment. The qualifying interests of the cSAC, identified within the zone of influence of the Foreshore Licence Application are described with regard to their occurrence, taking account of the potential for significant effects. The potential for significant effects takes account of the proposal, as set out in the BioAtlantis Licence Application (2014). Mitigation measures for the avoidance of significant impacts included in the proposal are deferred to the mitigation section of the current NIS. However, the 'Code of Practice' for sustainable, hand-harvesting of *A. nodosum* detailed as part of the BioAtlantis Licence Application (2014) is considered to comprise the proposal; with regard to determining the potential scale and significance of any impacts.

4.3.1 Potential for direct impacts

4.3.1.1 Potential for direct impacts affecting Annex I habitats

The proposal includes the sustainable harvesting of *A. nodosum* by hand within the inner Clew Bay Complex cSAC, including the shoreline of the bay and the islands. The removal of *A. nodosum* from within the Annex I habitat 'Large shallow inlet and bays' has the potential for the small-scale removal of substrate material (sand, shingle and stone). The reef component of the intertidal / sub-littoral habitat within the 'Shallow inlets and Bays' is identified in the Conservation Objectives of this site as being part of the overall intertidal complex of Clew Bay, rather than as a stand-alone Annex I 'Reef' habitat; 'Reef' is not listed as a qualifying interest of the cSAC. The proposal requires access to the intertidal zone of Clew Bay and will result in small-scale trampling and removal of 20% of the total available *A. nodosum* biomass harvested per site per annum. The conservation objectives of the Clew Bay Complex cSAC (NPWS, 2011b, 2011c) identified that the permanent habitat area of the Clew Bay area within the cSAC, including all Annex I habitats in the Bay, must be maintained at favourable conservation conditions to ensure stability of the permanent habitat area. This includes the presence of Annex I habitats not listed as individual qualifying interests of the cSAC complex i.e. reef habitat. The conservation of 'Reef' habitat is identified as an individual objective with regard to the maintenance of 'Reef' communities (NPWS, 2011c). Following the most recent consultation with NPWS, a draft of Table 4 below was provided to NPWS (09/09/14) which contains a list of each Annex I habitat in the Clew Bay SAC and the area affected by hand harvest activities. The only habitats to be impacted by hand harvesting of *A. nodosum* are reef and shingle, at levels of 4.9% and 12.7% respectively per annum. These figures fall below the 15% limit for structure and function, thereby complying with the EU Commission.

A wide range of floral and faunal species are associated with the intertidal reef community. Previous assessments of the intertidal zone in Clew Bay calculated a total of 87 species, including 28 floral and 56 faunal. Typical floral species within the intertidal reef community include *Ascophyllum nodosum, Fucus spiralis, Fucus vesiculosis, F. serratus, Pelvetia canaliculata, Osmundea pinnatifida* and *Mastocarpus stellatus*. The typical faunal species include *Littorina* spp. (periwinkle), *Patella vulgata* (limpet) and *Semibalanus balanoides* (barnacle). The floral reef community beyond the intertidal zone in Clew Bay Complex SAC includes *Laminaria hyperborea*, *L. digitata, L. saccharina* and *Saccorhiza polyschides* which occur on hard reef substrate at depths of between 2m and14m. At depths of between 11m

and 26m reef in Clew Bay is faunal dominated with the following species present: *Alcyonium digitatum* (soft coral), *Metridium senile* (plumose anemones), sea cucumbers *Aslia lefevrei* and *Pawsonia saxicola*, sponges *Cliona celata*, *Esperiopsis fucorum, Halichondria panicea* and *Myxilla fimbriata*, and hydroids (NPWS, 2011). Overall, the reef habitat in Clew Bay is considerably rich and must be maintained as such as required given its Annex I habitat status.

Table 4 List of marine community types in the Clew Bay SAC and the area affected by hand harvest activities.

Marine community types (Clew Bay SAC)	**Total Area in Clew Bay SAC (m^2)**	**Area affected by harvest activities/annum**	
		(m^2)	**(%)**
Zostera Community	1,423,891	0	0
Shingle	1,855,000	235,549	12.7%
Reef	26,870,000	1,331,699	4.9%
Maerl Dominated community	2,878,607	0	0
Fine Sands Dominated by *Nephtys cirrosa* community	2,950,308	0	0
Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex	7,817,100	0	0
Mudflats & sandflats not covered by seawater at low tide	12,541,069	0	0

The targeted removal of *A. nodosum* from within the Annex I habitat 'Large shallow inlet and bays' has the potential to give rise to direct effects including: (a) excessive removal of vegetative material per individual plant, (b) excessive removal of *A. nodosum* density from an area and (c) complete or partial removal of *A. nodosum* holdfast material. Excessive removal of *A. nodosum* vegetative growth above the holdfast may directly impact on the rate of *A. nodosum* regrowth. Excess removal of *A. nodosum* biomass throughout a site may lead to a prolonging of the duration required for a particular site to recover post-harvest. Removal of holdfast material in it's entirety directly results in *A. nodosum* mortality. The effects of partial removal of holdfast material are unknown and may give rise to direct mortality or reduced growth. *A. nodosum* substrate in Clew Bay is characterised is a heterogeneous mixture of small rocks, small stones & pebbles. The high degree of shelter afforded to the coastal areas of Clew Bay allows for extensive *A. nodosum* growth, even on such small, pebble-sized substrate. Inappropriate methods of harvesting *A. nodosum* on such substrate may give rise to further direct effects in the form of *A. nodosum* mortality, as small, friable substrate is known to increase the risk of holdfast by-catch (ref: paragraph. 3, page 19, Vandermeulen *et al.*, 2013).

The targeted removal of *A. nodosum* has the potential to give rise to direct effects by way of non-targeted, capture, injury or removal of non-target species. This is particularly true in the case of *Fucus* sp. as these species grow alongside and often in close proximity to *A. nodosum*. Species include *F. vesiculosis* and *F. spiralis*. The likelihood of removing *Fucus* sp. is reduced as the species will not be targeted for harvest directly. As the species is considerably shorter than *A. nodosum*, the likelihood of inadvertent co-removal is also lowered. Further loss of fucoid canopy could have negative effects on understory species within the biotope, particular given that many species residing within the *A. nodosum* canopy also graze or seek shelter within *Fucus* canopies. However, the likelihood of removing *Fucus* sp. cannot be ruled out entirely as in some cases, *Fucus* can grow very close to *A. nodosum* and in rare cases can even grow directly on the *A. nodosum* itself.

It is highly unlikely that hand harvesting *A. nodosum* will lead to removal of other non-target algae species which are located at the base, low down or in proximity to the *Ascophyllum* canopy as their avoidance will be ensured by means of harvesting at low tide. Such species include: Red algae *M. stellatus* (Stackhouse) Guiry, *Chondrus crispus* Stackhouse, Corallinaceae; Ephemeral green algae (e.g. *Cladophora rupestris* (Linnaeus) Kützing, *Ulva* sp. Linnaeus and *Enteromorpha* sp. Link); other seaweed species (e.g. *Lomentaria articulata* (Hudson) Lyngbye & *Membranoptera alata* (Hudson) Stackhouse). It is highly unlikely that hand harvesting *A. nodosum* will lead to removal of *P. canaliculata*, as this small brown algae is located at the upper shore at the upper littoral zone, beyond the point where *A. nodosum* will be harvested.

Species present above the base and higher up in the *A. nodosum* canopy may be directly affected by hand harvesting *A. nodosum*. Periwinkles and limpets are important grazing species within the *A. nodosum* biotope and changes in canopy cover can lead to changes in the numbers of these species. *A. nodosum* canopy removal has been shown to cause: (a) reductions in the numbers of periwinkles (*Littorina obtusata*, Black & Miller (1991) and (b) alterations to limpet density (Davies *et al*., 2007 and references therein). In particular, the location of periwinkles within the canopy may vary according to the tide. *L. obtusata* tends to feed at high tide. At low tide, *L. obtusata* crawls into the algae canopy and remains dormant unless conditions are favourable, such as dampness, etc (Williams *et al*., 1990). This behaviour protects the organism from desiccation and temperature stress, whilst also preventing predatory attack by birds. Likewise, *L. littorea* actively feeds at high tide, seeking shelter within the canopy at low tide, in order to trap enough moisture to facilitate gaseous exchange (Karleskint *et al*. 2009). As harvest will take place at low tide when periwinkles are less active, the likelihood of their removal is reduced considerably. *Fucus* also represents an important habitat for periwinkles. As *Fucus* will not be targeted for harvest, the likelihood of removal of periwinkles is further reduced. However, as small numbers of periwinkles may be active on *A. nodosum* at low tide, their co-removal cannot be ruled out entirely. *P. lanosa* (Linnaeus) Tandy is a small red algae which grows mainly on the tips of *A. nodosum* and in some cases, *P. lanosa* rhizoids penetrate *A. nodosum* largely for purposes of receiving structural support, thereby acting as an epiphyte. However, reciprocal exchange of photosynthetically fixed carbon compounds has been demonstrated, indicating the species is not a epiphyte in the strict definition of the term and a hemiparasitic relationship is implied (Ciciotte and Thomas, 1997). In rare cases, *P. lanosa* may also be found growing on *Fucus* sp. It's location on *A. nodosum* fronds increases the likelihood of its co-removal. However, spores from these species are highly successful in colonizing *A. nodosum*, and given the sustainable nature of the harvest system, effects are unlikely to be detrimental to the species.

Hand harvesting *A. nodosum* can give rise to the potential for removal, capture or injury to other non-target species including mobile amphipods and isopods. The likelihood of their co-removal is reduced given that hand harvesting will take place at low tide, during which time their extent and movements throughout the rocky shoreline are more limited. In particular, the compositions of intertidal communities change in accordance with the tides. Fishes, decapods Crustacean, and smaller invertebrates such as amphipods migrate into the intertidal zone on rising tide, with much of this behaviour relating to feeding requirements. Small or juvenile fish may also use the canopy at high tide. As harvest will take place at low tide when many of these mobile species are not present, the likelihood of their by-catch is reduced substantially. There is also the potential to disturb or displace marine fauna due to the targeted removal of *A. nodosum*. However, the likelihood of doing so is reduced as hand harvest will occur at low tide during which time, marine fauna will be present at lower levels. However, slow moving,

sessile species and even some mobile species may not leave the rocky shoreline at low tide. Therefore, their co-removal, disturbance or displacement during harvest, while unlikely, cannot be ruled out entirely.

The targeted removal of *A. nodosum* has the potential to give rise to direct effects by way of disturbance and displacement of species or substrate. *A. nodosum* can grow on almost any solid substrate provided that the coast is very sheltered. Examples include large boulders or small stony substrate (e.g. Clew Bay drumlin islands). The coastal substrate in Clew Bay is a heterogeneous mixture of small rocks, small stones & pebbles, all classified as reef by NPWS with stated objectives for its maintenance. The high degree of shelter afforded to the coastal areas of Clew Bay allows for extensive *A. nodosum* growth, even on such small, pebble-sized substrate. Given the frequent occurrence of small substrate, hand harvesters must have full view of the cutting process and have adequate training to ensure that substrate is not disturbed. Increased removal of holdfast by-catch can also occur due to the presence of underlying friable substrate (ref: paragraph. 3, page 19, Vandermeulen *et al*., 2013), effects which may be exacerbated through use of inappropriate harvesting methods. In turn, this has potential to displace or impact on species which reside at the base of the canopy, such as periwinkles and limpets. This is particularly relevant for Clew Bay given the type of substrate in question, potential impacts which must be mitigated against. While effects of harvesting in the form of disturbance and displacement of substrate may occur, the risk of disturbing or displacing substrate during hand harvest with a sickle or knife in Clew Bay will be minimal, as harvesters will operate at low tide and have full control over activities, coupled with robust training.

As the proposed works require use of a collection vessel to pick up harvested *A. nodosum*, there is the potential for direct effects in terms of displacement or disturbance of reef and species therein, due to poor navigation. Besides *A. nodosum*, many other floral and faunal species associated with reef in the Clew Bay Complex SAC occur between 2m and 26m.

The proposal does not include any works within the upper shore, or coastal habitats identified as Annex I habitats that may be affected by the harvesting activities. All access to the shoreline will be by existing road and slipways, with islands accessed from the sea by boat. There is therefore, no potential for direct impacts affecting the conservation status of the coastal and upper shore habitats listed as qualifying interests of the Clew Bay cSAC.

Specific control and mitigation measures have been included in the current proposal, integrated into the Harvest Management Plan and the ‘Code of Practice for *A. nodosum* harvest activities in Clew Bay cSAC’, to avoid the potential for significant direct impacts affecting the conservation status of the Annex I habitat ‘Large shallow inlets and bays’, with regard to Clew Bay as a whole. These measures are specified in detail in the proposed mitigations of the NIS.

4.3.1.2 Potential for direct impacts affecting Annex II species

As the proposal requires works within the Clew Bay Complex cSAC, which supports Annex II Common seal and Otter populations listed as qualifying interests of the site, there is the potential for direct impacts to arise with regard to human disturbance. Both the Common seal and the Otter utilise the shorelines and intertidal habitats of Clew Bay and the islands. Common seals require isolate shorelines, primarily on the islands, for important life-cycle stages: breeding, moulting and resting (haul-out). The proposed harvesting activities give rise

to the potential for direct human disturbance including increased noise, habitat disturbance and disturbance to foraging. The species is present during all aspects of its annual life cycle including breeding (approx. May-July), moulting (approx. August-September) and phases of non-breeding foraging and rest (approx. October-April). Harbour seals and their pups are vulnerable to disturbances during May-July, the time period just prior to and during the annual breeding season. This is due to the large amount to time spent in shallow waters or ashore. There are many established breeding locations used in Clew Bay, most of which occur in the Northern part of this complex. There are several moult haul-outs in Clew Bay which are important sites for moulting, of which include: Inishdeashmore, Inishdeashbeg and adjacent skerries, Inishnakillew, Inisheeny, Carrickwee, Inishgowla South, Forillan, Finnaun Island, Carrickawart Island, Corillan, Carricknamore, Stony Island and adjacent skerries, the Green Islands and adjacent skerries. There are also several resting haul-out sites in Clew Bay, of which include: Inishdeashbeg and adjacent skerries, Inishtubrid, Inishcuill, Carrickawart Island, Stony Island and adjacent skerries, the Green Islands and adjacent skerries (NPWS, 2011c). These locations are presented in a map of the Clew Bay Complex, Figure 4. Specific Conservation Objectives (NPWS, 2011c) for the Clew Bay cSAC with regard to the Common seal are:

- breeding sites should be maintained in a natural condition;
- moulting sites should be maintained in a natural condition;
- haul-out sites should be maintained in a natural condition;
- human activities should occur at levels that do not adversely affect the harbour seal population at the site.

Specific control and mitigation measures have been included in the current proposal, integrated into the Harvest Management Plan and the 'Code of Practice for *A. nodosum* harvest activities in Clew Bay cSAC', to avoid the potential for significant direct impacts affecting the conservation status of Common seal with regard to the Conservation Objectives of the Clew Bay Complex cSAC. These measures are specified in detail in the proposed mitigations of the NIS.

Otter are recognised to rely more closely on the shoreline and were found to occur in good numbers within the Clew Bay area (Bailey and Rochford, 2006). According to the NPWS Conservation Objectives (2011c), otters utilize a wide number of habitats and areas within the cSAC including the freshwater and estuarine reaches of rivers. Lough Furnace and the Burrishoole catchment area are identified as being of significant importance for otter populations, including a 10m buffer zone around the linear shoreline habitats. It is recognised that Otters can typically to forage to within 80m of the shoreline; thus their extent is likely to encompass the entire cSAC, including the islands. Commuting zones between island and coastlines are also considered to be extensive; giving rise to the potential for direct impacts arising from human disturbance including noise and disturbance of resting and foraging habitats. The Conservation Objectives of the Clew Bay cSAC (NPWS, 2011c) with regard to Otters are:

- No significant decline in distribution (i.e. & positive survey sites);
- No significant decline in extent of terrestrial habitat;
- No significant decline in extent of marine habitat;
- No significant decline in extent of freshwater (river) habitat;
- No significant decline in extent of freshwater (lake/lagoon) habitat;
- No significant decline in number of Couching sites and Holts (minimize disturbance);

- No significant decline in fish biomass available;
- No significant increase in barriers to connectivity.

Specific control and mitigation measures have been included in the current proposal, integrated into the Licence Application (BioAtlantis, 2014) and the 'Code of Practice for *A. nodosum* harvest activities in Clew Bay cSAC' (see Appendix 4), to avoid the potential for significant direct impacts affecting the conservation status of Otter with regard to the Conservation Objectives of the Clew Bay Complex cSAC. These measures are specified in detail in the proposed mitigations of the NIS.

4.3.2 Potential indirect impacts

4.3.2.1 Potential for indirect impacts affecting Annex I habitats

4.3.2.1.1 Large shallow inlets and bays

Indirect impacts potentially affecting the Clew Bay Complex cSAC, with regard to the Annex I habitat 'Large shallow inlets and bays' and taking cognisance of the complex of Annex I habitats and conservation objectives associated with this overall habitat area, are identified as follows:

- Hydrodynamics, erosion and water quality;
- Alteration of the shoreline algal community and associated infauna, epifauna and fish community within these biotopes arising from the removal of *A. nodosum*.

These potential indirect impacts are discussed separately hereunder.

4.3.2.1.1.1 Hydrodynamics, erosion and water quality

It is considered, based on the low intensity of boat usage and the limited equipment (hand-harvesting), that there would be no potential for significant impacts affecting the water quality or overall habitat area of Clew Bay in this regard. Protocols are in place for the management of boats and boat access during the operational phase of the proposal and are included in the mitigation section of the NIS.

As the proposed works require physical removal of *A. nodosum* material, there is the potential for indirect effects which could lead to increased scouring or erosion due to hydrodynamic forces associated with reduced *Ascophyllum* cover. In turn, this has potential to have impacts on settlement by animals within the biotope. This is most likely to occur due to inappropriate techniques being applied or extensive harvesting occurring, such as cutting close to the holdfast (Boaden and Dring, 1980). Excessive removal of *A. nodosum* may therefore, have impacts at a local level along the intertidal zone.

The influence of *A. nodosum* on hydrodynamics beyond the intertidal zone is likely to be more limited. *A. nodosum* itself is extremely sensitive to changes in hydrodynamic forces, having adapted to growing in highly sheltered environs and with substantial difficulty in remaining attached to hard substrate in less sheltered waters, wave swept conditions or in areas where hydrodynamics are intense. In the event of increased wave exposure, the rate of *A. nodosum* mortality is also likely to be increased, particularly as the *A. nodosum* fronds grow to levels large enough to exert greater pressure to holdfast to separate from substrate. It is unlikely

that severe reductions in *A. nodosum* cover would impact on hydrodynamics to levels that would affect habitats with mud and sand components or marine community types *Sandy mud with polychaetes and bivalves community complex* and *Sandy mud with polychaetes and bivalves community complex*.

Figure 4 Map showing the important island and shoreline habitats utilised by seals during sensitive life-cycle stages. This information has been utilised to inform the mitigation strategy for the proposal.

With respect to Annex I habitats, there is also potential for impacts via changes to sediment supply. Taking the habitat, Atlantic salt meadows, where accretion and erosion are natural elements of such systems, maintaining the sediment supply is vital for the continued development and natural functioning of a saltmarsh system. Interruption to the sediment circulation through physical structures can starve the system and lead to accelerated erosion rates. The regular ebb and flow of the tide brings salinity, but also nutrients, organic matter and sediment, which are central to the development, growth and indeed survival of saltmarshes. It is considered that similar principles can also be applied to mudflat and sandflat habitats with respect to sediment supply. Excessive removal of *A. nodosum,* which is a significant primary producer within the Clew Bay complex cSAC could lead to reductions in organic matter cycling and of deposition of dead seaweed on Annex I habitats. However, it's impact on nutrient cycling rates is likely to be more limited given the low levels of nitrogen and exceptionally low levels of potassium and phosphorus present in this species.

As the proposed works require physical removal of *A. nodosum* material, there is the potential for indirect effects which could lead to increasing negative impacts on already stressed *A. nodosum* growth. For example, severely polluted waters can have negative impacts on *A. nodosum* performance, epiphyte infestation, colonisation and competition by green algae (Hurd, CL et al., 2014), This is particularly the case when *A. nodosum* growth occurs in proximity to sewage outfalls.

Specific control and mitigation measures have been included in the current proposal, integrated into the Harvest Management Plan and the 'Code of Practice for *A. nodosum* harvest activities in Clew Bay cSAC' to avoid the potential for significant indirect impacts associated with hydrodynamics, erosion, or alterations to sediment supply or *A. nodosum* performance. These measures are specified in detail in the proposed mitigations of the NIS.

4.3.2.1.1.2 Intertidal community structure and biodiversity stasis

As the proposed works require physical removal of *A. nodosum* material, there is the potential for indirect effects on community structure and biodiversity status, which could arise due to inappropriate techniques being applied or extensive harvesting occurring. Factors with potential to affect community structure include: the quantity harvested, the size of the areas harvested, the level of homogeneity of harvest and the type of equipment used (Kelly *et al*., 2001).

More invasive methods of harvesting which require cutting 10-15cm (3.9 - 7.87inches) have been shown to have damaging effects, including: increased *Fucus*, *Enteromorpha* and *Ulva; Cirratulus*, increased the polychaete *Cirratulus* sp. Lamark, coarser sediment with increased crustacean meiofauna, decreased animals on undersides of boulders including mussels, barnacles and byrozoans, decreased *Cladophora* on the sides of boulders and decreases in *Halichondria, Hymeniacodon* and *Balanus* on under surfaces, and reductions in animal cover and number of species in habitable underside of boulders (Boaden and Dring, 1980, and references therein). The impact of more invasive methods cutting close to the holdfast was also found to reduce animals such as *L. obtusata*, amhipods and nemerteans but did not affect other crustaceans such as shore crab *Carcinus maenas* Linnaeus, the polychaete *Spirorbis* spp. or fish >25mm in length (Black and Miller, 1991). Assessments of the effects of hand harvesting at an increased height of ≥20cm (7.87inches) above the holdfast, demonstrated recovery of *A. nodosum* cover within 11 months in Clew Bay and 17 months in Galway. Effects on the biotope were also minimal with no effects on sessile animals such as

sponges or bryozoans. Overall, these studies indicate that hand harvesting of *A. nodosum* close to the holdfast has significant effects on community structure, while effects appear to be lessened by cutting at slightly higher levels of 20cm (7.87inches).

A reduction in *A. nodosum* plant numbers and density could allow for species such as *Fucus* sp. to grow in vacant areas which have been left, resulting in a change in the botanical community structure. Periwinkles and limpets are important grazer species within the *A. nodosum* biotope and changes in canopy cover can lead to changes in the numbers of these species. While tending to feed at high tide, *L. obtusata* crawls into the algae canopy at low tide, remaining dormant unless conditions are favourable, such as dampness, etc (Williams *et al.,* 1990). This behaviour protects the organism from desiccation and temperature stress, whilst also preventing predatory attack by birds. Likewise, *L. littorea* actively feeds at high tide, seeking shelter within the canopy at low tide, in order to trap enough moisture to facilitate gaseous exchange (Karleskint *et al*. 2009), thus highlighting the importance of the canopy to these species.

The removal of *A. nodosum*, at sustainable levels has been found to not affect the distribution or density of growth of this species. According to Kelly *et al.* (2001) sustainable hand-harvesting of *A. nodosum* does not affect the epifaunal or fish community within the intertidal habitat and would not lead to an alteration of the species composition within this habitat. There are no indirect impacts identified which would have the potential to significantly affect the sub-tidal and upper shore / coastal habitats listed as qualifying interests of the Clew Bay Complex cSAC. However, specific control and mitigation measures have been included in the current proposal, integrated into the Harvest Management Plan and the 'Code of Practice for *A. nodosum* harvest activities in Clew Bay cSAC', to avoid the potential for significant indirect impacts affecting the intertidal community structure and biostasis as a whole. These measures are specified in detail in the proposed mitigations of the NIS.

As a primary producer and canopy forming species, *A. nodosum* is well recognised as an important structuring species, modifying the physical environment through a range of biotic interactions (Gollety *et al*., 2008 and references therein). *A. nodosum* contributes to the organic deposition throughout the littoral zone and marine environment. However, the rocky shoreline by its very nature is not closed system and organic matter will tend to transfer from the area into the wider marine environment. *A. nodosum* is low in protein content and its contribution to nitrogen, phosphorous and potassium levels in the ecosystem are minimal. However, as a primary producer located close to the back shore, there is potential for that excessive loss in *A. nodosum* cover through inappropriate harvesting techniques may impact on nearby coastal habitats. From an assessment of scientific literature, there are two coastal habitats which have potential to be impacted indirectly by hand harvest activities, Atlantic salt meadows and Sand dune habitats (see below).

4.3.2.1.2 Atlantic salt meadows (Glauco-Puccinellietalia maritimae)

Clew Bay is characterised by the presence of saltmarsh habitats at various sites throughout the complex. They tend to 'fringe' the intertidal zone of muddy or sandy coasts of estuaries and protected shores. Primary producers in salt marshes include: *Spartina, distichlis, Puccinellia, Salicornia, Carex, Juncus.* Loose fronds of *Ascophyllum* and *Fucus* can occur at the lower part of the intertidal belt (Valiela, 1995). Some species of cordgrass may be considered as invasive species. *S. anglica* species of chordgrass is relatively new having formed by hybridization of *S. alterniflora* and *S. maritima* approximately 100 years ago

(Stokes K, O'Neill K, McDonald RA (2006)). This species was planted in Clew Bay in the vicinity of Westport House between 1929 and 1932 and while it not considered as posing a problem to mudflats in Clew Bay, significant swards are observed at Annagh Island sub-site (NPWS 2011).

There is some evidence for interactions between *A. nodosum* and salt marsh environments in general. Studies have indicated an "obligate occurrence of fucoid algae, primarily *A. nodosum* with *Spartina alterniflora* on the eastern coast of America" (Callaway, R. M. 2007 and references therein). It has been hypothesized that this relationship may be due to the formation of stable algae mats by grass roots. A study by Gerard *et al*., in 1999 identified lower levels of *S. alterniflora* biomass in areas where the *Ascophyllum nodosum Scorpiodes* was removed. *A. nodosum scorpiodes* represents a free living, dwarf form of *A. nodosum*. It may arise due to deposition of *A. nodosum* fragments on sheltered areas such as salt marshes. Factors determining this morphological expression may include: physical, abiotic factors such as temperature and light-intensity during winter and spring months and/or salinity (Brinkhuis BH and Jones, 1976 and references therein). Further research by O'Conner *et al*., (2011) found no effects of macroalgal removal final cordgrass abundance. However, in order to ensure that *A. nodosum* harvest does not negatively impact on the Atlantic Salt Meadow habitat in general, a mitigation measure is in place to ensure that *A. nodosum* will not be harvested at the fringes of ASM (see Code of Practice, Appendix 4).

Overall, the likelihood of hand harvesting impacting on Atlantic Salt Meadows is low, as rocky shorelines are the primary targeted for *A. nodosum* harvest. However, as the proposed works require physical removal of *A. nodosum* material, there is a low risk potential for that inappropriate harvest activities could occur in the form of harvesting algae along the fringes of salt marshes. Specific control and mitigation measures have been included in the current proposal, integrated into the Harvest Management Plan and the 'Code of Practice for *A. nodosum* harvest activities in Clew Bay cSAC' to avoid the potential for significant indirect impacts associated with harvesting *A. nodosum* along the fringes of ASM. These measures are specified in detail in the proposed mitigations of the NIS.

4.3.2.1.3 Sand dune habitats (Annual vegetation of drift lines, Embryonic shifting dunes, Shifting dunes along the shoreline with Ammophila arenaria)

Accumulation of organic matter is important for formation coastal of habitats such as sand dunes and for species which grow throughout these habitats. Some studies indicate that roots of *Ammophila brevilgulata* do not respond well to dead and decaying organic matter and in fact, the extension of roots of seedlings may be inhibited by the presence of decaying plant matter. However further studies demonstrated that under experimental conditions, the addition of *A. nodosum* organic drift litter material was associated with increased left length compared to other types of debris. This may be associated with the stimulation of growth due to a C:N ration of 15:1 in algae (Maun, 2009). *A. nodosum* organic drift litter may therefore contribute to the formation and integrity of sand dune habitats. As the proposed works require physical removal of *A. nodosum* material, there is the potential for indirect effects on sand dune habitats, which could arise due to inappropriate techniques being applied or extensive harvesting occurring. Specific control and mitigation measures have been included in the current proposal, integrated into the Harvest Management Plan and the 'Code of Practice for *A. nodosum* harvest activities in Clew Bay cSAC' to avoid the potential for overharvesting which could have potential indirect impacts on sand dunes. These measures are specified in detail in the proposed mitigations of the NIS. This involves a management system with a high

level of oversight to ensure that only sites which contain sufficient levels of *A. nodosum* biomass are harvested, using methodologies which will not result in extensive biomass removal.

4.3.2.1.4 Other Annex II habitats

It is deemed unlikely that *A. nodosum* harvesting will have any indirect impacts on other coastal habitats such as perennial vegetation of stony banks or coastal lagoons. The main lagoon within the Clew Bay cSAC complex is Furnace Lough. Lough Furnace is out of bounds for *A. nodosum* harvesters.

4.3.2.2 Potential for indirect impacts affecting Annex II species

Indirect impacts arising from the proposed harvesting of *A. nodosum* with regard to Annex II species are limited to the potential alteration of coastal and intertidal habitats supporting both Common seal and Otter. As set out above a study by Kelly *et al*. (2001) found that hand-harvesting of *A. nodosum* at sustainable levels does not alter the species composition of the intertidal community, nor does it affect the fish species utilising the intertidal habitat. It is these fish species that are indentified as being of particular importance for foraging Otter. There are no indirect impacts identified that would have the potential to affect the subtidal habitats or benthic and pelagic fish species upon which Common seal populations within Clew Bay rely. Furthermore the proposal does not give rise to any interactions between the freshwater or anadromous salmonid populations identified as being of importance for Otter within the freshwater and estuarine component of the cSAC.

4.3.3 Potential for cumulative or in-combination effects

When assessing cumulative and in-combination impacts it is necessary to consider the effect of other plans and proposals that, together with the current project, would have a cumulative impact on the qualifying interests and conservation objectives of the Clew Bay Complex cSAC. It is possible that other activities, existing operations or planned operations, which are not part of the BioAtlantis plan to hand harvest *A. nodosum*, may contribute to increasing overall interactions with structure and function in Clew Bay SAC. Existing background pressures within Clew Bay are identified with regard to marine activities including aquaculture, fishing, tourism and leisure interests, along with a number of other stakeholders. Grazing by stock is considered heavy in the remaining area of dunes at Rossmurvagh, while the level of recreational activities is high at the Bartraw dune system. Erosion has occurred at both systems and restoration works are ongoing. It is essential to assess these factors to ensure that activities are within the 15% disturbance limit for the planned harvesting, as outlined above.

Some activities may be considered potentially significant in the context of the proposed plan by BioAtlantis Ltd. These include current activities relating to the harvest of *A. nodosum* in the Clew Bay Complex cSAC, current fisheries-related activities in proximity to shorelines used by Common seal as haul out, breeding and moulting sites, natural mortality, planned operations and non-native, invasive species. Cumulative effects are discussed hereunder.

4.3.3.1 Existing harvesting of *A. nodosum* (traditional, planned and casual)

The potential for cumulative and 'in combination' impacts on the Clew Bay Complex was assessed given that hand harvest activities have taken place in the region in recent years. The study by Hession C, *et al*., (1998) concluded that Co. Mayo had the potential to sustainable yield 16,600 tonnes per annum, the majority of which is located in Clew Bay. This corresponds to a maximum yield of 66,400 tonnes per annum. Through use of data obtained from the on-site assessments (Appendix 1 of main application document), data from Hession C, *et al*., (1998) and maps and aerial photographs of the region, BioAtlantis have calculated the current maximum yield *A. nodosum* from the Clew Bay to be of the order 65,060 tonnes. This equates to an annual sustainable harvest of 13,012 tonnes.

BioAtlantis aim to harvest approximately 12,900 wet tonnes of *A. nodosum* per annum in Clew Bay, in a manner which is sustainable and does not exceed 20% of the total yield from any one site. The figure of 20% refers to the percentage of the total available *A. nodosum* biomass harvested per site per annum. In this context, the potential impact of other small-scale activities is likely to be minimal. The field surveys to inform the current Licence Application identified harvest activities in Clew Bay at levels higher than expected; moreover, cutting methods used were observed to be severe and not in line with best practice. A recent estimation of existing unlicensed and traditional harvesting activities has been performed through consultations stake holders in Clew Bay (August 2014). It has been established that there are approximately 20 hand harvesters operating in Clew Bay. Many of the harvesters have backgrounds in farming and fishing and the majority of work is undertaken part-time with some individuals working full-time. It has been established that seaweed has been and continues to be supplied to unlicensed companies and individuals. The existing methodology involves transfer of weed to pick up points by harvesters using individual boats.

Significant levels of *A. nodosum* have been harvested in Clew Bay by a number of companies, including Arramara. Details as to the quantities harvested are unknown. There is a risk therefore, for in combination effects of the proposed hand harvesting by BioAtlantis Ltd. and existing harvest activities. Also, there are risks for in combination effects associated with local companies (e.g. hotels and health Spas), who use seaweed as part of 'seaweed baths' and other health and beauty services. Some companies and individuals also offer "Seaweed harvesting discovery days", particularly in the Mulranny area. This potential in combination effects of each of these activities must also be mitigated against. Mitigation measures listed below in section 4.4 have been included in the Code of Practice for *A. nodosum* harvest activities in Clew Bay SAC (see Appendix 4).

There are over 18 companies specializing in watersports-related activities in Clew Bay (see Appendix 7 of the BioAtlantis Application, 2014 for details). Activities take place throughout the complex. There are also several important bases present. However, potential risks have been identified which include potential impacts on Annex II species and potential for increased anthropogenic disturbances along the intertidal zone. These are Annex II species & birdlife, Annex I habitats and species and Collanmore Island.

4.3.3.1.1 Annex II species and birdlife

The plethora of marine-based activities which can impact on Annex II species are well described by NPWS scientists and others. In Clew Bay, such activities include: power boat trips, sea trampoline, sit-on-top kayaking, sea kayaking, dinghy sailing, stand up paddle

boarding, keel boat sailing. In some cases, this may even involve targeted visits by tourist companies to sites with known "seal colonies" and birdlife. There is therefore, potential for in-combination effects associated with hand harvest activities and existing human interactions with harbour seals and birdlife.

4.3.3.1.2 Annex I habitats and species

There are many bases established by tourist companies in Clew Bay, varying in size and extent. Many utilize well-established bases which do not host intertidal *A. nodosum*. However, some smaller bases in more remote locations require transference of equipment into the water across substrate which can host intertidal seaweed. These activities can give rise to small patches which contain lower density of intertidal seaweed. An example of such an effect is Dinghy sailing activities in Rosmoney which appears to be associated with small, localised reductions in seaweed cover (Source: Adventure Islands website). While the impact of such anthropogenic disturbances is relatively low, in and of itself, it raises the potential that in-combination effects associated with hand harvest activities could occur. This anthropogenic disturbance risk will be mitigated against.

4.3.3.1.3 Collanmore Island

Collanmore island is a very active destination for recreational tourists and there are many associated marine based activities. Collanmore is not considered a site for sensitive harbour seals or protected bird species and as such, the risk of affecting Annex II species is very low. However, by virtue of increased numbers of recreational tourists in general in Collanmore, there is an increased chance for anthropogenic disturbances during peak tourist season. Individuals may also rest equipment such as kayaks on shingle or rocky shorelines containing *A. nodosum* or transfer equipment from bases into the water across reef or shingle substrate. Overall, there is potential for in-combination effects associated with hand harvest activities and the increased human presence on Collanmore and this will be mitigated against.

4.3.3.2 Interactions with aquaculture and fisheries

There are several companies specializing in Aquaculture in Clew Bay. Activities are diverse and include shellfish species (oyster, mussels, clams), culture of Atlantic Salmon and a fish hatchery (Marine Institute, 2014). Many aquaculture sites have been identified as predominating in mudflat and sandflat areas along northern and southern portions of the complex. There are other sites located in north-central Clew Bay and along the eastern shoreline. In many cases, aquaculture sites are located in proximity to sites which are sensitive to Annex II species such as harbour seals and protected bird species. There are risks therefore, that such activities may interact with hand harvesting activities and such affects must be mitigated against. There are also risks that activities associated with hand harvesting could interact with existing impacts attributed to aquaculture in these areas. A recent study by the Marine Institute (2014) assessed potential impacts of licensed and planned aquaculture activities on species and habitats in Clew Bay. The study concluded that existing aquaculture activities are non-disturbing to harbour seals species or otter species, and that the overall the risk of such interactions is considered low. However, the Marine Institute cannot rule out potential effects of aquaculture on seal behaviour at Inishcorky and potentially neighbouring site: Inishdeashmore, Inishdeadbeag, unnamed neighbouring island of Inishdeadbeag and Inishnacross (pg. 78, Marine Institute, 2014). The licence application for Inishcorky island is for abalone culture. Hand harvesting of *A. nodosum* would require

mitigation to prevent in combination effects. The potential for cumulative or in-combination effects of the proposed BioAtlantis *A. nodosum* harvesting interacting with Harbour seal activities is evaluated as being low and not significant given that:

- Corrie Channel, Rosslaher, Mynah, Murrisk and Carraholly production areas do not represent documented haul-out sites for Common seals nor do they lie in close proximity to haul out sites.
- The production site at Inishlaughil does not represent a haul out site, nor does it lie in close proximity to haul out sites. The nearest haul out site to Inishlaughil is over 200 meters away, and is largely shielded from view/disturbance by the presence of Inishfeis and Inishpult.
- There are two breeding sites located in very close proximity to Inishquirk. Harvest activities will not take place at these sites during breeding season between May and July. Between October and April, harvest activities will be undertaken according to the BioAtlantis 'Code of Practise for Protection of the Harbour seal' (see Appendix 4), thus ensuring that any potential impact on seal behaviour is averted.

There are potential interactions between hand harvest activities and aquaculture, including (a) direct impact on reef due to removal of species and (b) impacts upon intertidal sediments due to travel across the shore to harvest sites (Marine Institute, 2014). The study by the Marine Institute concludes that is it unlikely that hand harvest of seaweed and intertidal shellfish culture will overlap in Clew Bay, given that reef is not considered suitable for culture of shellfish. In relation to the potential impact of seaweed harvesting, the study also concludes that it is "unlikely that the in combination effects of transport routes across intertidal flats will give rise to persistent disturbance of >15% on intertidal mudflats and sandflats". While the risks cited above are unlikely to give rise to in combination effects, BioAtlantis have developed a Code of Practice (Appendix 4) which work to ensure such risks are mitigated against.

Designated Mollusc Production areas in Clew Bay (adapted from The Status of Irish Aquaculture report, Browne *et al*., 2006) are presented in Table 5. Shellfish production activities in the Clew Bay Complex include designated Mollusc Production Areas for Oysters and Mussels at specific bed locations:

- Newport Bay (Oysters, Mussels): Area bounded to the south by 53º 52.6'N and to the West by 09º 37'W and to the east by 09º 35.15'W1;
- Tieranaur Bay (Oysters): Area within a one nautical mile (1,852 M) radius of Roskeen Pt. (53º 53.46'N, 09º 40.10' W);
- Corrie Channel and Rosslaher Beds (Mussels and Oysters): Area bounded to the west by a line from Mulranny Pier to Old Head and to the south east by 09º 35.37'W1.

Table 5 Designated Mollusc Production Areas 2013 (adapted from Sea Fisheries Protection Authority, 2013).

Production area	Species	X coordinates	Y coordinates
Carraholly	Not specified	-9.5933	53.7997
Murrisk	*M. edulis*	-9.6297	53.7917
Corrie Channel	*M. edulis*	-9.577	53.861
Rosslaher	*C. Gigas*	-9.572	53.857
Mynah	*C. gigas*	-9.584	53.848
Inishlaughil	*C. gigas*	-9.631	53.863

Inisquirk	*C. gigas*	-9.6775	53.8856

Fisheries Statistics for Clew Bay in 2003 (ref: Newport Sewerage Scheme EIS; 2007) indicate removal of the following species from Clew Bay, at varying tonnages: edible crab, European lobster, velvet crab, blue mussel, Pacific oyster, shrimp *Palaemonid nei* and common periwinkle. As periwinkles and cockles are known to be hand gathered in parts of Clew Bay, the potential risk of in combination effects with hand harvesting *A. nodosum* must be assessed. In combination effects on other invertebrates is less likely. Risks identified are provided below. Mitigation measures are also indicated and have been included in the Code of Practice for hand harvest activities (see Appendix 4).

4.3.3.2.1 Hand gathering of periwinkles

Hand gathering of periwinkle occurs within the intertidal zone of Clew Bay, on shores containing *A. nodosum* and *Fucus* sp. The precise spatial distribution and extent of periwinkle harvesting in Clew Bay has not been established, but is likely to occur throughout the SAC and at varying levels. Potential risks associated with periwinkle harvesting are reductions in periwinkle population numbers due to their removal and anthropogenic disturbances caused by trampling. There is potential for in-combination effects associated with *A. nodosum* hand harvest activities and existing periwinkle harvest activities. The standards developed as part of the Code of Practice (Appendix 4) reduce the likelihood of any in combination effects associated with existing hand gathering of periwinkles activities.

4.3.3.2.1 Hand gathering of cockles

Cockles are known to occur on intertidal muddy sand shores east of Mullranny. Hand gathering may occur at a low scale. Commercial dredge fishery for cockles does not occur (Marine Institute, 2014). Potential impacts of cockle gathering include impacts on intertidal sedimentary communities (Mudflats and sandflats not covered by seawater at low tide [1140]). There is potential for in-combination effects associated with *A. nodosum* hand harvest activities and cockle hand gathering, as seaweed hand harvesting may involve activities along the rocky shoreline beyond mudflats and sandflats.

4.3.3.2.1 Other invertebrates

Other invertebrates are removed from Clew Bay, many of which are limited to deeper water, thus removing any risk of in-combination effects associated with hand harvesting activities. However, there is a risk that hand harvesting may impact on slow moving invertebrates in general given that nets are used along the intertidal zone.

4.3.3.3 Planned activities

The potential in combination effects of planned operations in Clew Bay and hand harvesting of *A. nodosum* have been assessed and the potential for increased anthropogenic disturbance has been identified. Westport Towns and Environs Development Plan 2010-2016 targets Roman Island for considerable development in terms of marine-based activities and tourism (Mayo County Council 2010), thus raising the potential for interaction between hand harvesting (e.g. increased anthropogenic disturbances). Increased numbers of small bases may be developed at Roman Island for commercial recreation activities such (dinghy, kayaks). In some cases, transference of equipment from bases into the water may give rise to

small patches which contain low density of intertidal seaweed, thus raising the potential for in combination effects.

Funding has been granted as part of the Mayo County Council 2014 budget, for new marine tourism/leisure infrastructure at Westport Harbour (Hynes, 2014), thus raising the potential for interaction between hand harvesting and increased tourism-related activities at Westport Quay (e.g. increased anthropogenic disturbances).

4.3.3.4 Natural mortality of *Ascophyllum nodosum*

The *A. nodosum* biotope is a major component of the Clew Bay Complex cSAC. Natural causes of *A. nodosum* mortality include storms, which can detach *A. nodosum* from substrate or both together. In addition, large or dense *A. nodosum* growth may become loose over time, leading to holdfast detachment. Therefore, as natural events can cause substantial *A. nodosum mortality*, it is critical that man-made harvest techniques do not cause any significant increase in mortality beyond natural background levels. Unregulated over-harvesting and inappropriate harvest methodologies are significant hazards in this regard, as both can cause significant increases in *A. nodosum* mortality due to holdfast removal. For example, the 'rake cutter' method can give rise to >6% of harvest containing holdfast material (Ugarte, 2011). In real terms, holdfast removal could give rise to reductions in *A. nodosum* plant numbers and density. In turn, this could allow for species such as *Fucus* to grow in vacant areas which have been left. Designated SACs in the EU are assigned distinct conservation objectives and high levels of *A. nodosum* morality are unlikely to be acceptable. Unregulated over-harvesting and inappropriate harvest methodologies are significant hazards in this regard, as both can cause significant increases in *A. nodosum* mortality.

4.3.3.5 Functionality and sediment supply

With respect to Annex I habitats, there is also potential for impacts via changes to functionality and sediment supply. In relation to the habitat perennial vegetation of stony banks, interference with the natural coastal processes, through offshore extraction or coastal defence structures in particular, can interrupt the supply of sediment and lead to beach starvation. The target is to maintain, or where necessary restore, the natural circulation of sediment and organic matter, without any physical obstructions. The target is to maintain, or where necessary restore, the natural circulation of sediment and organic matter, without any physical obstructions (NPWS, 2011b).

With regard to embryonic shifting dunes and marram dunes (white dunes), human interference is usually associated with changes in the sediment budget, either directly, through the removal of beach or inshore sediment, or indirectly, by impeding or altering sediment movement. Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Sediment supply is especially important in the embryonic dunes and mobile dunes, as well as the strandline communities where accumulation of organic matter in tidal litter is essential for trapping sand and initiating dune formation. The construction of physical barriers such as sea defences can interrupt longshore drift, leading to beach starvation and increased rates of erosion (NPWS, 2011b).

While excessive removal of *A. nodosum,* a primary producer within the Clew Bay complex cSAC, could lead to a level of reduction in organic matter cycling, it's impact on nutrient

cycling rates is limited due to low levels of nitrogen potassium and phosphorus present in this species.

4.3.3.6 Non-native, invasive species

The introduction and spread of non-native, invasive species is identified as a potential threat, arising both as an indirect impact from the proposed activities, and in combination with background commercial fishing / shellfish aquaculture and recreational use of the Clew Bay Complex. It is noted that non-native invasive species are not identified as a significant pressure or threat affecting the Annex I habitat 'Large, shallow inlets and bays' or the Annex II species Common seal and Otter, in the most recent NPWS Conservation Status reporting '*The Status of EU Protected Habitats and Species in Ireland*' (NPWS, 2013a). Boats to be utilised in the proposed operation will be limited to local fishing boats and there will be no requirement for the transport of boats (and associated bilgewater) or equipment, to or from the Clew Bay Complex. The only exception will be the collection vessel which may leave the complex on occasion. However, a mitigation measure is in place to prevent spread of invasive species through use of the collection vessel. This will effectively avoid the importation of non-native, invasive species into the Bay and will limit the potential for cumulative or in-combination effects.

Negative indicators on the Annex I habitat Embryonic shifting dunes include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat (NPWS 2011b). The introduction or spread of non-native Sea-buckthorn (*Hippophae rhamnoides*) would constitute a negative impact on this habitat type.

In the case of Clew Bay, an issue that has not occurred widely within the Large shallow inlet and bay habitat is that of invasive species. In particular, *Didemnum vexillum*, which is potentially a serious habitat modifying ascidian or sea-squirt, has become a cause of concern within this site. A colonial tunicate belonging to the genus Didemnum has recently been found in many temperate coastal regions throughout the world. It continues to spread rapidly and compete aggressively with native, hard substrate species (e.g., mussels, barnacles, bryozoans, other ascidians). In addition, it can form dense mats on deep water cobble-gravel substrates and influence the abundance and species composition of benthic epifauna and infauna. Thus, its ever-increasing presence is creating potentially severe detrimental economic and ecological impacts (Stefanaik *et al,* 2009).

However, there is a potential risk for hand harvesting activities to contribute to the spread of invasive species, *D. vexillum* as the collection vessel may leave Clew Bay. Specific control and mitigation measures have been included in the current proposal, integrated into the Harvest Management Plan and the 'Code of Practice for *A. nodosum* harvest activities in Clew Bay cSAC', to avoid the potential for hand harvesting activities from acting as a vector for the spread of *D. vexillum* within the Clew Bay complex SAC. These measures are specified in detail in the proposed mitigations of the NIS.

4.3.3.7 Hydrodynamics and water quality

Water quality and tidal movements were previously examined in Westport Bay, in making provisions for disposal of waste and contaminated storm water from the Westport

environment (Kirk McClure Morton, and MarEnCo (2013). However, no such water treatment facilities have been provided for Newport and potentially, other parts of the complex. Negative effects that polluted water can have on *A. nodosum* include reduced performance, epiphyte infestation, colonisation and competition by green algae (Hurd *et al*., 2014). *A. nodosum* is adapted to growing in highly sheltered environs and as such, has difficulty remaining attached to hard substrate in less sheltered waters. As such, *A. nodosum* may have limited influences on hydrodynamics.

4.4 Mitigation measures for the proposed project

4.4.1 Mitigation measures for the protection of Annex I habitats

The 'Code of Practice' for the harvesting of *A. nodosum*, prepared by BioAtlantis (2014) and included in the Licence Application, are included in Appendix 4 of the current report. The following measures are prescribed for the avoidance of significant impacts on this habitat complex and the communities it supports:

- With regard to the Annex I habitat 'Large, shallow inlets and bays', which includes the Clew Bay Complex cSAC as a whole, BioAtlantis will not interact with other existing and planned activities, to levels which would increase interactions beyond the stated 15% limit, The only habitats to be impacted by hand harvesting of *A. nodosum* are reef and shingle, at levels of 4.9% and 12.7% respectively per annum.

- Control measures are in place to ensure adequate training of harvesters to ensure no removal of permanent habitat area (e.g. sand, shingle, stones, *A. nodosum* holdfast, etc); this will avoid the removal or permanent impact on the shoreline and intertidal reef habitat within the bay complex. All hand-harvesting will sever the *A. nodosum* at 200-300mm (8-12 inches) above the holdfast, ensuring that the holdfast and associated substrate are left intact, allowing for re-growth and also avoiding permanent impacts to the intertidal habitat. The Resource Manager will inspect the harvest on collection and in the collection vessel. If excessive sand, shingle or debris is observed, the harvester may be re-trained. Production Operators will inspect the incoming harvest and record quality measures on Production Logsheets. Harvest which contains holdfast material will be considered as representing a severe non-conformance by BioAtlantis Management and could lead to disciplinary procedures. Boat engines will be regularly maintained to avoid leaks of fuel or oil into the marine environment. Harvesters will be trained to ensure cleaning takes place in a manner which does not lead to wash off into the environment. As holdfast removal will be avoided, the potential for exposure of understory species to predators such as birds, will also be prevented. Inspections will also take place at production facilities to ensure no holdfast or other contaminants are present.

- A mitigation measure is in place to ensure that harvest is limited to ≤20% of the total available *A. nodosum* biomass per site per annum. A cautious approach is taken to cut between 200-300mm (8-12 inches) above the holdfast which ensures that potential for further impacts are minimised. These standards are recorded on a regular basis on the GRN (Appendix 3). This measure effectively avoids over-harvesting which could impact on the ecosystem in general. It also prevents potential impacts on community structure, biodiversity stasis, hydrodynamics, functionality or

sediment supply throughout the complex. Table 6 gives a revised maximum annual harvest of *A. nodosum* from the harvesting locations in Clew Bay, taking into account the requirement for maintaining conservation status of the designated site with regard to biomass reduction and disturbance.

- A mitigation measure is in place to ensure that when cutting *A. nodosum*, at least 200-300mm (8-12 inches) of material must be left behind. This limit will be inspected by the Resource Manager as it is essential in order to:

  - Avoid extensive removal of *A. nodosum* canopy coverage;
  - Avoid dormant or resting species positioned at the base of the *A. nodosum* canopy, e.g. periwinkles;
  - Prevent by-catch of benthic species;
  - Prevent by-catch of slow moving, sessile species and even some mobile species may not leave the rocky shoreline at low tide;
  - Avoid occurrence of overharvesting which could impact on the ecosystem in general, e.g. animals resident in the intertidal zone, coastal habitats, etc;
  - Avoid severe reductions in canopy coverage which could otherwise lead to changes in community structure or biodiversity stasis;
  - Prevent changes in hydrodynamics, functionality or sediment supply within and beyond the intertidal zone.

- Harvest which contains holdfast material will be considered as representing a severe non-conformance by BioAtlantis management. A mitigation measure has been put in place to ensure that the technique employed in Clew Bay does not permit greater than 1% mortality, i.e. complete removal of the entire *A. nodosum* plant and holdfast during harvest (see 'Code of Practice', Appendix 4). This process will be monitored by the Resource Manager and details recorded on the GRN. This 1% limit is essential in order to:

  - Prevent mortality of *A. nodosum*;
  - Prevent injury to *A. nodosum* holdfast;
  - Prevent severe removal of habitat for understory species;
  - Prevent exposure of understory species to predators such as birds;
  - Avoid physical disturbance of dormant or resting species at the base of the canopy;
  - Avoid occurrence of overharvesting which could impact on the ecosystem in general;
  - Avoid occurrence of overharvesting which could impact on community structure, biodiversity stasis, hydrodynamics, functionality or sediment supply.

- Harvest which contains *Fucus* sp. will be considered as representing a severe non-conformance by BioAtlantis Management. BioAtlantis Ltd. produce pure extracts of *A. nodosum* and as such, consider *Fucus* as a contaminant material. From an environmental perspective, by-catch of *Fucus* will not be tolerated by management, as doing so could unnecessarily increase loss of fucoid canopy during harvest. With appropriate training, harvesters will be required to focus all efforts on harvesting *A. nodosum* specifically with direct avoidance of *Fucus* co-harvest being a necessary requirement. This quality parameter will be assessed by the Resource Manager. A

mitigation measure has been put in place to ensure that permits no more than 1% *Fucus*. This process will be monitored by the Resource Manager and details recorded on the GRN. As many species residing within the *A. nodosum* canopy also graze or seek shelter beneath *Fucus*, this mitigation measure prevents removal of an additional canopy source which supports periwinkles and other species.

- It is critical that hand harvesting does not negatively impact on community structure on the foreshore in general. Central to achieving this aim will be to ensure that canopies are maintained at levels which provide adequate coverage of underlying substrate and prevent invasion by species such as *Fucus*. Traditional practices in Ireland involve cutting between ~150-180 or 200mm (Kelly L. *et al*., 2001 and Arramara Teoranta website respectively). To ensure that harvesting is carried out in a safe and practical manner, harvesters will receive a high level of training so as to inform them of the importance of cutting as high as possible. They will be required to cut at levels between 8-12 inches (200-300mm). BioAtlantis will take a strict approach which forbids cutting less than 200mm (8 inches), which will represent a serious non-conformance and could results in disciplinary procedures (see Appendix 4 'Code of Practice'). This standard will be monitored by the Resource Manager and recorded on the GRN form (Appendix 3). Harvest activities aimed at not reducing the height of *A. nodosum* below 200mm will avoid dramatic changes in biomass levels within the intertidal zone so significant hydrodynamic changes are unlikely to occur. Moreover, the long term effects of harvesting is minimized as sufficient photosynthetic tissue left behind which will allow for faster *A. nodosum* recovery post harvest. Moreover, limiting the harvest to 20% of the total available biomass per site per annum will ensure that sufficient biotope coverage remains.

- The BioAtlantis approach will ensure that harvest will be carried out at low tide. This ensures:

    - *A. nodosum* holdfast removal is avoided;
    - *Fucus* by-catch is reduced;
    - A lower incidence of by-catch of benthic invertebrates, as most species are relatively inactive at low tide, taking cover beneath the *A. nodosum* canopy;
    - Understory species are not contacted as cutting occurs higher up along the *A. nodosum* plant.

- A mitigation measure is in place to ensure that potential for anthropogenic impacts (e.g. intensity of trampling) on the biotope is avoided. As such, approximately 2-4 harvesters are required on small-medium sized sites. Medium to large islands may require between 4-6, while larger islands will likely require approximately 6-10 harvesters. The Resource Manager and scientific or engineering personnel may inspect sites for brief periods. Other personnel are not permitted. Low numbers of individuals working along the foreshore in this way will ensure that potential for anthropogenic impacts are minimized. Hand harvesters will not work within 50m of bases where equipment or vessels are manually introduced in the water. This ensures that no in combination effects occur, such as exacerbation of anthropogenic disturbance which could give rise to lower density of intertidal seaweed and the associated biotope.

Table 6 Harvesting locations and quantity estimates within the Clew Bay study area.

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m^2)	Typical Density (Kg / m^2)	Coverage§	Harvest levels (Tonne)†		Area in use / Per Year‡	
						Available Seaweed	Maximum Annual Harvest	Reef (m^2)	Shingle (m^2)
	Bartraw - Westport	CZ 1.1	226318	0	46%	0.0 T	0.0 T	0	0
		CZ 1.2	83288	0.7	100%	58.3 T	11.7 T	16658	0
		CZ 1.3	57560	0.7	98%	39.4 T	7.9 T	11260	252
		CZ 1.4	46890	0.7	100%	32.8 T	6.6 T	9378	0
		CZ 1.5	59466	0.7	70%	29.3 T	5.9 T	8365	3528
		CZ 1.6	32360	1.25	100%	40.4 T	8.1 T	6472	0
		CZ 1.7	47684	0.7	100%	33.4 T	6.7 T	9537	0
		CZ 1.8	77259	0	54%	0.0 T	0.0 T	0	0
		CZ 1.9	7961	0.7	100%	5.6 T	1.1 T	1592	0
		CZ 1.10	5559	1.25	100%	6.9 T	1.4 T	1112	0
		CZ 1.11	11271	1.25	100%	14.1 T	2.8 T	2254	0
		CZ 1.12	4254	1.25	100%	5.3 T	1.1 T	851	0
		CZ 1.13	136927	10.5	94%	1354.0 T	270.8 T	25790	1596
		CZ 1.14	76090	10.5	94%	751.9 T	150.4 T	14322	896
		CZ 1.15	37232	0.5	100%	18.6 T	3.7 T	7446	0
		CZ 1.16	35400	0.5	100%	17.7 T	3.5 T	7080	0
		CZ 1.17	35419	0.5	100%	17.7 T	3.5 T	7084	0
		CZ 1.18	6633	0.5	100%	3.3 T	0.7 T	1327	0
	Westport - Rosmoney	CZ 2.1	38658	0	82%	0.0 T	0.0 T	0	0
		CZ 2.2	5199	0	100%	0.0 T	0.0 T	0	0
		CZ 2.3	8889	0	100%	0.0 T	0.0 T	0	0
		CZ 2.4	35324	0	94%	0.0 T	0.0 T	0	0
		CZ 2.5	74945	0.55	98%	40.4 T	8.1 T	14693	296
		CZ 2.6	30076	0.8	100%	24.1 T	4.8 T	6015	0
		CZ 2.7	7831	0	57%	0.0 T	0.0 T	0	0
		CZ 2.8	6710	0	100%	0.0 T	0.0 T	0	0
		CZ 2.9	125537	0.8	100%	100.4 T	20.1 T	25107	0
		CZ 2.10	109815	0.8	97%	85.0 T	17.0 T	21259	704
		CZ 2.11	9303	0	100%	0.0 T	0.0 T	0	0
		CZ 2.12	27612	0	91%	0.0 T	0.0 T	0	0
		CZ 2.13	328	0	100%	0.0 T	0.0 T	0	0
		CZ 2.14	22527	0	100%	0.0 T	0.0 T	0	0
		CZ 2.15	3842	0	94%	0.0 T	0.0 T	0	0
		CZ 2.16	6082	0	100%	0.0 T	0.0 T	0	0
		CZ 2.17	3636	0	0%	0.0 T	0.0 T	0	0
	Rosmoney - Moyna Strand	CZ 3.1	18865	0	50%	0.0 T	0.0 T	0	0
		CZ 3.2	40641	4.35	100%	176.8 T	35.4 T	8128	0
		CZ 3.3	97095	4.35	100%	422.4 T	84.5 T	19419	0

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m^2)	Typical Density (Kg / m^2)	Coverage§	Harvest levels (Tonne)†		Area in use / Per Year‡	
						Available Seaweed	Maximum Annual Harvest	Reef (m^2)	Shingle (m^2)
		CZ 3.4	12914	4.35	100%	56.2 T	11.2 T	2583	0
		CZ 3.5	9650	4.35	100%	42.0 T	8.4 T	1930	0
		CZ 3.6	78317	4.35	95%	323.9 T	64.8 T	14891	772
		CZ 3.7	117114	4.35	100%	509.4 T	101.9 T	23423	0
		CZ 3.8	8398	4.35	100%	36.5 T	7.3 T	1680	0
	Rostoohy Pt - Newport	CZ 4.1	84464	4.35	92%	339.0 T	67.8 T	15587	1305
		CZ 4.2	27181	4.35	100%	118.2 T	23.6 T	5436	0
		CZ 4.3	150517	4.35	100%	654.8 T	131.0 T	30103	0
		CZ 4.4	38351	4.35	99%	164.9 T	33.0 T	7580	90
		CZ 4.5	26354	0	96%	0.0 T	0.0 T	0	0
		CZ 4.6	6397	0	83%	0.0 T	0.0 T	0	0
		CZ 4.7	5572	0	100%	0.0 T	0.0 T	0	0
		CZ 4.8	6703	0	100%	0.0 T	0.0 T	0	0
		CZ 4.9	9671	0	100%	0.0 T	0.0 T	0	0
		CZ 4.10	24594	0	64%	0.0 T	0.0 T	0	0
		CZ 4.11	117165	0.85	81%	80.2 T	16.0 T	18866	4567
		CZ 4.12	77555	0.85	100%	65.9 T	13.2 T	15511	0
		CZ 4.13	278265	0.85	79%	187.7 T	37.5 T	44163	11490
		CZ 4.14	110969	0.85	100%	94.3 T	18.9 T	22194	0
	Newport - Mallaranny Pier	CZ 5.1	61157	0	100%	0.0 T	0.0 T	0	0
		CZ 5.2	58948	3.5	79%	163.3 T	32.7 T	9334	2455
		CZ 5.3	105121	3.5	84%	310.9 T	62.2 T	17763	3261
		CZ 5.4	258002	3.5	92%	833.8 T	166.8 T	47644	3956
		CZ 5.5	82278	3.5	83%	240.2 T	48.0 T	13728	2728
		CZ 5.6	41272	3.5	100%	144.5 T	28.9 T	8254	0
		CZ 5.7	145329	3.5	89%	454.2 T	90.8 T	25955	3110
		CZ 5.8	84126	3.5	100%	294.4 T	58.9 T	16825	0
		CZ 5.9	8260	3.5	100%	28.9 T	5.8 T	1652	0
		CZ 5.10	17114	3.5	100%	59.9 T	12.0 T	3423	0
		CZ 5.11	4451	3.5	100%	15.6 T	3.1 T	890	0
		CZ 5.12	1689	3.5	100%	5.9 T	1.2 T	338	0
		CZ 5.13	29666	3.5	100%	103.8 T	20.8 T	5933	0
		CZ 5.14	3900	1.75	100%	6.8 T	1.4 T	780	0
		CZ 5.15	30450	1.75	100%	53.3 T	10.7 T	6090	0
		CZ 5.16	11735	1.75	100%	20.5 T	4.1 T	2347	0
		CZ 5.17	47890	1.75	79%	65.8 T	13.2 T	7524	2054
1	Forillan, Illanavrick	IS 11.1	40653	6	100%	243.9 T	48.8 T	8131	0
1		IS 11.2	13763	10	100%	137.6 T	27.5 T	2753	0
2	Kid Isd East		3966	14	100%	55.5 T	11.1 T	793	0
3	Roslynagh		7990	0	0%	0.0 T	0.0 T	0	0

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m^2)	Typical Density (Kg / m^2)	Coverage§	Harvest levels (Tonne)†		Area in use / Per Year‡	
						Available Seaweed	Maximum Annual Harvest	Reef (m^2)	Shingle (m^2)
4	Illannambraher		57901	19	96%	1053.2 T	210.6 T	11086	494
5	Inishdasky		14818	18	100%	266.7 T	53.3 T	2964	0
6	Inishquirk		25206	15	82%	308.9 T	61.8 T	4119	922
7	Inishtubrid		45540	18	100%	819.7 T	163.9 T	9108	0
8	Inishlim		13308	16	100%	212.9 T	42.6 T	2662	0
9			41752	18	100%	75.1 T	15.0 T	8350	0
9	Beetle Isd North								
9	Inishbobunnan								
10			566589	16	27%	246.1 T	49.2 T	30775	82543
10	Inishgowla								
10	Beetle Isd South								
11	InishKeel	IS 11.1	16036	12.5	100%	200.5 T	40.1 T	3207	0
11		IS 11.2	2083	16.75	100%	34.9 T	7.0 T	417	0
11		IS 11.3	300	17.5	100%	5.3 T	1.1 T	60	0
11		IS 11.4	5876	17.5	100%	102.8 T	20.6 T	1175	0
12	Black Rock		24348	2.5	100%	60.9 T	12.2 T	4870	0
13	Moynish More		0	0	0%	0.0 T	0.0 T	0	0
14	Moynish Beg		0	0	0%	0.0 T	0.0 T	0	0
15	Inisherkin		53097	18	41%	387.7 T	77.5 T	4308	6312
16	Inishnacross		46888	18.5	61%	525.0 T	105.0 T	5675	3702
17	Inishilra		36300	18	78%	507.0 T	101.4 T	5633	1627
18	Inishcooa		70929	12	57%	486.2 T	97.2 T	8104	6082
19	Roeillaun		77113	5	100%	385.6 T	77.1 T	15423	0
20	Inishdeashbeag		62555	0	100%	0.0 T	0.0 T	0	0
20									
20	Inishdeashmore								
21	Inishcorky		17912	18.75	100%	335.8 T	67.2 T	3582	0
22	Inishcarrick		34846	19	60%	397.3 T	79.5 T	4182	2787
23	Inishcoragh		24041	15	100%	360.6 T	72.1 T	4808	0
24	Muckinish		33800	19.25	100%	650.6 T	130.1 T	6760	0
25	Inishdaweel		22175	20	77%	342.8 T	68.6 T	3428	1007
26	Rabbit Isd		52391	8	58%	242.1 T	48.4 T	6053	4425
26									
27	Illanascrraw		10411	18	100%	187.4 T	37.5 T	2082	0
28	Freaghillanluggagh		23358	20	100%	467.2 T	93.4 T	4672	0
29	Inishkee		16398	19	100%	311.6 T	62.3 T	3280	0
30			15889	18	100%	286.0 T	57.2 T	3178	0
31	Freaghillan West		20456	19	50%	194.8 T	39.0 T	2050	2041
32	Innishcannon		8656	16	100%	138.5 T	27.7 T	1731	0
33	Carricklahan		0	0	0%	0.0 T	0.0 T	0	0
34	Carrickachorra		0	0	0%	0.0 T	0.0 T	0	0

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m^2)	Typical Density (Kg / m^2)	Coverage§	Harvest levels (Tonne)†		Area in use / Per Year‡	
						Available Seaweed	Maximum Annual Harvest	Reef (m^2)	Shingle (m^2)
35	Illanmaw		74045	0	66%	0.0 T	0.0 T	0	0
36	Freaghillan East		6422	18	100%	115.6 T	23.1 T	1284	0
37			1476	16	100%	23.6 T	4.7 T	295	0
38	Inishcuill West		82042	20.75	79%	1348.2 T	269.6 T	12995	3413
39	Mauherillan		14262	16.75	91%	217.5 T	43.5 T	2598	255
40	Inishfesh		54236	18	70%	685.8 T	137.2 T	7620	3228
41	Inishmolt		23618	18	100%	425.1 T	85.0 T	4724	0
42	Inishloy		36182	18.5	100%	669.4 T	133.9 T	7236	0
43	Inishdaff		70875	20.5	100%	1452.9 T	290.6 T	14175	0
44	Inishbollog		13201	20.75	100%	273.9 T	54.8 T	2640	0
45	Inishlaughil		55888	0	100%	0.0 T	0.0 T	0	0
46	Inishgowla		67983	16	22%	243.7 T	48.7 T	3046	10550
47	Inishoo		23072	0	13%	0.0 T	0.0 T	0	0
48	InishTurk	IS 48.1	56134	21	100%	1178.8 T	235.8 T	11227	0
48		IS 48.2	10755	21	100%	225.9 T	45.2 T	2151	0
49	Illannaconney		17437	15	77%	201.6 T	40.3 T	2688	800
50	Inishakillew	IS 50.1	69800	21.75	100%	1518.1 T	303.6 T	13960	0
50		IS 50.2	18583	21.75	100%	404.2 T	80.8 T	3717	0
51	Trawbaun		256815	19.5	89%	4468.7 T	893.7 T	45833	5530
51	Carrigeenglass North								
51	Moneybeg								
51	Inishcottle								
52	Calf Island		30778	19.75	81%	490.3 T	98.1 T	4965	1190
53	Inishbee, Derrinish & Dernish West		200836	17.5	58%	2021.6 T	404.3 T	23104	17063
54	Freaghillan	IS 54.1	27454	19.75	66%	357.1 T	71.4 T	3616	1875
54		IS 54.2	55101	20	90%	989.7 T	197.9 T	9897	1123
54		IS 54.3	5995	21	100%	125.9 T	25.2 T	1199	0
55	Clynish		102154	18.5	77%	1463.2 T	292.6 T	15818	4612
56	llaunnamona		25370	16	95%	384.3 T	76.9 T	4804	270
57	Rabbit Island, Island More &Quinnsheen Island	IS 57.1	14757	19.5	100%	287.8 T	57.6 T	2951	0
57		IS 57.2	92903	16	88%	1307.4 T	261.5 T	16342	2239
57		IS 57.3	7894	17.5	100%	138.1 T	27.6 T	1579	0
57		IS 57.4	9330	18	100%	167.9 T	33.6 T	1866	0
58	Collan More, Carrigeenglass South & Collan Beg	IS 58.1	501217	16.75	100%	8395.4 T	1679.1 T	100243	0
58		IS 58.2	55220	18.75	100%	1035.4 T	207.1 T	11044	0

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m^2)	Typical Density (Kg / m^2)	Coverage§	Harvest levels (Tonne)†		Area in use / Per Year‡	
						Available Seaweed	Maximum Annual Harvest	Reef (m^2)	Shingle (m^2)
58		IS 58.3	29858	19.5	100%	582.2 T	116.4 T	5972	0
59	Inishgort		64954	15.5	57%	571.7 T	114.3 T	7376	5614
60	Inishlyre		121285	5	57%	347.3 T	69.5 T	13891	10366
61	Illanataggart & Crovinish		442259	14	99%	6133.0 T	1226.6 T	87614	838
62	Ininhgowla South + Carrickwee		183389	15	100%	2750.8 T	550.2 T	36678	0
63	Forilan		30569	9.75	100%	298.0 T	59.6 T	6114	0
64	Carrickawart	IS 64.1	26696	16	100%	427.1 T	85.4 T	5339	0
64		IS 64.2	1276	14.25	100%	18.2 T	3.6 T	255	0
65	Inishlaghan		32314	14.5	83%	388.4 T	77.7 T	5358	1105
66	Dorinish More & Dornish Beag		27107	12.5	100%	338.8 T	67.8 T	2980	2441
67	Inishimmel		0	0	0%	0.0 T	0.0 T	0	0
68	Inishleauge		54366	8	77%	334.3 T	66.9 T	8358	2515
69	Inishdaugh		22949	6.5	72%	108.0 T	21.6 T	3322	1268
70	Inishraher		81224	14.7	85%	1014.1 T	202.8 T	13798	2447
71	Inisheeney		53625	16	85%	725.4 T	145.1 T	9068	1657
72	Finnaun Island		0	0	0%	0.0 T	0.0 T	0	0
73	Corillan	IS 73.1	6787	6.5	100%	44.1 T	8.8 T	1357	0
73		IS 73.2	1016	6.5	100%	6.6 T	1.3 T	203	0
73		IS 73.3	1737	6.5	100%	11.3 T	2.3 T	347	0
73		IS 73.4	3001	6.5	100%	19.5 T	3.9 T	600	0
74	Carricknamore	IS 74.1	2436	6.75	100%	16.4 T	3.3 T	487	0
74		IS 74.2	1393	6.75	100%	9.4 T	1.9 T	279	0
74		IS 74.3	2640	6.75	100%	17.8 T	3.6 T	528	0
75		IS 75.1	6494	6.75	100%	43.8 T	0.0 T	1299	0
75		IS 75.2	1107	6.75	100%	7.5 T	0.0 T	221	0
75		IS 75.3	5463	6.75	100%	36.9 T	0.0 T	1093	0
75	Stony Island	IS 75.4	7984	0	100%	0.0 T	0.0 T	0	0
75		IS 75.5	5822	5	100%	29.1 T	0.0 T	1164	0
75		IS 75.6	10649	6.5	100%	69.2 T	0.0 T	2130	0
75		IS 75.7	1649	6.5	100%	10.7 T	0.0 T	330	0
75		IS 75.8	9495	6.5	100%	61.7 T	0.0 T	1899	0
76	Green Islands	IS 76.1	11054	0	100%	0.0 T	0.0 T	0	0
76		IS 76.2	3460	0	100%	0.0 T	0.0 T	0	0
76		IS 76.3	6690	0	100%	0.0 T	0.0 T	0	0
77	Carricknacally		2860	6.5	100%	18.6 T	3.7 T	572	0
78	Monkellys Rock		4425	8.75	100%	38.7 T	7.7 T	885	0
79	Inishweela		24604	10	97%	238.7 T	47.7 T	4775	146
80	Illanroe		28522	14	100%	399.3 T	79.9 T	5704	0

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m^2)	Typical Density (Kg / m^2)	Coverage§	Harvest levels (Tonne)†		Area in use / Per Year‡	
						Available Seaweed	Maximum Annual Harvest	Reef (m^2)	Shingle (m^2)
81	Roeillan		16126	15	100%	241.9 T	48.4 T	3225	0
	Totals						**12900 T**		

***** Harvesting Zone ID's were assigned by BioAtlantis as part of establishing the management system.

† Maximum Annual Harvest (Tonnes) is calculated as 20% of the total available biomass per site. The figure of 20% refers to the percentage of the total available *A. nodosum* biomass harvested per site, per annum.

‡ Area in use per year was calculated using shapefile data obtained courtesy of NPWS.

§ Denotes the percentage of coastline which can support *A. nodosum* growth.

- A mitigation measure is in place to monitor and ensure that substrate is not disturbed to the extent whereby it could enter into the harvested weed. The risk of disturbing or displacing substrate during hand harvest with a sickle or knife in Clew Bay will be minimal as harvesters will have full view of the cutting process and will be trained by BioAtlantis to take care not to disturb the substrate. This quality measure will be recorded on the GRN by the Resource Manager. This ensures that disturbance and displacement of species or substrate does not occur. The traditional sickle/knife hand harvest method at low tide allows for necessary sufficient oversight over cutting. BioAtlantis consider levels of *Fucus* exceeding 1% as being unacceptable (see 'Code of Practice', Appendix 4). A mitigation measure is also in place to monitor and ensure that substrate is not disturbed to the extent whereby it could enter into the harvested weed or give rise to holdfast in the harvested seaweed (see Appendix 4, 'Code of Practice'). This quality measure will be recorded on the GRN by the Resource Manager (Appendix 3), along with spot checks at production facilities to ensure such contaminants are absent (recorded on production logsheets).

- A mitigation measure is in place to ensure that by-catch is limited and when it occurs, is immediately returned to the biotope i.e. any periwinkles, amphipods, isopods or other *Animalia* by-catch observed on the boat, will be collected and returned to the water (See Appendix 4, 'Code of Practice'). This measure requires that seaweed be harvested in nets with mesh space large enough to allow for Amphipods, isopods or other by-catch to escape. Typically, 2 hours will be available for animals to migrate out of the nets before transfer to the collection vessel. Measures relating to by-catch will be monitored by the Resource Manager.

- A mitigation measure is in place which requires harvesters to actively avoid *A. nodosum* plants which contain substantial periwinkle egg masses. This is important to prevent harvest of viable eggs. The technique employed by BioAtlantis will ensure that harvest takes place at low tide when periwinkles are more likely to be dormant or covered. Harvest will not take place during the feeding stage at high tide when periwinkles are out of their shells. In addition, most periwinkles will reside low down within the canopy at low tide, thus reducing the chances inadvertent by-catch. It is important to note that periwinkles do not exclusively feed on *A. nodosum* and also graze and reside in canopies of *Fucus* species, including *Fucus vesiculosus* and *F. serratus*. BioAtlantis will not harvest *Fucus* species, thus ensuring that this portion of the perwinkle and limpet environment is unaffected. In terms of reproduction, *L.*

obtusata lays white, oval eggs masses containing a large number of eggs, on *Ascophyllum*, *F. vesiculosus* and *F. serratus*. The eggs masses are visible to the naked eye. Eggs may sometimes be laid on the surface of rocks. As part of their training requirements, harvesters will be learn how to identify and avoid *A. nodosum* plants or fronds which contain eggs masses (see Appendix 4, 'Code of Practise'). In the case of *L. littorina*, eggs are released with the tide. Following development from a free-living form, *L. Littorina* settles at the base of the *A. nodosum* canopy. As part of their training, harvesters will learn to avoid disturbance by (a) cutting at low tide, (b) aiming to leave between 200-300mm (8-12 inches) of material behind and (c) under no circumstances cutting less than 200mm above the holdfast. By avoiding *Fucus vesiculosus* and *F. serratus*, harvesters can avoid *L. obtusata* eggs masses growing on these seaweed species. *L. littorina* present at the base of these canopies will likely be unaffected as biomass levels are maintained.

- In order to ensure that *A. nodosum* harvest does not negatively impact on the Atlantic Salt Meadow habitat in general, a mitigation measure is in place which does not allow harvesters to remove *A. nosodum* at the fringes of ASM (see Code of Practice, Appendix 4).

- BioAtlantis will not harvest beyond Rossmurvagh, thus avoiding much of the Mulranny area. Harvest will occur on Collanmore only between Sept-April, thus avoiding peak tourist season. Hand harvesters will not work at Roman Island or Westport harbour between May and August. This will prevent in combination effects such as exacerbation of anthropogenic disturbance which may occur during peak tourist/excursion season.

- Hand harvest activities will not take place at established harbour seal and bird sites at sensitive times of the year, thus preventing any in combination effects from occurring.

- BioAtlantis will not harvest within 50m of sewage outfalls or other source of pollution. This will ensure that stressed *A. nodosum* growth is not exacerbated further by harvest activities. BioAtlantis will be recommending to Mayo County Council that they contribute to protecting the Clew Bay SAC by installing an effluent treatment system in Newport and requiring other large contributors to pollution in the area to also ensure compliance on this matter. To protect the SAC in Clew Bay, the NPWS, DOE and DGHLG should not allow this to continue.

- A mitigation measure is in place to ensure that large-scale unlicensed harvesting will be reported to The Department. This is to ensure compliance with the conservation objectives for the site, and to ensure adequate record keeping, monitoring of the resource and access to sensitive sites and particular times of the year. In terms of casual harvesting, BioAtlantis will permit low scale removal of <0.5 tonnes for personal usage. Any commercial usage must be managed by BioAtlantis to ensure the SAC objectives are met. Any commercial user having low requirements of >0.5 tonnes per annum (e.g. hotels, health Spas), will be approached by BioAtlantis to discuss their requirements and assess the potential for in combination effects. Appropriate action will be taken on a case-by-case basis.

- Mitigation measures are in place to avoid the potential for hand harvesting activities from acting as a vector for the spread of *D. vexillum* within the Clew Bay complex SAC. This will require the following:

  - All harvester boats and the main collection vessel will be painted once a year with appropriate anti-fouling paint;
  - The harvesters boats will not leave Clew Bay. In the rare case that they do leave Clew Bay, harvesters are required to implement a cleaning measure on land which will involve cleaning with sodium hypochlorite;
  - Nets are cleaned with sodium hypochlorite on delivery to production facilities and returned to harvesters in a clean condition.

- The potential for impacts affecting sublittoral and benthic habitats (including *Zostera* and maerl) and sandy mud intertidal areas are avoided, as these habitats do not overlap with the intertidal zone where the proposed harvesting will take place. In areas where mud / sand flats occur, boats shall only be operated at high tide to reach rocky shores supporting the *A. nodosum* community beyond these areas. The Code of Practice ensures that harvesters do not disrupt these areas. In addition, the Code of Practice ensures the potential for displacement or disturbance of reef and species therein, due to poor navigation is avoided through use of a depth sounder device on the collection vessel.

- To continually validate and improve the methodology, scientists and engineers at BioAtlantis will assess the potential impact of the hand harvesting system on understory species on an ongoing basis and on a long term basis throughout the life-time of the licence. This will ensure that scientific knowledge is increased beyond the time-frame undertaken by Kelly et al. (2001). This will be essential to ensure that conservation objectives are met continually into the future. Moreover, the harvesting system may be improved into the future as new datasets emerge from NPWS and others.

- Clew Bay has in excess of 90 islands and 100km of coastline that contain harvestable quantities of *A. nodosum*. For the effective management of this area BioAtlantis will create a database of the islands and coastal areas. This database will be used to:

  - Determine sites which require a fallowing period to allow for adequate recovery from recent activities;
  - Determine rotation requirements (i.e. extrapolation and calculation of the duration or fallowing period required prior to a particular areas being fit for re-harvest);
  - Prevent harvest activities that would lead to a decline in yield;
  - Record the details of each harvest, how much, by whom & when.

With reference to the conservation objectives of the Clew Bay complex cSAC, disturbance of each community type via licensed activities should not exceed an approximate area of 15%. Community types within the designated areas are provided in Map 4 of the site conservation objectives (NPWS, 2011b), see Appendix 4). This is in line with the Department of Environment, Heritage and Local Government Department view that licensing of activities likely to cause continuous disturbance of each community type should not exceed an approximate area of 15%.As shown in Table 4, BioAtlantis will work within the 15% limit.

BioAtlantis are applying for an exclusive licence and have constructed the licence application on this basis. As sole licence holder, BioAtlantis will be responsible for all aspects of commercial harvesting. Large-scale unlicensed harvesting will not be tolerated and BioAtlantis will document and record and any incident of such activities. Depending on the severity, this issue may be reported to the Department of the Environment. This is to ensure compliance with the conservation objectives for the site, and to ensure adequate record keeping, monitoring of the resource and access to sensitive sites and particular times of the year. In terms of traditional or casual harvesting, BioAtlantis will permit low scale removal of <0.5 tonnes, for personal usage. Any commercial usage must be managed by BioAtlantis. Any commercial user having small requirements of >0.5 tonnes per annum (e.g. hotels, health Spas), will be approached by BioAtlantis to discuss their requirements and assess whether there are potential in combination effects. Appropriate action will be taken on a case-by-case basis. In terms of traditional harvesting activities, BioAtlantis aim to utilize the existing system and employ those with experience in the traditional hand cutting methodology. In addition, the hand cutting approach avoids holdfast removal and the harvesters have sufficient oversight on the cutting process and co-harvest of holdfast is strictly forbidden. In effect, this avoids potential for *A. nodosum* mortality. For these reason, BioAtlantis have chosen the hand harvest method over other methods such as rake cutters. BioAtlantis aim to get the best from the traditional approach but provide improvements which ensure better working conditions and compliance with the SAC objectives. On approval to hand harvest in Clew Bay, BioAtlantis will work to identify all sites which have been harvested recently. These areas will then be designated as requiring an appropriate fallowing period, depending on the level and severity of harvest. This approach will ensure that BioAtlantis hand harvest activities will not occur in recently harvested sites, thus preventing any cumulative effects.

In order to ensure that harvest activities are sustainable and not damaging to protected species and habitats, as specified by the NPWS, it is the aim of BioAtlantis to be granted an exclusive license to manage and undertake hand harvest activities in the region. In such an event, BioAtlantis will commit to ensuring that all activities are monitored, controlled and recorded with full traceability. This will include a non-conformance reporting system and strict corrective actions. Coupled to this will be robust documented oversight in the form of regular, in depth, auditing of the harvesting system on a quarterly and annual basis. Management systems such as these represent the only practical means of guarantying that there are no significant risks either direct, indirect, isolated, interactive, cumulative or short term or long-term on this SAC site. Quarterly and annual audits will cover the areas outlined below. For further details, please see Appendix 8 (Clew Bay Audit template) of the main application document.

(a) Quarterly Audit:

- Audit Part A: Records, Forms & Documents
  Step 1: Forms: receipt of training & verification of understanding
  Step 2: Completed Training Certs & Permits (obtained through training above.)
  Step 3: Records, forms & documents (general)

- Audit Part B: Quality Assessment (documentation)
  Step 1. GRNs (Clew Bay)
  Step 2. Production logsheets (Production Facilities)
  Step 3. Incident Reports
  Step 4. Non-conformance Reports

Step 5. Software Systems

(b) Annual Audit (on-site):
Step 1. Site Quality (inspection of harvested sites);
Step 2. Harvest methods (inspection of techniques);
Step 3.Collection vessel.

4.4.2 Mitigation measures for the protection of Annex II species

4.2.2.1 Common seal

The potential for significant disturbance of Common seal populations within the Clew Bay Complex cSAC during the periods of greatest sensitivity for this species (breeding, moulting and haul-out/resting) has been avoided with the measures included in the 'Code of Practice', as set out in the Licence Application (BioAtlantis, 2014), see also Appendix 4. Sensitive shorelines and islands of importance for Common seal and which would be subject to disturbance impacts have been identified and are to be avoided during the seasonal requirements of this species. These measures form part of the sustainable harvest management plan for the proposal. Hand harvest of *A. nodosum* will not involve the use of artificial physical barriers which would restrict or affect the species range of harbour seals in Clew Bay. The 'Code of Practice', with specific regard to Common seal ensure that harvesters:

- Have full knowledge of the sites in Clew Bay known to be relevant the harbour seal;
- Full knowledge of harbour seal sites which are out of bounds at relevant times of the year;
- Understand the steps required to ensure that all contact with seals is prevented from day to day;
- Operate boat according to practises which minimise impact on harbour seal.

The 'Code of Practice' incorporated into the Licence Application (BioAtlantis, 2014) ensures that no disturbance events occur at Common seal breeding sites (i.e. no harvest between May-July) and includes navigation guidelines to ensure that seals are not disturbed resulting in entry or 'flushing' into the water. The probability of human presence or activities affecting Common seals at known moulting sites of Clew Bay is reduced given that harvesters will not be permitted to harvest at these sites during the moulting period (August-September). Measures to avoid human presence or activities affecting Common seals at known resting sites including Inishcorky are set out, where harvesters will not be permitted to harvest at these sites during the obligate resting period (October-April).

4.2.2.2 Otter

Specific mitigation measures have been included for the avoidance of significant impacts affecting Otter, with regard to the habitat requirements of this species and the conservation objectives of the Clew Bay Complex cSAC. Freshwater habitats are excluded from all harvest activities. In addition, the Burrishoole catchment area will be excluded. The mouth of Lough Furncace and the Rosmurrevagh shoreline area will be also excluded from all harvest activity, thus preventing any impact on important otter populations within this area; these measures will further avoid impacts affecting the andadromous life-cycles of trout or salmon which are an important food source for otters within these locations.

Harvest activities will not require construction of barriers which would affect access to sites of habitats. Linear habitats will not be damaged or blocked in anyway therefore ensuring that otter have undisrupted access to the marine zone and existing foraging locations, couching sites and commuting routes between holts and foraging areas. Harvest activities will take place in the *A. nodosum* intertidal zone and will not lead to any destruction of terrestrial habitat. The harvest of *A. nodosum* will not exceed 20% of the available biomass per site per annum, thus ensuring the maintenance of the *A. nodosum* habitat. Otter food supply will not be affected due to harvest activities in Clew Bay, as hand harvest is unlikely to be associated with reductions in fish numbers within the *A. nodosum* biotope. Harvesting activities will take place in the intertidal zone and along existing road and slipway access points and will not affect otter holts.

Overall, BioAtlantis Ltd. will implement an 'Adaptive Management Approach' to ensure continual improvements to the harvesting plan during its implementation and its effectiveness into the future. This will include ongoing liaison with the NPWS regarding shoreline and island locations of importance to Common seal and Otter and will provide for the amendment and alteration of Code of Practice in order to limit environmental impacts and ensure the sustainable strategy adopted by the company.

4.4.3 Mitigation measures for changes in community structure

The study by Kelly et al. (2001) examined the impact of hand harvesting over an 18 month period. While this study demonstrated recovery of *A. nodosum* biomass and relatively minimal impacts on understory species, the study has some deficiencies, primarily due the study's short duration, focus on macro-invertebrates and a lack of quantitative data in relation to species prevalence. Therefore, while conclusions can be made regarding the short term impacts of hand harvesting in Clew Bay, there is a lack of evidence regarding long term impacts on community structure.

BioAtlantis will build on the findings of Kelly *et al*., (2001) and continually assess the impact of *A. nodosum* harvesting over the life-time of the licence. The experimental design will involve measurement of (a) rates of re-growth of *A. nodosum* post-harvest, (b) associated biodiversity. An experimental site will be chosen which will allow for comparisons between non-harvested areas and harvested areas. Sections will be taken which are large enough to allow for sufficient numbers of replicates. A range of parameters will be measured, including numbers of *A. nodosum* plants, numbers of *Fucus* plants, and numbers of *Animalia*. Particular focus will be placed on assessing the numbers of key species such as periwinkles, limpets, barnacles and presence of red algae (Tandy) and Ephemeral green algae. Assessments will be performed on an annual basis to allow for monitoring over an extended time-period, preferably between 5-10 years. An initial pilot study has also already been performed as can be found in Appendix 1 to the main application application. Key features of the experimental design for measuring the potential impact of hand harvesting on biodiversity are outlined below:

- Designation of experimental sites to facilitate comparisons between non-harvested areas and harvested areas. The chosen sites which will not be subjected to commercial harvest activitites. During assessment, research scientists will divide the site into distinct sections, to include replicates where harvesting will take place and replicates where harvesting will not take place;

- Sections will be large enough to allow for sufficient numbers of replicates. A minimum of 4 x 1m^2 replicates will be required to compare harvest versus non-harvest areas. However, to ensure robust statistical analysis, this number may be increased depending on the levels of variability between replicates and with respect to the individual parameters assessed. Each quadrant will be spaced approximately 3 meters apart where possible. In order to accurately assess changes in biodiversity over time, replicates will be assigned to the same position every year, either as determined via GPS or through demarcation;
- Numbers and/or density of *A. nodosum* plants, numbers of *Fucus* plants, and numbers of *Animalia* will be measured. Density will be measured as wet weight per unit area. Numbers and/or density of periwinkles, limpets, barnacles will be measured. The presence/absence of red algae (Tandy) and Ephemeral green algae will also be assessed. For more details on the general methodology, see Appendix 1;
- Statistical analysis will be performed by research scientists and statisticians using geospatial tools and/or by means of One-Way ANOVA, linear regression or similar tests using software such as GraphPad PRISM;
- Assessments will be performed on an annual basis to allow for monitoring over an extended time-period, ideally between 5-10 years.

These assessments will allow BioAtlantis to continually monitor community structure within the bioptope on an ongoing and long term basis throughout the life-time of the licence. Annual reports and datasets will be made available to NPWS and others if requested. This approach will allow scientists and engineers at BioAtlantis to continually validate and improve the methodology on an ongoing basis if required. This will also ensure that scientific knowledge is increased beyond the timeframe assessed by Kelly *et al*., 2001. This will be important in ensuring that conservation objectives are met continually into the future.

A code of practice is in place to ensure environmentally safe navigation when operating mudflats and sandflat areas. This will prevent any impact on mudflats or sandflats or intertidal sedimentary communities therein. Crucially, it ensures that any existing negative effects associated with aquaculture are not exacerbated by hand harvest of *A. nodosum.* The environmentally safe navigation component of the Code of Practise also includes fine sand areas, shingle, reef and Atlantic Salt Meadows.

4.5 Implications for the conservation objectives of the Natura 2000 sites within the study area

The Conservation Objectives of the Clew Bay Complex cSAC are provided in Appendix 2. These conservation objectives are based on the generic conservation objectives for designated Natura 2000 sites; that is '*to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected'*. In the case of the Clew Bay Complex cSAC, specific conservation objectives have been set out for the designated site with regard to qualifying interests of the site (NPWS 2011a; NPWS, 2011b; NPWS, 2011c). From the results of the Screening Assessment and NIS impact assessment, it has been determined that the potential for adverse effects arising from the BioAtlantis proposal is with regard to the Annex I habitat 'Large, shallow inlets and bays' and the Annex II species Common seal and Otter. The conservation objectives of the Clew Bay Complex cSAC with reference to these qualifying interests and their conservation status are discussed in this section.

4.5.1 Large shallow inlets and bays [1160]

Objective: To maintain the favourable conservation condition of Large shallow inlets and bays in Clew Bay Complex SAC.

Target: The permanent habitat area is stable or increasing, subject to natural processes. Maintain natural extent of *Zostera* and maerl dominated communities. Maintain the high quality of both *Zostera*-dominated and maerl-dominated communities. The following sediment communities should be maintained in a natural condition: Intertidal sandy mud with *Tubificoides benedii* and *Pygospio elegans* community complex; Sandy mud with polychaetes and bivalves community complex; and Fine sand dominated by *Nephtys cirrosa* community, Shingle habitat and Reef habitat.

The Conservation Objectives for this habitat overlap significantly with those prescribed for the Annex I habitat 'Mudflats and sandflats not covered by seawater at low tide [1140]' and which are included within the Annex I 'Large, shallow inlet and bay' habitat complex with regard to the Clew Bay Complex cSAC.

At a national level fishing and harvesting aquatic resources are identified as being of high importance with regard to pressures and threats on the Annex I habitat. However, hand collection is evaluated as being of low importance (NPWS, 2013a). The national evaluation of the conservation status of this habitat is:

- Range: Favourable (FV);
- Area: Favourable (FV);
- Specific structures and functions (incl Species): Inadequate (but improving);
- Future prospects: Favourable (FV);
- Overall assessment of Conservation Status: Inadequate (based on Structures and Functions).

4.5.2 Common seal Phoca vitulina

Objective: To maintain the favourable conservation condition of harbour seal (Annex II species) in Clew Bay Complex SAC with regard to the following targets:

- Species range should not be restricted by artificial barriers to site use. Harbour seals occupy aquatic and terrestrial habitats in Clew Bay, including intertidal shorelines. The species is present during all aspects of its annual life cycle including breeding (approx. May-July), moulting (approx. August-September) and phases of non-breeding foraging and rest (approx. Oct-April);
- Breeding sites should be maintained in a natural condition. Harbour seals and their pups are vulnerable to disturbances during May-July, the time period just prior to and during the annual breeding season;
- Moult-out sites should be maintained in a natural condition. There are several haul-outs in Clew Bay which are important sites for moulting: Inishdeashmore, Inishdeashbeg and adjacent skerries, Inishnakillew, Inisheeny, Carrickwee, Inishgowla South, Forillan, Finnaun Island, Carrickawart Island, Corillan, Carricknamore, Stony Island and adjacent skerries, the Green Islands and adjacent skerries;
- Resting haul-out sites should be maintained in a natural condition. There are several resting haul-out sites in Clew Bay: Inishdeashbeg and adjacent skerries, Inishtubrid, Inishcuill, Carrickawart Island, Stony Island and adjacent skerries, the Green Islands and adjacent skerries;
- Human activities should occur at levels that do not adversely affect the harbour seal population at the site.

The main pressures and threats affecting Common seal are identified as Marine and Freshwater Aquaculture; Fishing and harvesting aquatic resources; Illegal taking/ removal of marine fauna; Outdoor sports and leisure activities, recreational activities; Marine water pollution; Noise nuisance, noise pollution; Seismic exploration, explosions; and changes in abiotic conditions. These have all been evaluated as being of low importance, with the exception of seismic exploration/explosions which are evaluated as being of medium importance (NPWS, 2013b). The current conservation status reporting for this species (NPWS, 2013b) states that current population size and distribution information for the species at a national levels is such pressures may not be impacting with sufficient intensity in Ireland to constitute a threat to the Common seal population. The national evaluation of the conservation status of this species is:

- Range: Favourable (FV);
- Area: Favourable (FV);
- Specific structures and functions (incl. Species): Favourable (FV);
- Future prospects: Favourable (FV);
- Overall assessment of Conservation Status Favourable (FV).

4.5.3 Otter Lutra lutra

Objective: To restore the favourable conservation condition of Otter in Clew Bay Complex SAC with regard to the following targets:

- No significant decline in distribution (i.e. & positive survey sites);
- No significant decline in extent of terrestrial habitat;
- No significant decline in extent of marine habitat;
- No significant decline in extent of freshwater (river) habitat;
- No significant decline in extent of freshwater (lake/lagoon) habitat;
- No significant decline in number of couching sites and holts (minimize disturbance);
- No significant decline in fish biomass available;
- No significant increase in barriers to connectivity.

Otters are subject to pressures on land and in water (freshwater and marine). Impacts that reduce the availability or quality of, or cause disturbance to, their terrestrial or aquatic habitats are likely to affect otters. The main threats to otters in Ireland are: habitat destruction (including river drainage and the clearance of bank-side vegetation); pollution, particularly organic pollution resulting in fish kills; and accidental deaths (road traffic and fishing gear). The primary pressures and threats facing this species are identified as roads and motorways, professional passive fishing and water pollution (NPWS, 2013b). The national evaluation of the conservation status of this species is:

- Range: Favourable (FV);
- Area: Favourable (FV);
- Specific structures and functions (incl. Species): Favourable (FV);
- Future prospects: Favourable (FV);
- Overall assessment of Conservation Status Favourable (FV).

Based on the above Conservation Objectives, taking account of the data obtained and available for the assessments used to inform the current NIS and with regard to the sensitivities of the qualifying interests within the cSAC, it is concluded that the proposed project will not cause an adverse effect on the integrity of the Clew Bay cSAC either alone or in-combination with other plans and projects. This evaluation is made with regard to residual impacts, taking account of specific and detailed mitigation measures set out in the 'Code of Practice' developed by BioAtlantis Ltd. for the Licence Application (BioAtlantis, 2014) and included as Appendix 4 to the current report.

4.6 Conclusions

The potential for impacts on the Clew Bay Complex cSAC Natura 2000 site resulting from the proposed Foreshore Licence application for the sustainable hand-harvesting of *Ascophyllum nodosum* within Clew Bay have been recognised. Appropriate conservation measures are identified for implementation to ensure the habitats and species for which this site has been designated are maintained at a favourable conservation status (compliance with Article 6(1) of the EU Habitats Directive). The proposed operational management plans will also avoid damaging activities that could significantly disturb these species or deteriorate the habitats of the protected species or habitat types (compliance with Article 6(2) of the EU Habitats Directive).

The Clew Bay Complex cSAC, within the works area of the proposed Foreshore Licence Application was assessed with particular regard to potential impacts affecting qualifying interests of the designation, including Annex I habitats (large shallow inlets and bays) and Annex II listed mammal species. It is evaluated that the proposal will not have a significant adverse effect on this Natura 2000 site; with the implementation of prescribed mitigation measures. These mitigation measures have been incorporated into the Foreshore Licence Application (BioAtlantis, 2014) and in particular, the associated 'Code of Practice' in order to ensure the avoidance of significant impacts on these sensitive receptors. There will therefore, be no long-term impact on the integrity of the Clew Bay Complex cSAC site.

Taking account of the mitigation measures proposed for the avoidance and reduction of adverse effects on the qualifying interests and conservation objectives of the designated Natura 2000 sites within the study area, it is concluded that the proposal will not result in direct, indirect or cumulative impacts which would have the potential to adversely affect the qualifying interests / special conservation interests of the Natura 2000 site within the study area with regard to the structure and function; range; population densities; or conservation status of the habitats and species for which the Clew Bay Complex cSAC is designated.

Table 7 and Table 8 summarise the type and number of potential in-combination effects which could arise through hand harvesting *A. nodosum*. Each type of potential interaction has been mitigated against in order to ensure that such interactions will not occur. On this basis, it is concluded that areas of reef and shingle affected by harvest activities, will remain unchanged and will not exceed 15% required by NPWS.

The provisions of Article 6 of the 'Habitats' Directive 92/43/EC (2000) defines 'integrity' as the 'coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and / or population of species for which the site is or will be classified'. From the evidence presented in the current assessment, it is concluded, beyond reasonable scientific doubt, that the proposed project, with the implementation of the prescribed mitigation measures, will not give rise to direct, indirect or cumulative impacts that would adversely affect the integrity of any designated Natura 2000 site.

Table 7 Potential in-combination & cumulative effects with marine community types which could arise through hand harvesting *A. nodosum.*

Marine Community Types (Clew Bay SAC)	**Total Area in Clew Bay SAC (m^2)**	**Area affected by harvest activities/annum**		**Potential in-combination effects**				**Do mitigation measures prevent in-combination effects? (Y/N)**
				Existing Operations		**Planned Operations**		
		(m^2)	**(%)**	**Type**	**No. of risks***	**Type**	**No. of risks***	
Zostera community	1,423,891	0	0	0	0		0	n/a
Shingle	1,855,000	235,549	12.7%	• Recreation & tourism • Existing harvest activities • Existing aquaculture • Invertebrate harvesting	2 3 0 3	• Recreation & Tourism • Harvest activities • Aquaculture • Invertebrate harvesting	2 0 0 0	Yes. See Appendix 4, "Code of Practice"
Reef	26,870,000	1,331,699	4.9%					
Maerl dominated community	2,878,607	0	0	0	0	0	0	n/a
Fine Sands dominated by *Nephtys cirrosa* community	2,950,308	0	0	0	0	0	0	n/a
Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex	7,817,100	0	0	• Recreation & tourism • Existing harvest activities • Existing aquaculture • Invertebrate harvesting	0 0 1 0	0	0	Yes. See Appendix 4, "Code of Practice"
Mudflats & sandflats not covered by seawater at low tide	12,541,069	0	0	• Recreation & tourism • Existing harvest activities • Existing aquaculture • Invertebrate harvesting	0 0 1 0	0	0	Yes. See Appendix 4, "Code of Practice"

***** 'No. of Risks' refers to the number of different types of risks identified in the analysis of in combination and cumulative effects (see Appendix 7 of the main application document for details). The figures of 0% are assigned to areas where *A. nodosum* does not grow or where BioAtlantis have specifically avoided in this application due to the sensitive nature of some of these areas.

Table 8 Potential in-combination and cumulative effects with Annex II Species & birds. which could arise through hand harvesting *A. nodosum*.

Species	**Potential in-combination effects identified**				**Mitigation measures**
	Existing Operations		**Planned Operations**		**Do measures prevent in-combination effects? (Y/N)**
	Type	**No. of risks***	**Type**	**No. of risks***	
Harbour seals	• Recreation & Tourism • Existing harvest activities • Existing aquaculture • Invertebrate harvesting	1 0 0 0	• Recreation & Tourism • Harvest activities • Aquaculture • Invertebrate harvesting	0 0 1 0	Yes. See Appendix 4, "Code of Practice"
Protected bird species	• Recreation & Tourism • Existing harvest activities • Existing aquaculture • Invertebrate harvesting	1 0 0 0	• Recreation & Tourism • Harvest activities • Aquaculture • Invertebrate harvesting	0 0 1 0	Yes. See Appendix 4, "Code of Practice"
Otter	• Recreation & Tourism • Existing harvest activities • Existing aquaculture • Invertebrate harvesting	0 0 0 0	• Recreation & Tourism • Harvest activities • Aquaculture • Invertebrate harvesting	0 0 0 0	Not applicable, as no in-combination risk have been identified

***** 'No. of Risks' refers to the number of different types of risks identified in the analysis of in combination and cumulative effects (see Appendix 7 of the main application document for details).

REFERENCES

Allen, S. G., Ainley, D. G., Page, G. W. & Ribic, C. A (1984) The effect of disturbance on harbour seal haul-out patterns at Bolinas Lagoon, California. Fish. Bull. 82, 493–500.

Andersen, S. M., Teilmann, J., Dietz, R., Schmidt, N. M., and Miller, L. A. (2012). Behavioural responses of harbour seals to human-induced disturbances. Aquatic Conservation: Marine and Freshwater Ecosystems.

Anderson SM (2011). Harbour seals and human interactions in Danish waters. PhD thesis. Aarhus University – Denmark.

Aqua-Fact (1999) A survey of selected littoral and sublittoral sites in Clew Bay, Co. Mayo. Duchas, The Heritage Service, Dublin.

Bailey, M. and Rochford J. (2006) Otter Survey of Ireland 2004/2005. Irish Wildlife Manuals, No. 23. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

BioAtlantis (2014) Licence Application for Sustainable hand-harvesting of *Ascophyllum nodosum* at Clew Bay (SAC Site Code 1482). BioAtlantis Ltd., Tralee, Co. Kerry.

Brinkhuis BH and Jones RF (1976). The ecology of temperate salt-marsh fucoids. II. In situ growth of transplanted *Ascophyllum nodosum* ecads. Marine Biology Volume 34, Issue 4, pp 339-348.

Bowers-Marriott, B. (1997) Practical Guide to Environmental Impact Assessment: A Practical Guide. Published by McGraw-Hill Professional, 1997, 320 pp.

Browne, R., Deegan, B., O'Carroll, T., Norman, M. and Ó'Cinnéide, M., 2007. Status of Irish Aquaculture, 2006. Marine Institute/Bord Iascaigh Mhara/Taighde Mara Teo: 113pp

Callaway, R. M. 2007. Positive interactions and interdependence in plant communities. Springer, Dordrecht, The Netherlands. Pg. 106

Crowe, O. (2005). Ireland's wetlands and their waterbirds: Status and distribution. Birdwatch Ireland.

DoEHLG (2009). Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government, Dublin.

European Commission (2001) Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43EEC. European Commission Environment DG, Brussels.

English Nature (2001) Habitats Regulations Guidance Note (No.4): Alone or in combination.

Falvey, J., Costello, M. and Dempsey, S. (1997) Survey of intertidal sediment biotopes in estuaries in Ireland. Unpublished report to the National Parks and Wildlife Service, Dublin, 258 pp.

Gerard, V.A., 1999. Positive interactions between cordgrass *Spartina alterniflora*, and the brown alga *Ascophyllum nodosum ecad scorpioides* in a mid-Atlantic coast salt marsh. J. Exp. Mar. Biol. Ecol. 239, 157– 164

Gollety, C., Mign´e, A., and D., D.: Benthic metabolism on a sheltered rocky shore: role of the canopy in the carbon budget., J. Phycol., 44, 1146–1153, 2008.

Guiry M, and Morrison L (2013). The sustainable harvesting of *Ascophyllum nodosum* (Fucaceae, Phaeophyceae) in Ireland with notes on the collection and use of some other brown algae. Journal of Applied Phycology: 1-8.

Hession, C., Guiry, M.D., McGarvey, S. & Joyce, D. (1998) Mapping and assessment of the seaweed resources (*Ascophyllum nodosum*, *Laminaria* spp.) off the west coast of Ireland. Marine Resource Series No. 5.

Henry, E., Hammill, M.O., 2001. Impact of small boats on the haulout activity of harbour seals (*Phoca vitulina*) in Metis Bay, Saint Lawrence Estuary, Quebec, Canada. Aquatic Mammals 27, 140–148.

Hurd, CL and Harrison, PJ and Bischof, K and Lobban, CS, Seaweed Ecology and Physiology, Cambridge University Press, UK, pp. 570. ISBN 9780521145954 (In Press) [Revision/New Edition]. Page 402.

Hynes, P. (2014). Adopted Annual Budget for Mayo County Council. Web: http://www.mayococo.ie/lgdocuments/adopted_annual_budget_2014.pdf. Accessed: 16/09/2014.

JNCC website: http://jncc.defra.gov.uk/page-6297

Johnson, A., and A. Acevedo-Gutierrez. 2007. Regulation compliance by vessels and disturbance of harbour seals (Phoca vitulina). Canadian Journal of Zoology 85:290–294.

Karleskint, G., Turner, R., & Small, J. 2009. Introduction to Marine Biology. 3rd edn. Cengage Learning.

Kelly L, Louise Collier, Mark J. Costello, Michael Diver, Seamus McGarvey Stefan Kraan, Jim Morrissey and Michael D. Guiry (2001). Impact Assessment of Hand and Mechanical Harvesting of *Ascophyllum nodosum* on Regeneration and Biodiversity.

Kirk McClure Morton, and MarEnCo (2013). Westport marine survey. Volume 1. Hydrodynamic & water quality modelling. Epa export 25-07-2013:23:43:16

Marine Institute (2014). Report supporting Appropriate Assessment of Aquaculture and Risk Assessment of Fisheries in Clew Bay Complex SAC (Site Code: 1482). Web: https://www.agriculture.gov.ie/media/ClewBaySACAA290714.pdf., accessed: 15/09/2014

Maun MA. 2009. The biology of coastal sand dunes. Oxford Univ. Press. pg. 109-110.

Mayo County Council (2010). Westport Towns and Environs Development Plan 2010-2016 (incorporating variation 1, 2 and 3).

McCorry, M. (2007) Saltmarsh Monitoring Project 2006: Summary Report. Research Branch, National Parks and Wildlife Service, Dublin.

McCorry, M. & Ryle, T. (2009) Saltmarsh Monitoring Project 2007-2008: Volume 4. Research Branch, National Parks and Wildlife Service, Dublin.

MERC Consultants (2006) Surveys of sensitive subtidal benthic communities in Slyne Head Peninsula SAC, Clew Bay Complex SAC and Galway Bay Complex SAC. Project Report on behalf of the National Parks and Wildlife Service. MERC Consultants, Galway.

Newport Sewerage Scheme EIS (2007). Chapter 3.9, pages 161-162. Web: http://www.mayococo.ie/EIS/Volume%20II%20-%20Main%20Text/Chapter%203.9.pdf . accessed: 15/09/2014

NPWS (2011a) Conservation Objectives: Clew Bay Complex SAC 001482. Version 1.0 (July 2011). National Parks and Wildlife Service, Dublin.

NPWS (2011b) Clew Bay SAC (site code 1482) Conservation objectives supporting document - coastal habitats. Version 1. National Parks and Wildlife Service, Dublin.

NPWS (2011c) Clew Bay Complex SAC (site code: 1482) Conservation objectives supporting document- marine habitats and species. Version 1. National Parks and Wildlife Service, Dublin.

NPWS (2012) Marine Natura Impact Statements in Irish Special Areas of Conservation: a working document. National Parks & Wildlife Service of the Department of Arts, Heritage & the Gaeltacht.

NPWS (2013a) The Status of EU Protected Habitats and Species in Ireland. Habitat Assessments: Volume 2. Version 1.0. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

NPWS (2013b) The Status of EU Protected Habitats and Species in Ireland. Species Assessments Volume 3, Version 1.0. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

O'Connor MI, Violin CR, Anton A, Ladwi LM, Piehler MF (2011). Salt marsh stabilization affects algal primary producers at the marsh edge. Wetlands Ecology and Management. Vol. 19, Issue 2, pp 131-140.

Oireactas Committee Debate (2014). Joint Committee on Environment, Culture and the Gaeltacht Debate. Licensing and Harvesting of Seaweed in Ireland, July 8th 2014, Oireachtas Committee Room 4. Web: http://oireachtasdebates.oireachtas.ie/debates%20authoring/debateswebpack.nsf/committeetakes/ENJ2014070800001?opendocument . Date accessed: 01/08/2014

Osborn, L. S. (1985) Population dynamics, behaviour, and the effect of disturbance on haulout patterns of the harbour seal *Phoca vitulina richardsi* in Elkhorn Slough, Monterey Bay, California. B.A. Thesis, Dep. Environ. Stud. & Dep. Biol., Univ. Calif., Santa Cruz. 75 pp.

Ryle, T., Murray, A., Connolly, K. & Swann, M. (2009) Coastal Monitoring Project 2004-2006. National Parks and Wildlife Service, Dublin.

Sea Fisheries Protection Authority (2013). Clew Bay Live Bivalve Mollusc (Classified Production Areas 2013). Web source: http://www.sfpa.ie/ (accessed 20_09_2013).

Suryan RM, Harvey JT. 1999. Variability in reactions of Pacific harbour seals, *Phoca vitulina richardsi*, to disturbance. Fish. Bull. (Wash., D.C.) 97: 332-339

Stefaniak, L., Lambert, G., Gittenberger, A., Zhang, H., Lin, S. and Whitlatch, R.B. (2009) Genetic conspecificity of the worldwide populations of *Didemnum vexillum* Kott, 2002. Aquatic Invasions (2009) Volume 4, Issue 1: 29-44. Special issue "Proceedings of the 2nd International Invasive Sea Squirt Conference".

Stokes K, O'Neill K, McDonald RA (2006). Invasive species in Ireland. Report to environment and heritage service and national parks and wildlife service by Quercus, Queens University, Environment and Heritage Service, Belfast and National Parks and Wildlife Service, Dublin

Ugarte R (2011). An evaluation of the mortality of the brown seaweed *Ascophyllum nodosum* (L.) Le Jol. produced by cutter rake harvests in southern New Brunswick, Canada. J Appl Phycol 23:401–407.

Valiela L (1995). Marine Ecological Processes. Originally published by Springer-Verlag New York, Inc. Second edition, pg 12.

Vandermeulen (2013). Information to Support Assessment of Stock Status of Commercially Harvested Species of Marine Plants in Nova Scotia: Irish Moss, Rockweed and Kelp. Canadian Science Advisory Secretariat (CSAS).

Williams, G. A. 1990. The comparative ecology of the flat periwinkles *Littorina obtusata* (L.) and *L. mariae* Sacchi et Rastelli. Field Studies 7:469–482.

PLATES

Plate 1 Exposed westerly shore of Inishoo.

Plate 2 Lagoon (priority Annex I habitat) recorded away from the shoreline at Inishgowla.

Plate 3 Inishgowla shoreline, low *A. nodosum* cover

Plate 4 Inishgowla South, view of the south eastern shoreline, with low *A. nodosum* density.

Plate 5 Limited, low-density cutting was recorded at Inishgowla South.

Plate 6 Illauncarrick south shore, with *A. nodosum* and boulder.

Plate 7 Dense *A. nodosum* cover on Inishleague, low-intensity cutting was recorded at this shoreline.

Plate 8 Inishbeg in the south of Clew Bay was found to comprise an extensive band of *A. nodosum* along the easterly shore.

Plate 9 Limited, low-density cutting was recorded on Inishbeg.

Plate 10 Harvested *A. nodosum* on roadside awaiting transportation from the bay, Rosmoney Pier, Clew Bay.

APPENDIX 1 Clew Bay Complex cSAC Site Synopsis

An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

SITE SYNOPSIS

Site Name: Clew Bay Complex SAC

Site Code: 001482

Clew Bay is a wide, west-facing bay on the west coast of Co. Mayo. It is open to the westerly swells and winds from the Atlantic, with Clare Island giving only a small amount of protection. This drumlin landscape was formed during the last glacial period when sediments were laid down and smoothed over by advancing ice. The sea has subsequently inundated the area, creating a multitude of islands. The geomorphology of the bay has resulted in a complex series of interlocking bays creating a wide variety of marine and terrestrial habitats.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

[1140] Tidal Mudflats and Sandflats
[1150] Coastal Lagoons*
[1160] Large Shallow Inlets and Bays
[1210] Annual Vegetation of Drift Lines
[1220] Perennial Vegetation of Stony Banks
[1330] Atlantic Salt Meadows
[2110] Embryonic Shifting Dunes
[2120] Marram Dunes (White Dunes)
[91A0] Old Oak Woodlands

[1013] Geyer's Whorl Snail (*Vertigo geyeri*)
[1355] Otter (*Lutra lutra*)
[1365] Common (Harbour) Seal (*Phoca vitulina*)

Within the shallow bay, subtidal sediments are characterised by typical bivalve communities in fine sand (*Chamelea striatula* and *Ensis* sp.), and by the polychaete worm *Euclymene* sp. and the bivalve *Thyasira flexuosa* in muddy sand. The intertidal sediment communities are characterised by polychaetes and bivalves in the mid shore and by the sand mason worm *Lanice conchilega* in the low shore. In areas where there is maerl debris with small amounts of live maerl, the infaunal community has a mixture of species characteristic of coarse sand (e.g. the bivalves *Timoclea ovata*, *Spisula* sp., and the polychaetes *Nepthys cirrosa* and *Glycera lapidum*) and medium sand (e.g., the bivalve *Ensis* sp. and the polychaetes *Lanice conchilega*, *Scoloplos armiger* and *Sthenelais boa*). The bivalves *Timoclea ovata*, *Tapes rhomboides* and the polychaetes *Branchiomma bombyx* and *Glycera lapidum* are typical of gravels and medium sands,

whereas the bivalves *Abra alba, Corbula gibba, Thyasira flexuosa* and *Mysella bidentata* and the polychaete *Euclymene* are characteristic of muddy sands. Beds of live maerl of *Lithothamnion corallioides* are also present in a number of areas.

Around the edges of the inner part of the bay are shores of mixed boulders, cobbles, gravel with some sand and mud. They have a typical zonation of intertidal communities found on sheltered shores of mixed substratum. The shore at Murisk is unusual as a distinct zone characterised by archiannelids occurs above the sandhopper zone in the upper shore under the boulders and cobbles. This is an unusual habitat. In sheltered areas of shallow water with little sand scour a well developed community of hydroids, sponges and solitary sea squirts is present. Where the sediments include gravel and mud the species richness in the area can be exceptionally high (180 species). A number of marine species that are rarely recorded are found in Clew Bay: the stalked jellyfish *Lucernariopsis cruxmelitensis*; the polycheates *Anitides rosea, Clymenura clypeata, Pterosyllis formosa* and *Pionosylis* sp. and the snail *Clypterea chinensis.*

Clew Bay is considered to have the most significant shingle reserves in the country, and has (on the islands) the only examples of incipient gravel barriers in Ireland. Associated with the shingle (and dunes) are good examples of annual vegetation of drift lines. Characteristic species found in these habitats include: Spear-leaved Orache (*Atriplex prostrata*), Red Fescue (*Festuca rubra*), Sea Sandwort (*Honkenya peploides*), Thrift (*Armeria maritima*), Common Scurvygrass (*Cochlearia officinalis*), Sea Mayweed (*Matricaria maritima*) and Sea Campion (*Silene vulgaris* subsp. *maritima*).

Lough Furnace is located at the north-eastern corner of Clew Bay. The lough is a good example of a deep, stratified, saline lake lagoon in a very natural state. Salinity levels can vary considerably here depending on rainfall and tides. The lake is one of the very few permanently stratified lakes known in Ireland and Britain. The lake is ringed by Common Reed (*Phragmites australis*) and Common Club-rush (*Scirpus lacustris*), with small patches of Great Fen-sedge (*Cladium mariscus*) and Bottle Sedge (*Carex rostrata*). Lough Furnace supports a relatively high faunal diversity (41 taxa recorded in a 1996 survey), including a number of important invertebrate species. The relict mysid species *Neomysis integer*, the isopods *Jaera albifrons, J. ischiosetosa* and *J. nordmanni*, and two rare amphipods (*Lembos longipes* and *Leptocheirus pilosus*) have all been recorded from the lake. Both Irish species of tasselweed (*Ruppia maritima* and *R. cirrhosa*) occur in the lagoon. Eel, Flounder and Mullet also occur in the lake waters. Mallard nest around the lough, while Saint's Island contains nesting Black-headed Gull.

At the north-western end of Lough Furnace lie two associated lakes, Lough Napransky and Lough Navroony. A stream drains from the latter into the main lake. The area contains flush and quaking-mire vegetation, which is of interest as Irish Heath (*Erica erigena*) is found there, with bog mosses (*Sphagnum* spp.), Black Bog-rush (*Schoenus nigricans*), Bog Asphodel (*Narthecium ossifragum*), Common Cottongrass (*Eriophorum angustifolium*) and Round-leaved Sundew (*Drosera rotundifolia*). Bog Orchid (*Hammarbya paludosa*), a species listed in the Irish Red Data

Book and the Flora (Protection) Order, 1999, is also found in this area. Beyond the wet area there is a Hazel (*Corylus avellana*) dominated woodland growing over abandoned fields. Downy Birch (*Betula pubescens*), Hawthorn (*Crataegus monogyna*) and Holly (*Ilex aquifolium*) are common, with occasional Sessile Oak (*Quercus petraea*). The ground flora contains such species as Bluebell (*Hyacinthoides non-scripta*), Sanicle (*Sanicula europaea*) and Wood-sorrel (*Oxalis acetosella*).

Keeloges Wood is a medium-sized woodland on the north-east corner of Clew Bay. The woodland lies in a sheltered location between several drumlins and occurs on a shallow, moist, brown-earth soil with an organic-rich A horizon which is occasionally peaty. The soil is gleyed near streams and flushes. The woodland is dominated by Sessile Oak, with Downy Birch and occasional Ash (*Fraxinus excelsior*). Hazel, Holly and Hawthorn are the principal components of the shrub layer. In moister sites Rusty Willow (*Salix cinerea* subsp. *oleifolia*) and Alder (*Alnus glutinosa*) occur. The woodland is at the more fertile end of the spectrum of oak woodlands and is transitional to Ash woodland. Consequently the field layer is species-rich. Elements of oak woodland, e.g. Hard Fern (*Blechnum spicant*), Greater Stitchwort (*Stellaria holostea*), Great Wood-rush (*Luzula sylvatica*) and Honeysuckle (*Lonicera periclymenum*), are mixed with elements of Ash woodland, e.g. False Brome (*Brachypodium sylvaticum*), Lords-and-ladies (*Arum maculatum*), Enchanter's-nightshade (*Circaea lutetiana*) and Wood Speedwell (*Veronica montana*), as well as indicators of poorly-drained soil, e.g. Tufted Hair-grass (*Deschampsia cespitosa*), Meadowsweet (*Filipendula ulmaria*) and Marsh Hawk's-beard (*Crepis paludosa*). The epiphyte *Lobaria pulmonaria* is also present, together with numerous other lichen and bryophyte species (including *Usnea* spp).

The wood was cut during the second World War so most of the trees are approximately 60 years old, but a few very much larger oaks occur, principally on the shoreline. There is a low but well-developed canopy with a well-developed shrub layer and often luxuriant field layer. There is good regeneration of trees. A most unusual feature is the juxtaposition of oak woodland with saltmarsh where the woodland borders the shoreline. The wood has been well-managed in recent times with occasional filling in of wind-blown coupes with trees derived from seed collected on-site. A stock-proof fence has been maintained along the land boundary. No invasive exotics were encountered during recent survey. The woodland appears on the 1st Edition Ordnance Survey map indicating that it is long-established and possibly ancient. The species-list also supports this contention with at least 14 species present here which have been found to be significantly more frequent in potentially ancient woodlands. This woodland is of particular significance in view of its location in the extreme north-west of the country where there is very little woodland, its position on the coast, its species-richness, excellent structure and its possible ancient status.

The Rosmurrevagh area in the north of Clew Bay displays a high diversity of habitats, from seashore to dunes and coastal grassland, as well as saltmarsh, bog and fen. The sandy beach on the seaward side grades into dunes of Marram (*Ammophila arenaria*). Adjacent to this, the saltmarsh vegetation, which is approximately 5 m

wide, comprises Thrift, Common Scurvygrass, Common Saltmarsh-grass (*Puccinellia maritima*) and 'turf fucoids' (diminutive forms of brown algae). These plant species are typical of Atlantic salt meadows. Similar saltmarshes occur scattered around the entire shoreline of the bay. Next to the saltmarsh at Rosmurrevagh is an area of coastal grassland with species such as Daisy (*Bellis perennis*), Ribwort Plantain (*Plantago lanceolata*), Dandelion (*Taraxacum* agg.), Heath Wood-rush (*Luzula multiflora*), Common Ragwort (*Senecio jacobaea*) and Yarrow (*Achillea millefolium*). Flushes introduce a species-rich bog/fen type vegetation. Yellow Iris (*Iris pseudacorus*), Soft Rush (*Juncus* effusus), Irish Heath, bog mosses, sedges, Water Mint (*Mentha aquatica*), Bog-myrtle (*Myrica gale*), Bog Asphodel and Cuckooflower (*Cardamine pratensis*) are found.

A further dune system occurs at Bartraw in the south-west of the site. Here Marram and embryonic dunes occur along a shingle ridge which links a small island where dunes also occur. Embryonic dunes, characterised by the presence of Sand Couch (*Elymus farctus*), also occur on some of the islands in the bay.

Important populations of Otter and Common (Harbour) Seal are found in Clew Bay. A total of 95 Common Seals were recorded ashore within Clew Bay Complex SAC in August 2003 during a national aerial survey for the species. Continued land-based monitoring within the site recorded 121 seals of all ages ashore in August 2009 and 118 in August 2010. The snail species *Vertigo geyeri*, which is also listed on Annex II of the E.U. Habitats Directive, has been recorded from this site.

The Clew Bay Complex supports a good diversity of wintering waterfowl, with nationally important numbers of Red-breasted Merganser (average maximum of 70 in the winters 1995/96-1999/00) and Ringed Plover (average maximum of 142 in the winters 1995/96-1999/00). A population of Barnacle Goose (100-200 birds) frequents the islands during winter. Other species which occur in significant numbers include Great Northern Diver (14), Brent Goose (118), Shelduck (74), Wigeon (112), Teal (127), Mallard (64), Oystercatcher (250), Dunlin (450), Bar-tailed Godwit (73), Curlew (373), Redshank (172), Greenshank (10) and Turnstone (27) (all figures are average maxima for the winters 1995/95-1999/00). Species which breed in important numbers include Cormorant (115 pairs in 1985), Common Tern (20+ pairs in 2000/01), Arctic Tern (100+ pairs in 2000/01) and Little Tern (9 pairs in 2000). The various tern species, as well as Barnacle Goose, Great Northern Diver and Bar-tailed Godwit, are listed on Annex I of the E.U. Birds Directive.

The juxtaposition within Clew Bay of a wide variety of habitats, including nine listed on Annex I of the E.U. Habitats Directive, and the combination of important flora and fauna, including one Red Data Book plant and three animals listed on Annex II of the E.U. Habitats Directive, make this a site of considerable national and international importance.

APPENDIX 2 Clew Bay Complex Conservation Objectives

National Parks and Wildlife Service

Conservation Objectives

Clew Bay Complex SAC 001482

An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht

Introduction

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Notes/Guidelines:

1. The targets given in these conservation objectives are based on best available information at the time of writing. As more information becomes available, targets for attributes may change. These will be updated periodically, as necessary.
2. An appropriate assessment based on these conservation objectives will remain valid even if the targets are subsequently updated, providing they were the most recent objectives available when the assessment was carried out. It is essential that the date and version are included when objectives are cited.
3. Assessments cannot consider an attribute in isolation from the others listed for that habitat or species, or for other habitats and species listed for that site. A plan or project with an apparently small impact on one attribute may have a significant impact on another.
4. Please note that the maps included in this document do not necessarily show the entire extent of the habitats and species for which the site is listed. This should be borne in mind when appropriate assessments are being carried out.
5. When using these objectives, it is essential that the relevant backing/supporting documents are consulted, particularly where instructed in the targets or notes for a particular attribute.

Qualifying Interests

**** indicates a priority habitat under the Habitats Directive***

001482 Clew Bay Complex SAC

QI	Description
1013	Geyer's whorl snail *Vertigo geyeri*
1140	Mudflats and sandflats not covered by seawater at low tide
1150	* Coastal lagoons
1160	Large shallow inlets and bays
1210	Annual vegetation of drift lines
1220	Perennial vegetation of stony banks
1330	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
1355	Otter *Lutra lutra*
1365	Common seal *Phoca vitulina*
2110	Embryonic shifting dunes
2120	Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")

Supporting documents, relevant reports & publications (listed by date)

Supporting documents, NPWS reports and publications are available for download from: www.npws.ie/Publications

Title:	Monitoring and Assessment of Irish Lagoons for the purpose of the EU Water Framework Directive
Year:	in prep
Author:	Roden, C.M.; Oliver, G.
Series:	Unpublished report to the EPA
Title:	Clew Bay Complex SAC (001482): Conservation objectives supporting document - marine habitats and species [Version 1]
Year:	2011
Author:	NPWS
Series:	Unpublished Report to NPWS
Title:	Clew Bay Complex SAC (001482): Conservation objectives supporting document - coastal habitats [Version 1]
Year:	2011
Author:	NPWS
Series:	Unpublished Report to NPWS
Title:	Otter tracking study of Roaringwater Bay
Year:	2010
Author:	De Jongh, A.; O'Neill, L.
Series:	Unpublished Draft Report to NPWS
Title:	Subtidal benthic surveys (Clew Bay)
Year:	2009
Author:	Aquafact
Series:	Unpublished Report to NPWS
Title:	Saltmarsh Monitoring Report 2007-2008
Year:	2009
Author:	McCorry, M.; Ryle, T.
Series:	Unpublished Report to NPWS
Title:	Clew Bay baseline intertidal survey
Year:	2009
Author:	RPS
Series:	Unpublished Report to NPWS
Title:	Coastal Monitoring Project 2004-2006
Year:	2009
Author:	Ryle, T.; Murray, A.; Connolly, C.; Swann, M.
Series:	Unpublished Report to NPWS
Title:	The phytosociology and conservation value of Irish sand dunes
Year:	2008
Author:	Gaynor, K.
Series:	Unpublished PhD thesis, National University of Ireland, Dublin

Title:	Saltmarsh Monitoring Report 2006
Year:	2007
Author:	McCorry, M.
Series:	Unpublished Report to NPWS
Title:	Inventory of Irish coastal lagoons
Year:	2007
Author:	Oliver, G.
Series:	Unpublished Report to NPWS
Title:	A Survey of Intertidal Mudflats and Sandflats in Ireland
Year:	2006
Author:	Aquafact
Series:	Unpublished Report to NPWS
Title:	Otter Survey of Ireland 2004/2005
Year:	2006
Author:	Bailey, M.; Rochford, J.
Series:	Irish Wildlife Manuals No. 23
Title:	Otters - ecology, behaviour and conservation
Year:	2006
Author:	Kruuk, H.
Series:	Oxford University Press
Title:	Survey of sensitive subtidal benthic marine communities
Year:	2006
Author:	MERC
Series:	Unpublished Report to NPWS
Title:	Harbour seal population assessment in the Republic of Ireland: August 2003
Year:	2004
Author:	Cronin, M.; Duck, C.; Ó Cadhla, O.; Nairn, R.; Strong, D.; O'Keeffe, C.
Series:	Irish Wildlife Manuals No. 11
Title:	Summary of National Parks & Wildlife Service surveys for common (harbour) seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*), 1978 to 2003
Year:	2004
Author:	Lyons, D.O.
Series:	Irish Wildlife Manuals No. 13
Title:	Broadscale mapping of candidate marine Special Area of Conservation. Clew Bay Complex, cSAC (001482)
Year:	2003
Author:	SSI; Aquafact
Series:	Unpublished Report to NPWS
Title:	A Survey of selected littoral and sublittoral sites in Clew Bay, Co. Mayo
Year:	1999
Author:	Aquafact
Series:	Unpublished Report to NPWS

Title:	National Shingle Beach Survey of Ireland 1999
Year:	1999
Author:	Moore, D.; Wilson, F.
Series:	Unpublished Report to NPWS
Title:	Aquatic vegetation of Irish coastal lagoons
Year:	1998
Author:	Hatch, P.; Healy, B.
Series:	Bulletin of the Irish Biogeographical Society. 21: 2-21
Title:	A survey of the vegetation of Irish coastal lagoons
Year:	1996
Author:	Hatch, P.
Series:	Unpublished Report to NPWS
Title:	The spatial organization of otters (*Lutra lutra*) in Shetland
Year:	1991
Author:	Kruuk, H.; Moorhouse, A.
Series:	J. Zool, 224: 41-57
Title:	Otter survey of Ireland
Year:	1982
Author:	Chapman, P.J.; Chapman, L.L.
Series:	Unpublished Report to Vincent Wildlife Trust
Title:	Lough Furnace, County Mayo; physical and chemical studies of an Irish saline lake, with reference to the biology of *Neomysis integer*
Year:	1977
Author:	Parker, M.M.
Series:	Unpublished PhD thesis, University of Dublin, Trinity College.

Spatial data sources

Year:	Interpolated 2011
Title:	Intertidal and subtidal surveys 1999, 2006, 2009; broadscale mapping 2003
GIS operations:	Polygon feature classes from marine community types base data sub-divided based on interpolation of marine survey data; expert opinion used as necessary to resolve any issues arising
Used for:	Marine community types, 1140 (maps 2 & 4)
Year:	2005
Title:	OSi Discovery series vector data
GIS operations:	High Water Mark (HWM) polyline feature class converted into polygon feature class; clipped to SAC boundary
Used for:	1160, 1365 (maps 3 & 9)
Year:	2005
Title:	OSi Discovery series vector data
GIS operations:	High water mark (HWM) and low water mark (LWM) polyline feature classes converted into polygon feature classes and combined; Saltmarsh and Sand Dune CO datasets erased out if applicable
Used for:	Marine community types base data (map 4)
Year:	Revision 2011
Title:	Inventory of Irish Coastal Lagoons. Version 3
GIS operations:	Clipped to SAC boundary
Used for:	1150 (map 5)
Year:	Revision 2010
Title:	Saltmarsh Monitoring Project 2007-2008. Version 1
GIS operations:	QIs selected; clipped to SAC boundary; overlapping regions with Sand Dune CO data investigated and resolved with expert opinion used
Used for:	1330 (map 6)
Year:	2009
Title:	Coastal Monitoring Project 2004-2006. Version 1
GIS operations:	QIs selected; clipped to SAC boundary; overlapping regions with Saltmarsh CO data investigated and resolved with expert opinion used
Used for:	1210, 2110, 2120 (map 7)
Year:	2005
Title:	OSi Discovery series vector data
GIS operations:	Creation of an 80m buffer on the marine side of the high water mark (HWM); creation of a 10m buffer on the terrestrial side of the HWM; combination of 80m and 10m HWM buffer datasets; creation of a 10m buffer on the landward side of the river banks data; creation of a 20m buffer applied to river centerline and stream data; combination of 10m river banks and 20m river and stream centerline buffer datasets; combined river and stream buffer dataset clipped to HWM; combination of HWM buffer dataset with river and stream buffer dataset; overlapping regions investigated and resolved; resulting dataset clipped to SAC boundary; expert opinion used as necessary to resolve any issues arising
Used for:	1355 (map 8)

Year:	2011
Title:	NPWS rare and threatened species database
GIS operations:	Dataset created from spatial references in database records; expert opinion used as necessary to resolve any issues arising
Used for:	1365 (map 9)

Conservation objectives for: Clew Bay Complex SAC [001482]

1013 Geyer's whorl snail *Vertigo geyeri*

The status of Geyer's whorl snail as a qualifying Annex II species for Clew Bay Complex SAC is currently under review. The outcome of this review will determine whether a site-specific conservation objective is set for this species.

Conservation objectives for: Clew Bay Complex SAC [001482]

1140 Mudflats and sandflats not covered by seawater at low tide

To maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes. See map 2	Habitat area was estimated using OSI data as 1277ha. See marine supporting document for further details
Community distribution	Hectares	The following sediment communities should be maintained in a natural condition: Intertidal sandy mud with *Tubificoides benedii* and *Pygospio elegans* community complex; Sandy mud with polychaetes and bivalves community complex; and Fine sand dominated by *Nephtys cirrosa* community. See map 4	The likely area of sediment communities was derived from a combination of intertidal and subtidal surveys undertaken in 1999, 2006 and 2009. See marine supporting document for further details

Conservation objectives for: Clew Bay Complex SAC [001482]

1150 * Coastal lagoons

To maintain the favourable conservation condition of Lagoons in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 5 for mapped lagoons	The main lagoon is Furnace Lough. Claggan Lagoon has also been mapped, however, further information is required on this lagoon. NB there maybe other lagoons within the SAC. The following targets and notes concentrate on the largest lagoon, Furnace Lough
Habitat area	Hectares	Area stable, subject to slight natural variation. Favourable reference area of surveyed lagoons is 163.3ha. Furnace Lough- 162.1ha; Claggan Lagoon- 1.2ha. See map 5	Areas calculated from spatial data derived from Oliver, 2007. NB there maybe other lagoons within the SAC
Salinity regime	Practical salinity units (psu)	Maintain current spatial and temporal variation in salinity regime	Furnace Lough is a natural, deep (up to 21m), stratified lagoon with natural periodic overturns and anoxia. It has permanent open connection to the sea through which seawater enters when tides exceed MHWN though this connection is somewhat constricted by weirs. There are major freshwater inputs at the northern end from the large Lough Feeagh/Burrishoole catchment area. The surface layer is oligohaline to mesohaline (0.5-12.0 psu) for most of the time but salinity varies from north (fresh water) to south (high salinity) and summer to winter. The waters are sharply stratified, a permanant halocline runs from 1-3m down to 8m, below which the water is of constant salinity (approx. 20psu), anaerobic and stagnant (Parker, 1977). See Oliver (2007) and Roden and Oliver (in prep.) for further information
Hydrological regime	Metres	Maintain current annual water level fluctuations	This is to ensure maintenance of the current communities of the lagoon margins and the current hydrological functioning of the lagoon itself, especially the salinity regime
Hydrological regime	Discharge (m^3/second)	Maintain/restore freshwater discharge regime	There is evidence that the original hydrological regime in the Burrishoole catchment has been impacted due to overgrazing and afforestation resulting in changes to run-off regimes with associated increased siltation and eutrophication. The extent to which these changes have impacted on Lough Furnace is unclear but needs further study

Conservation objectives for: Clew Bay Complex SAC [001482]

1150 * Coastal lagoons

To maintain the favourable conservation condition of Lagoons in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Barrier	Weir function	Maintain current weir structure at Furnace Lough to ensure maintenance of the current salinity regime	In Furnace Lough, input to and output of saline water is affected to an unknown degree by two weirs. The effect of the weirs needs to be quantified to determine their effect on the salinity regime of the lagoon. These weirs or some similar type structures are shown on the first edition of the 6" OS maps and therefore have been in place for over 170 years
Water quality: chlorophyll a	µg/L	Maintain annual median chlorophyll in Furnace Lough at less than 2.5µg/L	These limits are needed to ensure that excessive shading from phytoplankton does not reduce submergent macrophytes colonisation of the littoral zone the lagoon (J. Ryan, pers comm). The current median levels are less than the target but summer levels are elevated (Roden and Oliver, in prep.) and should be closely monitored
Water quality: Molybdate Reactive Phosphorus (MRP)	mg/L	Maintain annual median MRP in Furnace Lough at less than 0.01mg/L	These limits are needed to ensure that excessive shading from phytoplankton does not reduce submergent macrophytes colonisation of the littoral zone areas of the lagoon (J. Ryan, pers comm). The current median levels in Furnace Lough are 0.005mg/L (Roden and Oliver, in prep). It is possible that the target may be exceeded during periods of overturn. Collection of data on nutrient levels close to the halocline would be useful for the assessment of this possibility
Water quality: Dissolved Inorganic Nitrogen (DIN)	mg/L	Maintain annual median DIN (Dissolved inorganic nitrogen) in Furnace Lough at less than 0.15mg/L	These limits are needed to ensure that excessive shading from phytoplankton does not reduce submergent macrophytes colonisation of the littoral zone of the lagoon (J. Ryan, pers comm). The current median levels of DIN in Furnace Lough are less than 0.1mg/L (Roden and Oliver, in prep)
Water quality: Biological Oxygen Demand (BOD)	mg/L	Maintain annual median BOD (Biological Oxygen Demand) in Furnace Lough at less than 2.0mg/L	These limits are needed to ensure that excessive shading from phytoplankton does not reduce submergent macrophytes colonisation of the littoral zone of the lagoon (J. Ryan, pers comm). The current annual median levels of BOD in Furnace Lough are just below the target (Roden and Oliver, in prep) and should be closely monitored. The relationship between organic matter, mainly peat silt, imput from L. Feeagh and BOD in the surface waters and anoxia in the deeper waters warrants further investigation

19 July 2011 *Version 1.0* *Page 12 of 24*

Conservation objectives for: Clew Bay Complex SAC [001482]

1150 * Coastal lagoons

To maintain the favourable conservation condition of Lagoons in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Depth of submergent macrophyte colonisation	Metres	Maintain/increase the depth of submergent macrophyte colonisation of the lagoon	Increased depth of colonisation increases both the extent and diversity of submergent macrophytes. In comparison with similar lagoons the extent of submergent macrophyte colonisation in Furnace Lough appears to be restricted probably due to high water colour. However data on the depth of colonisation and water colour and the relationship between them is lacking. It is also possible that anoxia may be a problem, at least in some areas. These issues need to be investigated
Typical plant species	Number and m^2	Maintain number and extent of listed lagoonal specialists, subject to natural variation	Species in Furnace Lough listed in Oliver (2007), Hatch (1996) and Hatch and Healy (1998). A very limited number of plant species are currently listed for the site based on a series of shallow water transects. A snorkelling survey of this complex lagoon is required establish if that list is fully representative of the flora of the lagoon
Typical animal species	Number	Maintain listed lagoon specialists, subject to natural variation	Species in Furnace Lough listed in Oliver (2007), which rated the aquatic fauna as of moderate-high conservation value based on its high diversity and the presence of rare and unexpected crustaceans
Negative indicator species	Number and % cover	Negative indicator species absent or under control	Eutrophication would favour phytoplankton blooms at the expense of submerged macrophytes

Conservation objectives for: Clew Bay Complex SAC [001482]

1160 Large shallow inlets and bays

To maintain the favourable conservation condition of Large shallow inlets and bays in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes. See map 3	Habitat area was estimated using OSI data as 10189ha. See marine supporting document for further details.
Community extent	Hectares	Maintain the natural extent of the *Zostera* dominated and maërl dominated communities. See map 4	The likely extent of the *Zostera* dominated and maërl dominated communities was derived from the acoustic survey and the dive survey undertaken in 2006. See marine supporting document for further details
Shoot density	Shoots per m^2	Maintain the high quality of *Zostera* dominated community	2006 diver observation and underwater viewer. See marine supporting document for further details
Community structure	Biological composition	Maintain the high quality of maërl dominated communities	Area established from an acoustic mapping survey 2003 and a 2006 diver observation and underwater viewer. See marine supporting document for further details
Community distribution	Hectares	The following communities should be maintained in a natural condition: Sandy mud with polychaetes and bivalves community complex; Fine sand dominated by *Nephtys cirrosa* community; Intertidal sandy mud with *Tubificoides benedii* and *Pygospio elegans* community complex; Shingle; and Reef. See map 4	The likely area of sediment communities was derived from a combination of acoustic mapping survey in 2003, intertidal data from 1999, 2006 and 2009 and subtidal data obtained in 1999 and 2009. See marine supporting document for further details

Conservation objectives for: Clew Bay Complex SAC [001482]

1210 Annual vegetation of drift lines

To maintain the favourable conservation condition of Annual vegetation of driftlines in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-sites mapped: Bartraw - 0.04ha and Rosmurrevagh - 0.08ha. See map 7	Current area unknown. Two sub-sites (Bartraw and Rosmurrevagh) were mapped during the Coastal Monitoring Project (Ryle et al., 2009), giving a total estimated area of 0.12ha. NB further unsurveyed areas maybe present in the site. Habitat is very difficult to measure in view of its dynamic nature which means that it can appear and disappear within a site from year to year. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, subject to natural processes	Current distribution unknown. Majority of habitat found at Bartraw and Rosmurrevagh, although there may be additional patches distributed throughout the site. See coastal habitats supporting document for further details
Physical structure: functionality and sediment supply	Presence/absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Accumulation of organic matter in tidal litter is essential for trapping sand and initiating dune formation. Physical barriers can lead to fossilisation or over-stabilisation of dunes, as well as beach starvation resulting in increased rates of erosion. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative number of monitoring stops	Maintain the presence of species-poor communities with typical species: *Cakile maritima, Honckenya peploides*, *Salsola kali* and *Atriplex* spp.	Based on data from Ryle et al. (2009) . See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover	Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. Based on data from Ryle et al. (2009). See coastal habitats supporting document for further details

Conservation objectives for: Clew Bay Complex SAC [001482]

1210 Annual vegetation of drift lines

To maintain the favourable conservation condition of Annual vegetation of driftlines in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-sites mapped: Bartraw - 0.04ha and Rosmurrevagh - 0.08ha. See map 7	Current area unknown. Two sub-sites (Bartraw and Rosmurrevagh) were mapped during the Coastal Monitoring Project (Ryle et al., 2009), giving a total estimated area of 0.12ha. NB further unsurveyed areas maybe present in the site. Habitat is very difficult to measure in view of its dynamic nature which means that it can appear and disappear within a site from year to year. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, subject to natural processes	Current distribution unknown. Majority of habitat found at Bartraw and Rosmurrevagh, although there may be additional patches distributed throughout the site. See coastal habitats supporting document for further details
Physical structure: functionality and sediment supply	Presence/absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Accumulation of organic matter in tidal litter is essential for trapping sand and initiating dune formation. Physical barriers can lead to fossilisation or over-stabilisation of dunes, as well as beach starvation resulting in increased rates of erosion. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative number of monitoring stops	Maintain the presence of species-poor communities with typical species: *Cakile maritima, Honckenya peploides*, *Salsola kali* and *Atriplex* spp.	Based on data from Ryle et al. (2009) . See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover	Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. Based on data from Ryle et al. (2009). See coastal habitats supporting document for further details

Conservation objectives for: Clew Bay Complex SAC [001482]

1220 Perennial vegetation of stony banks

To maintain the favourable conservation condition of Perennial vegetation of stony banks in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession	Current area unknown, but Clew Bay is considered to have the largest shingle reserves in the country. It was recorded from Clew Bay Complex, Bartraw and Rosmurrevagh during the National Shingle Beach Survey (Moore and Wilson, 1999), but the extent was not mapped. The Coastal Monitoring Project mapped 0.48ha of this habitat at Bartraw and 0.01ha at Rosmurrevagh (Ryle et al., 2009). The extent is considerably greater than this figure, as substantial shingle deposits are known to occur in association with many of the drumlins in Clew Bay. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, subject to natural processes	Distribution unknown at present, although the habitat has been recorded at Clew Bay Complex (Moore and Wilson, 1999), as well as Bartraw and Rosmurrevagh (Moore and Wilson, 1999; Ryle et al., 2009). See coastal habitats supporting document for further details
Physical structure: Functionality and sediment supply	Presence/absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Site represents the only known example of incipient gravel barrier formation in the country. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Moore and Wilson (1999) and Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative sample of monitoring stops	Maintain the presence of species-poor communities with typical species: *Honckenya peploides*, *Beta vulgaris* ssp. *maritima*, *Crithmum maritimum*, *Tripleurospermum maritimum*, *Glaucium flavum* and *Silene uniflora*	Based on data from Moore and Wilson (1999) and Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover	Based on data from Moore and Wilson (1999) and Ryle et al. (2009). Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. See coastal habitats supporting document for further details

Conservation objectives for: Clew Bay Complex SAC [001482]

1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

To restore the favourable conservation condition of Atlantic salt meadows in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-sites mapped: Mallaranny - 19.76ha, Tooreen - 1.06ha, Rosmurrevagh - 6.40ha, Tierna - 0.39ha, Rockfleet Castle - 0.37ha, Rosharnagh East - 0.03ha, Caraholly - 0.36ha, Kiladangan - 0.96ha, Annagh Island - 5.23ha, Bartraw - 0.38ha. See map 6	Based on data from the Saltmarsh Monitoring Project (McCorry, 2007). Ten sub-sites were mapped (34.94ha) and additional areas of potential saltmarsh (3.92ha) were identified for an examination of aerial photographs, giving a total estimated area of 38.86ha. NB further unsurveyed areas maybe present within the site. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 6 for known distribution	Based on data from McCorry (2007). See coastal habitats supporting document for further details
Physical structure: sediment supply	Presence/absence of physical barriers	Maintain/restore natural circulation of sediments and organic matter, without any physical obstructions	See coastal habitats backing document for further details
Physical structure: creeks and pans	Occurrence	Maintain creek and pan structure, subject to natural processes, including erosion and succession	Based on data from McCorry (2007). The efficiency of sediment circulation throughout a saltmarsh depends on the creek pattern. See coastal habitats supporting document for further details
Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime	See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from McCorry and Ryle (2009). See coastal habitats supporting document for further details
Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward	Based on data from McCorry (2007). See coastal habitats supporting document for further details
Vegetation structure: vegetation cover	Percentage cover at a representative sample of monitoring stops	Maintain more than 90% area outside creeks vegetated.	Based on data from McCorry (2007). See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative sample of monitoring stops	Maintain range of sub-communities with typical species listed in Saltmarsh Monitoring Project (McCorry & Ryle, 2009)	Based on data from McCorry (2007). See coastal habitats supporting document for further details

Conservation objectives for: Clew Bay Complex SAC [001482]

1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

To restore the favourable conservation condition of Atlantic salt meadows in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Vegetation structure: negative indicator species - *Spartina anglica*	Hectares	No significant expansion of *Spartina*. No new sites for this species and an annual spread of less than 1% where it is already known to occur	Based on data from McCorry (2007). See coastal habitats supporting document for further details

Conservation objectives for: Clew Bay Complex SAC [001482]

1355 Otter *Lutra lutra*

To restore the favourable conservation condition of Otter in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Percentage positive survey sites	No significant decline	Measure based on standard otter survey technique. FCS target, based on 1980/81 survey findings, is 88% in SACs. Current range in west estimated at 70% (Bailey and Rochford, 2006)
Extent of terrestrial habitat	Hectares	No significant decline. Area mapped and calculated as 233.1ha above high water mark (HWM); 47.3ha along river banks/ around ponds	No field survey. Areas mapped to include 10m terrestrial buffer along shoreline (above HWM and along river banks) identified as critical for otters (NPWS, 2007)
Extent of marine habitat	Hectares	No significant decline. Area mapped and calculated as 2426.7ha	No field survey. Area mapped based on evidence that otters tend to forage within 80m of the shoreline (HWM) (NPWS, 2007; Kruuk, 2006)
Extent of freshwater (river) habitat	Kilometres	No significant decline. Length mapped and calculated as 10.2km	No field survey. River length calculated on the basis that otters will utilise freshwater habitats from estuary to headwaters (Chapman and Chapman, 1982)
Extent of freshwater (lake/lagoon) habitat	Hectares	No significant decline. Area mapped and calculated as 141.3ha	No field survey. Area mapped based on evidence that otters tend to forage within 80m of the shoreline (NPWS, 2007)
Couching sites and holts	Number	No significant decline	Otters need lying up areas throughout their territory where they are secure from disturbance (Kruuk, 2006; Kruuk and Moorhouse, 1991)
Fish biomass available	Kilograms	No significant decline	Broad diet that varies locally and seasonally, but dominated by fish, in particular salmonids, eels and sticklebacks in freshwater (Bailey and Rochford, 2006) and wrasse and rockling in coastal waters (Kingston et al., 1999)
Barriers to connectivity	Number	No significant increase. For guidance, see map 8	Otters will regularly commute across stretches of open water up to 500m. e.g. between the mainland and an island; between two islands; across an estuary (De Jongh and O'Neill, 2010). It is important that such commuting routes are not obstructed

Conservation objectives for: Clew Bay Complex SAC [001482]

1365 Common seal *Phoca vitulina*

To maintain the favourable conservation condition of Harbour seal in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use	See marine supporting document for further details
Breeding behaviour	Breeding sites	The breeding sites should be maintained in a natural condition. See map 9	Attribute and target based on background knowledge of Irish breeding populations, review of data from Lyons (2004) and unpublished National Parks and Wildlife Service records. See marine supporting document for further details
Moulting behaviour	Moult haul-out sites	The moult haul-out sites should be maintained in a natural condition. See map 9	Attribute and target based on background knowledge of Irish populations, review of data from Lyons (2004), Cronin et al. (2004) and unpublished National Parks and Wildlife Service records. See marine supporting document for further details
Resting behaviour	Resting haul-out sites	The resting haul-out sites should be maintained in a natural condition. See map 9	Attribute and target based on background knowledge of Irish populations, review of data from Lyons (2004) and unpublished National Parks and Wildlife Service records. See marine supporting document for further details
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the harbour seal population at the site	See marine supporting document for further details

19 July 2011 *Version 1.0* *Page 20 of 24*

Conservation objectives for: Clew Bay Complex SAC [001482]

2110 Embryonic shifting dunes

To restore the favourable conservation condition of Embryonic shifting dunes in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-sites mapped: Bartraw - 0.02ha and Rosmurrevagh - 1.38ha. See map 7	Current area unknown. Two sub-sites (Bartraw and Rosmurrevagh) were mapped during the Coastal Monitoring Project (Ryle et al., 2009), giving a total estimated area of 1.40ha. NB further unsurveyed areas maybe present in the site. Habitat is very difficult to measure in view of its dynamic nature. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 7 for known distribution	Mobile dunes are well developed at Rosmurrevagh, while those at Bartraw have been compromised by the installation of coastal protection works. See coastal habitats supporting document for further details
Physical structure: functionality and sediment supply	Presence/absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Physical barriers can lead to fossilisation or over-stabilisation of dunes, as well as beach starvation resulting in increased rates of erosion. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation composition: plant health of foredune grasses	Percentage cover	More than 95% of *Elytrigia* and/or *Leymus* should be healthy (i.e. green plant parts above ground and flowering heads present)	Based on data from Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover	Maintain the presence of species-poor communities with typical species: *Elytrigia juncea* and/or *Leymus arenarius*	Based on data from Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover	Based on data from Ryle et al. (2009). Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. Sea-buckthorn (Hippophae rhamnoides) should be absent or effectively controlled. See coastal habitats supporting document for further details

Conservation objectives for: Clew Bay Complex SAC [001482]

2120 Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")

To restore the favourable conservation condition of Shifting dunes along the shoreline with Ammophila arenaria in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes including erosion and succession. For sub-sites mapped: Bartraw - 0.18ha and Rosmurrevagh - 0.36ha. See map 7	Current area unknown. Two sub-sites (Bartraw and Rosmurrevagh) were mapped during the Coastal Monitoring Project (Ryle et al., 2009), giving a total estimated area of 0.54ha. NB further unsurveyed areas maybe present in the site. Habitat is very difficult to measure in view of its dynamic nature. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 7 for known distribution	Mobile dunes are well developed at Rosmurrevagh, while those at Bartraw have been compromised by the installation of coastal protection works. See coastal habitats supporting document for further details
Physical structure: functionality and sediment supply	Presence/absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Dunes are naturally dynamic systems that require continuous supply and circulation of sand. *Ammophila* reproduces vegetatively and requires constant accretion of fresh sand to maintain active growth encouraging further accretion. Physical barriers can lead to fossilisation or over-stabilisation of dunes, as well as beach starvation resulting in increased rates of erosion. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Gaynor (2008) and Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation composition: plant health of dune grasses	Percentage cover	More than 95% of *Ammophila* and/or *Leymus* should be healthy (i.e. green plant parts above ground and flowering heads present)	Based on data from Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative number of monitoring stops	Maintain the presence of species-poor communities dominated by *Ammophila arenaria* and/or *Leymus arenarius*	Based on data from Gaynor (2008) and Ryle et al. (2009). See coastal habitats supporting document for further details

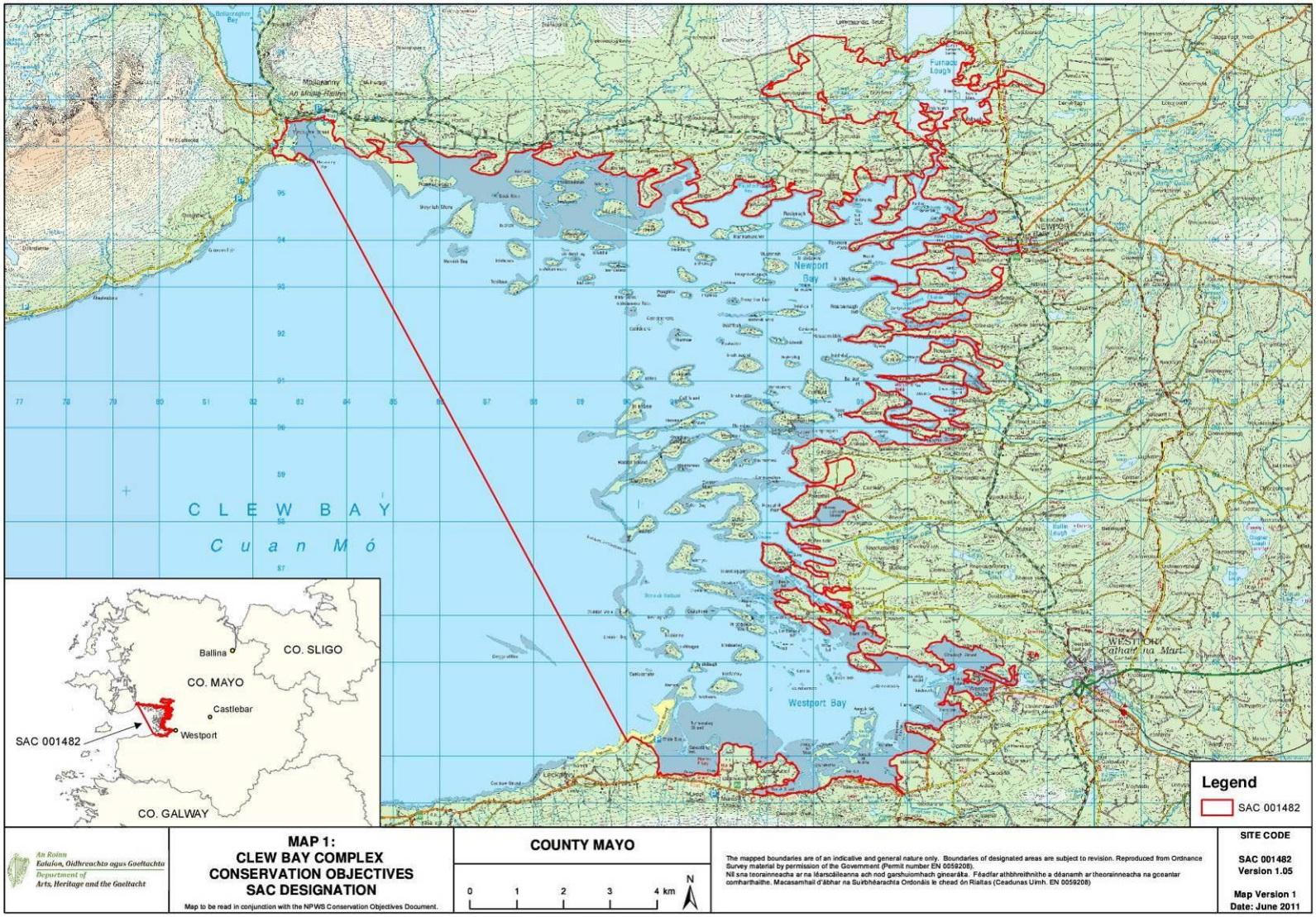
19 July 2011 *Version 1.0* *Page 22 of 24*

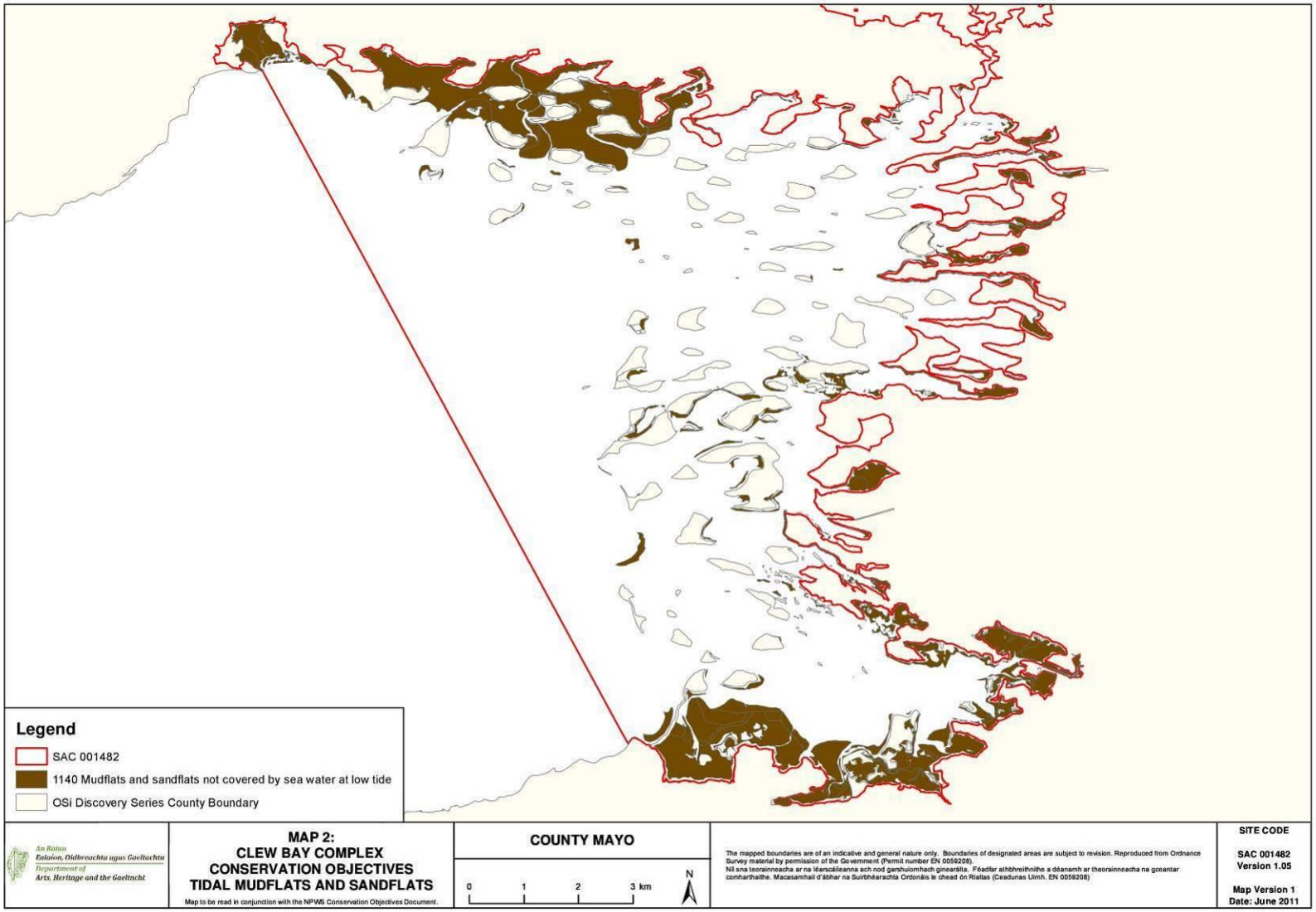
Conservation objectives for: Clew Bay Complex SAC [001482]

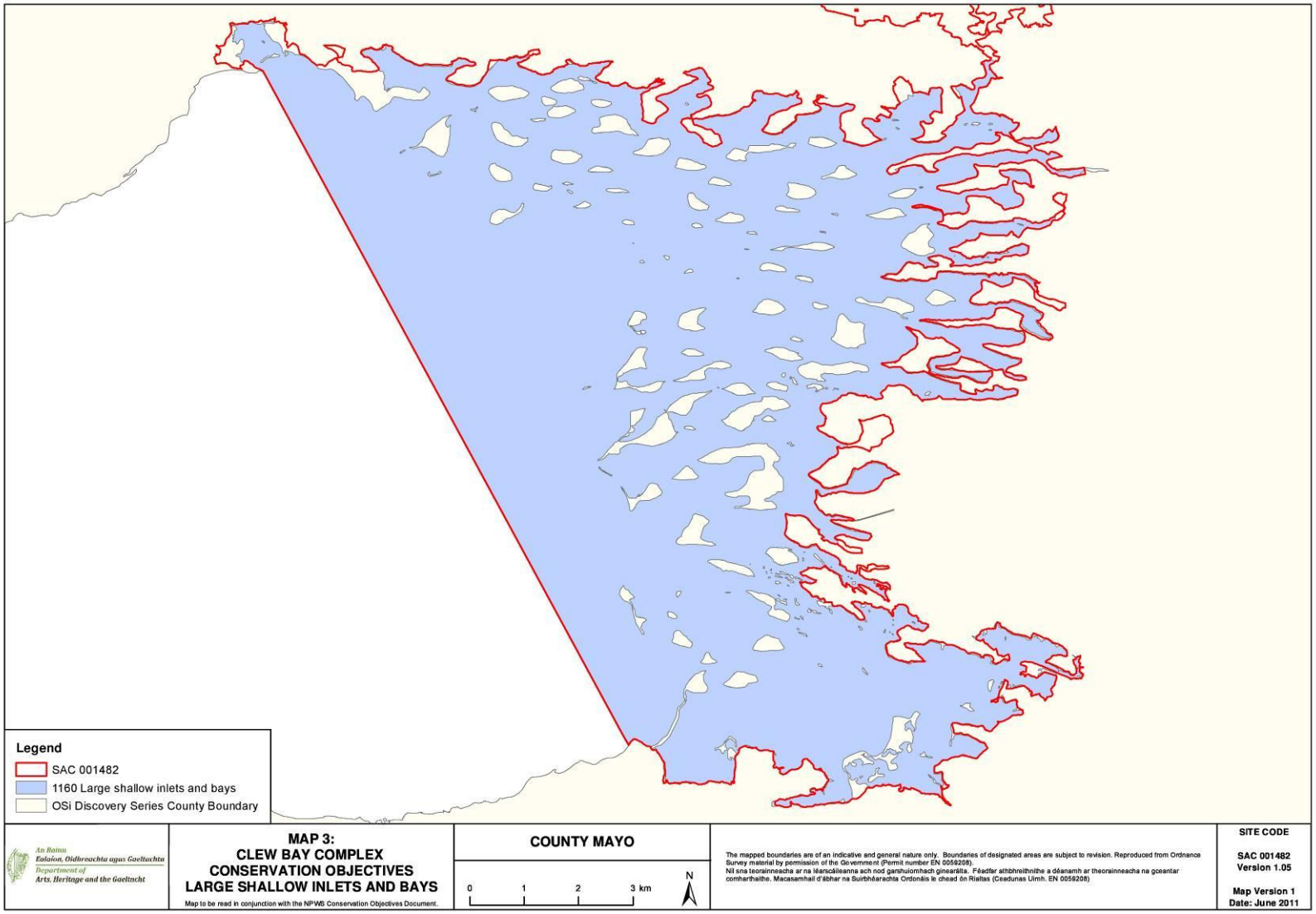
2120 Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")

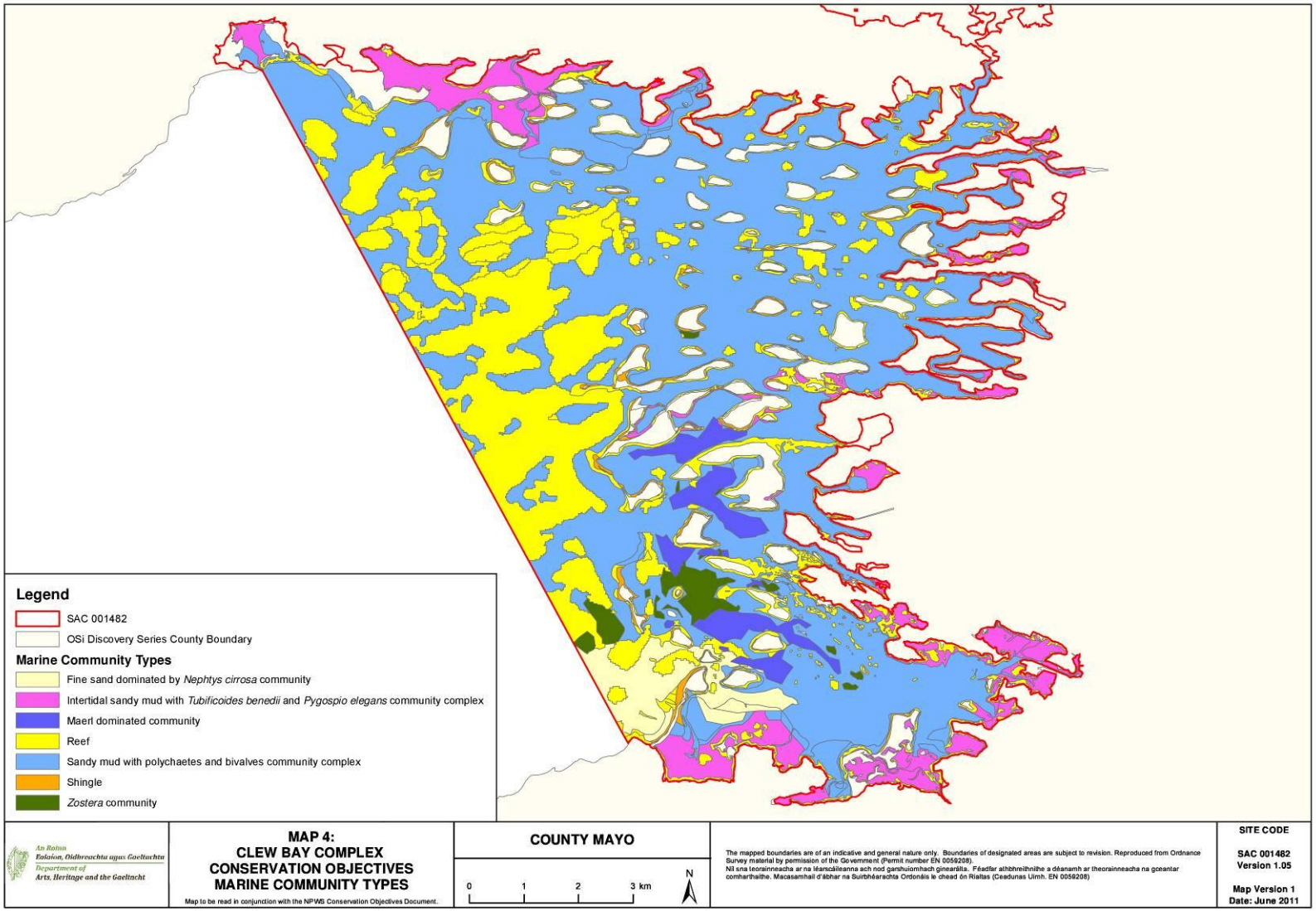
To restore the favourable conservation condition of Shifting dunes along the shoreline with Ammophila arenaria in Clew Bay Complex SAC, which is defined by the following list of attributes and targets:

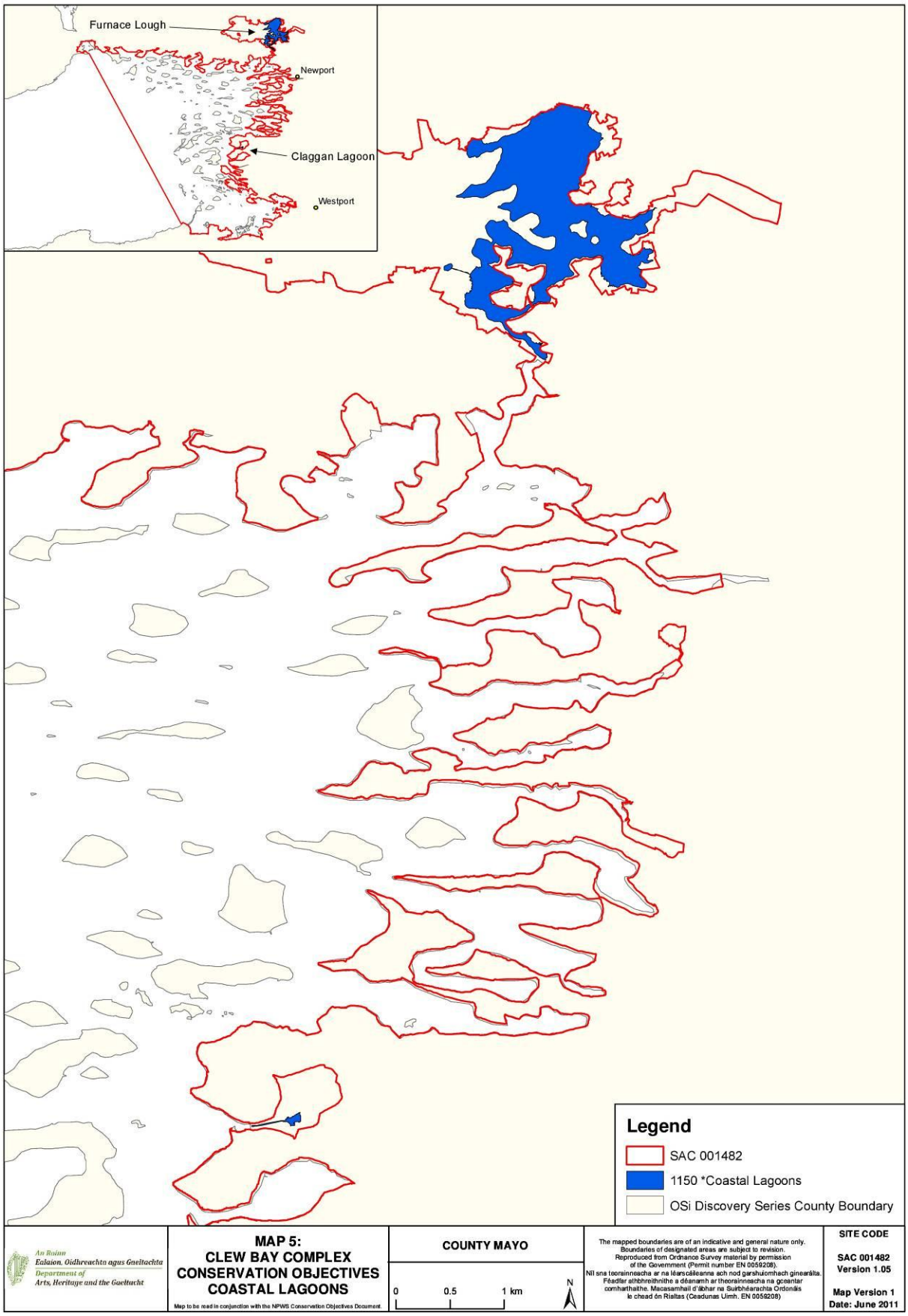
Attribute	Measure	Target	Notes
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover	Based on data from Ryle et al. (2009). Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. Sea-buckthorn (*Hippophae rhamnoides*) should be absent or effectively controlled. See coastal habitats supporting document for further details

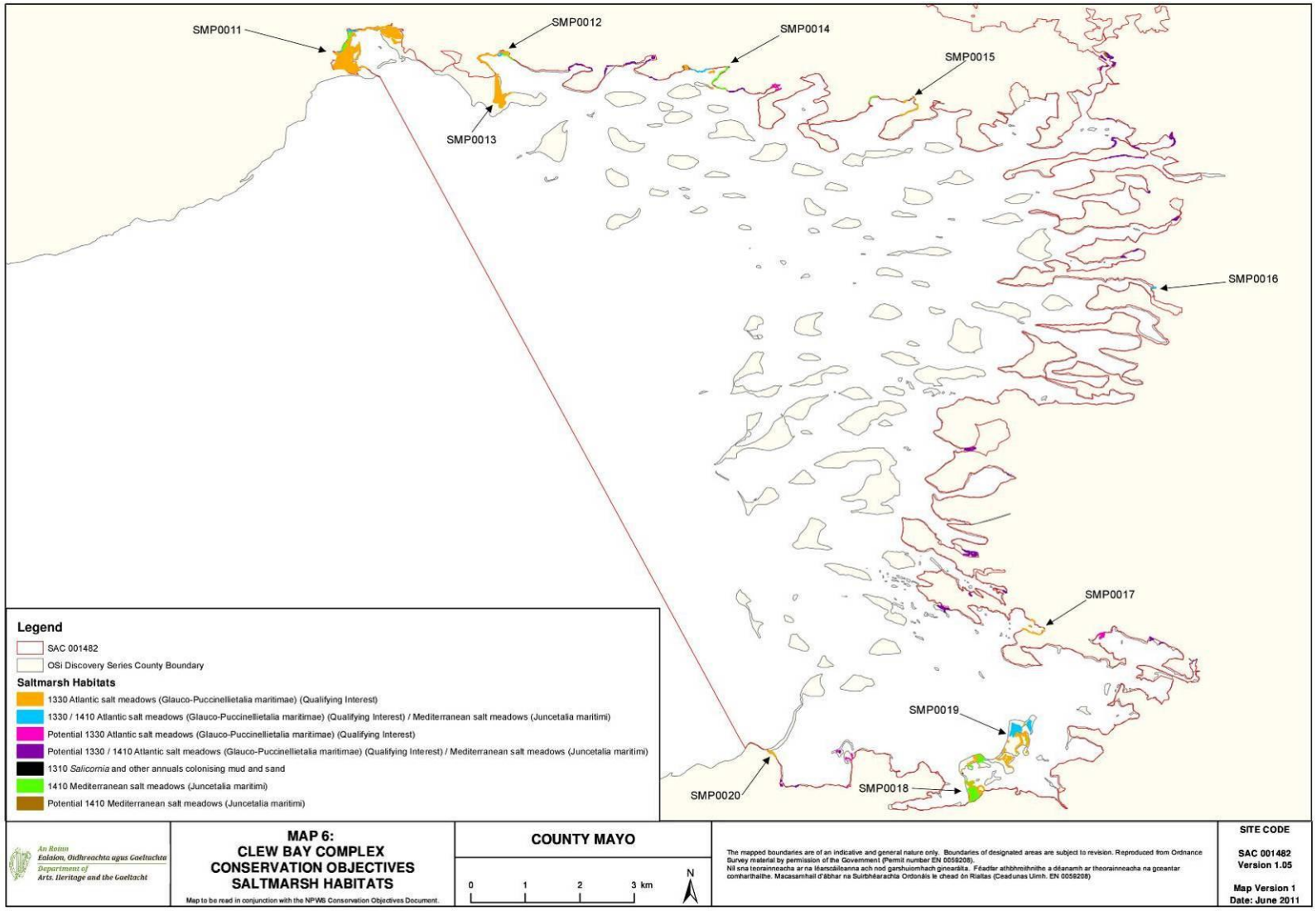

C L E W B A Y
C u a n M ó
Newport Bay
Westport Bay
Furnace Lough
Ballina
CO. SLIGO
CO. MAYO
Castlebar
Westport
SAC 001482
CO. GALWAY
Legend
SAC 001482
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MAP 1:
CLEW BAY COMPLEX
CONSERVATION OBJECTIVES
SAC DESIGNATION
Map to be read in conjunction with the NPWS Conservation Objectives Document.
COUNTY MAYO
0 1 2 3 4 km
N
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
SITE CODE
SAC 001482
Version 1.05
Map Version 1
Date: June 2011

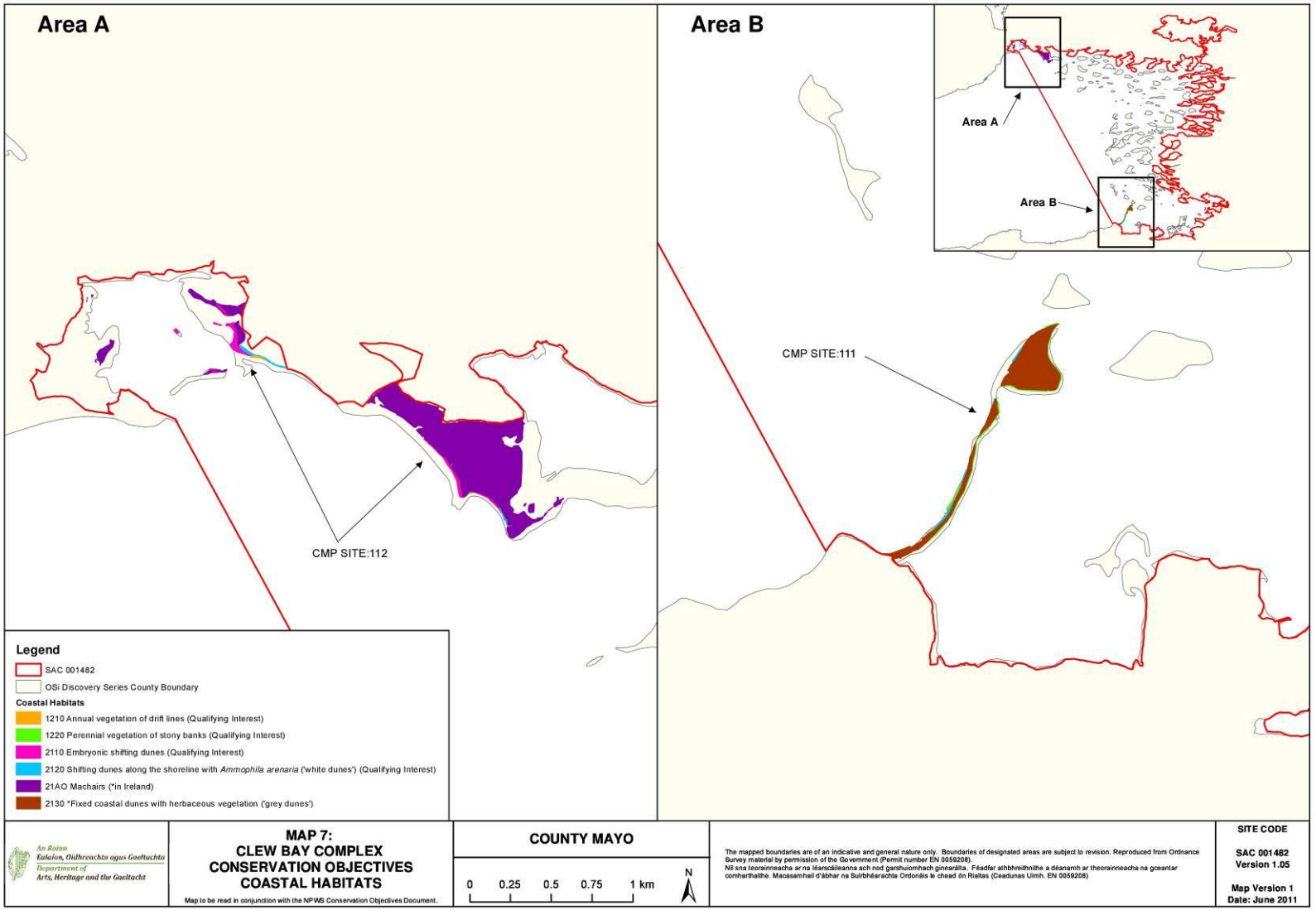

Legend
SAC 001482
1140 Mudflats and sandflats not covered by sea water at low tide
OSi Discovery Series County Boundary
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MAP 2:
CLEW BAY COMPLEX
CONSERVATION OBJECTIVES
TIDAL MUDFLATS AND SANDFLATS
Map to be read in conjunction with the NPWS Conservation Objectives Document.
COUNTY MAYO
0 1 2 3 km
N
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach gineardta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadúnas Uimh. EN 0059208)
SITE CODE
SAC 001482
Version 1.05
Map Version 1
Date: June 2011

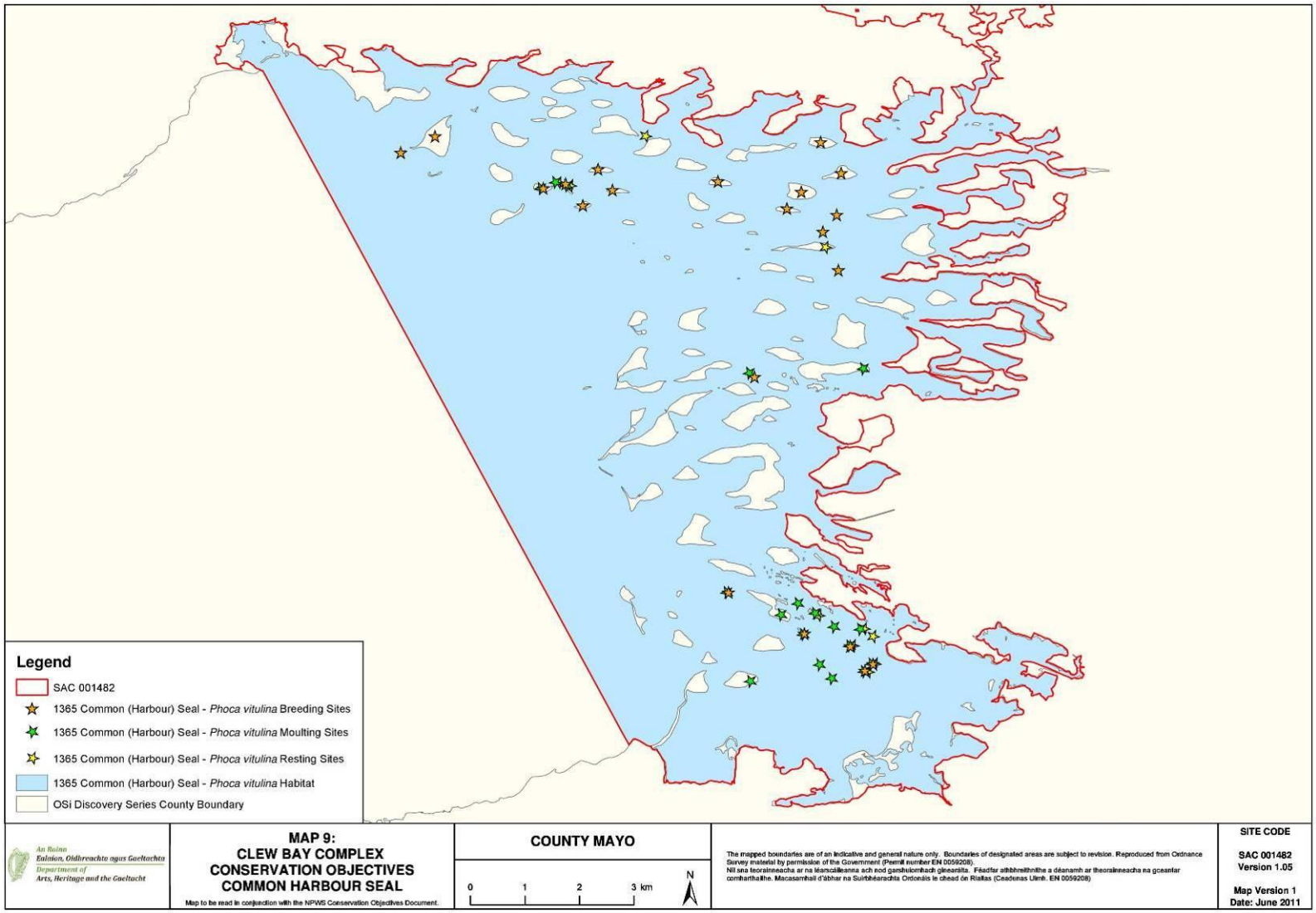

Legend
SAC 001482
1160 Large shallow inlets and bays
OSi Discovery Series County Boundary
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MAP 3:
CLEW BAY COMPLEX
CONSERVATION OBJECTIVES
LARGE SHALLOW INLETS AND BAYS
Map to be read in conjunction with the NPWS Conservation Objectives Document.
COUNTY MAYO
0 1 2 3 km
N
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéireachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
SITE CODE
SAC 001482
Version 1.05
Map Version 1
Date: June 2011

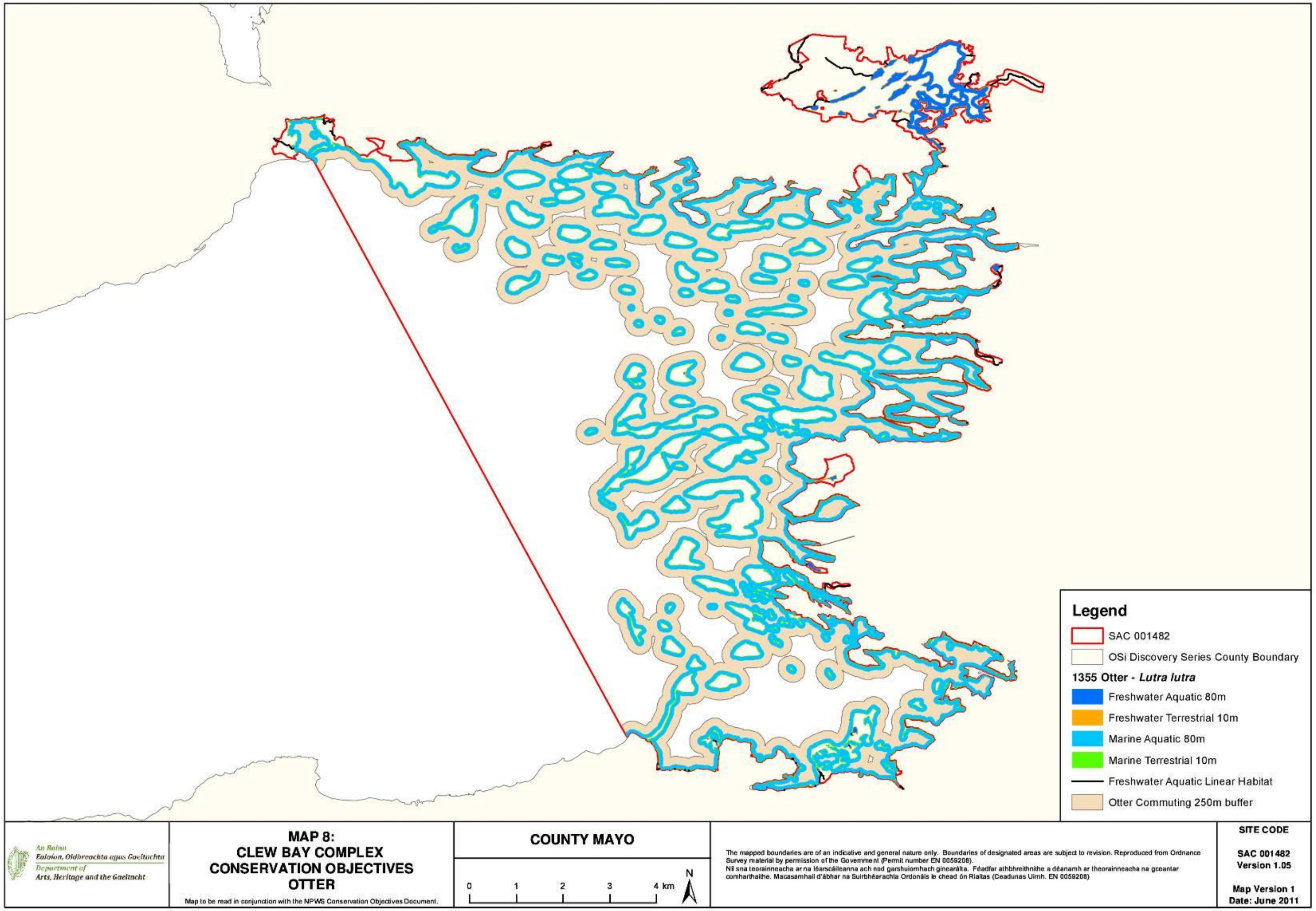

Legend
SAC 001482
OSi Discovery Series County Boundary
Marine Community Types
Fine sand dominated by Nephtys cirrosa community
Intertidal sandy mud with Tubificoides benedii and Pygospio elegans community complex
Maerl dominated community
Reef
Sandy mud with polychaetes and bivalves community complex
Shingle
Zostera community
An Roinn Tealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MAP 4:
CLEW BAY COMPLEX
CONSERVATION OBJECTIVES
MARINE COMMUNITY TYPES
Map to be read in conjunction with the NPWS Conservation Objectives Document.
COUNTY MAYO
0 1 2 3 km
N
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Nil sna leoranneacha ar na léarscáileanna ach nod garshuiomhach gineartha. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéireachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
SITE CODE
SAC 001482
Version 1.05
Map Version 1
Date: June 2011


Furnace Lough
Newport
Claggan Lagoon
Westport
Legend
SAC 001482
1150 *Coastal Lagoons
OSi Discovery Series County Boundary
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MAP 5:
CLEW BAY COMPLEX
CONSERVATION OBJECTIVES
COASTAL LAGOONS
Map to be read in conjunction with the NPWS Conservation Objectives Document.
COUNTY MAYO
0 0.5 1 km
N
The mapped boundaries are of an indicative and general nature only.
Boundaries of designated areas are subject to revision.
Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Nil sna teorainneacha ar na léarscáileanna ach nod garshuíomhach ginearálta.
Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadúnas Uimh. EN 0059208)
SITE CODE
SAC 001482
Version 1.05
Map Version 1
Date: June 2011


SMP0011
SMP0012
SMP0013
SMP0014
SMP0015
SMP0016
SMP0017
SMP0018
SMP0019
SMP0020
Legend
SAC 001482
OSi Discovery Series County Boundary
Saltmarsh Habitats
1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (Qualifying Interest)
1330 / 1410 Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (Qualifying Interest) / Mediterranean salt meadows (Juncetalia maritimi)
Potential 1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (Qualifying Interest)
Potential 1330 / 1410 Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (Qualifying Interest) / Mediterranean salt meadows (Juncetalia maritimi)
1310 Salicornia and other annuals colonising mud and sand
1410 Mediterranean salt meadows (Juncetalia maritimi)
Potential 1410 Mediterranean salt meadows (Juncetalia maritimi)
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MAP 6:
CLEW BAY COMPLEX
CONSERVATION OBJECTIVES
SALTMARSH HABITATS
Map to be read in conjunction with the NPWS Conservation Objectives Document.
COUNTY MAYO
0 1 2 3 km
N
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Níl sna teorainneacha ar na tírsaibleanna ach nod garshuiomhach gineardlíla. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'obair na Suirbhéireachta Ordonáis le chead ón Rialtas (Ceadúnas Uimh. EN 0059208)
SITE CODE
SAC 001482
Version 1.05
Map Version 1
Date: June 2011


Area A
Area B
Area A
Area B
CMP SITE:112
CMP SITE:111
Legend
SAC 001482
OSi Discovery Series County Boundary
Coastal Habitats
1210 Annual vegetation of drift lines (Qualifying Interest)
1220 Perennial vegetation of stony banks (Qualifying Interest)
2110 Embryonic shifting dunes (Qualifying Interest)
2120 Shifting dunes along the shoreline with Ammophila arenaria ('white dunes') (Qualifying Interest)
21A0 Machairs (*in Ireland)
2130 *Fixed coastal dunes with herbaceous vegetation ('grey dunes')
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MAP 7:
CLEW BAY COMPLEX
CONSERVATION OBJECTIVES
COASTAL HABITATS
Map to be read in conjunction with the NPWS Conservation Objectives Document.
COUNTY MAYO
0 0.25 0.5 0.75 1 km
N
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéireachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
SITE CODE
SAC 001482
Version 1.05
Map Version 1
Date: June 2011


Legend
SAC 001482
1365 Common (Harbour) Seal - Phoca vitulina Breeding Sites
1365 Common (Harbour) Seal - Phoca vitulina Moulting Sites
1365 Common (Harbour) Seal - Phoca vitulina Resting Sites
1365 Common (Harbour) Seal - Phoca vitulina Habitat
OSi Discovery Series County Boundary
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MAP 9:
CLEW BAY COMPLEX
CONSERVATION OBJECTIVES
COMMON HARBOUR SEAL
Map to be read in conjunction with the NPWS Conservation Objectives Document.
COUNTY MAYO
0 1 2 3 km
N
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Nil sna teorainneacha ar na léarscáileanna ach nod garsheomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéireachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
SITE CODE
SAC 001482
Version 1.05
Map Version 1
Date: June 2011


Legend
SAC 001482
OSi Discovery Series County Boundary
1355 Otter - Lutra lutra
Freshwater Aquatic 80m
Freshwater Terrestrial 10m
Marine Aquatic 80m
Marine Terrestrial 10m
Freshwater Aquatic Linear Habitat
Otter Commuting 250m buffer
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
MAP 8:
CLEW BAY COMPLEX
CONSERVATION OBJECTIVES
OTTER
Map to be read in conjunction with the NPWS Conservation Objectives Document.
COUNTY MAYO
0 1 2 3 4 km
N
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuíomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadunas Uimh. EN 0059208)
SITE CODE
SAC 001482
Version 1.05
Map Version 1
Date: June 2011

An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht

Produced by: National Parks and Wildlife Service,
Department of Arts, Heritage and the Gaeltacht,
7 Ely Place, Dublin 2, Ireland.
Web: www.npws.ie
E-mail: natureconservation@environ.ie

Citation:
NPWS (2011) Conservation Objectives: Clew Bay Complex SAC 001482. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Series Editors: Rebecca Jeffrey & Naomi Kingston
ISSN 2009-4086

APPENDIX 3 BioAtlantis Compliance and Record Forms

28/10/2014

BioAtlantis
Nature Working Naturally™

License Application for Sustainable hand-harvesting of *Ascophyllum nodosum* at Clew Bay (SAC Site Code 1482). In accordance with National Parks & Wildlife Service conservation objectives for marine and coastal habitats and species and the EU Habitats Directive 92/43/EEC.

Appendix 3:
Compliance & Record forms.

Prepared by: BioAtlantis Ltd.
Date of submission: 20/01/2014
Date of revision: 28/10/2014

BioAtlantis Ltd,
Kerry Technology Park,
Tralee,
Co. Kerry

Page 1

28/10/2014

BioAtlantis

Contents

Goods Received Note (GRN) 3

Non-Conformance Report (NCR) Form (G012) 4

Incident Report Form (IRF, G008) 5

Document No. GRN/14/001

BioAtlantis

Goods Received Note (GRN)

GRN No. :

Date: _____

Harvested By: _____ _____

_____ _____

Site Code	Time of Collection	Tidal conditions at time of collection	Bag tag No.	Weight (Kg)	Batch Code No.	Inspection Check Pass (Y/N)

Quality Check	**Yes**	**No**
Is seaweed free of the following:		
Sand, gravel, stones or debris	☐	☐
A. nodosum holdfasts	☐	☐
Other species (e.g. Fucus, <1% max.)	☐	☐
Assessment of harvest operations		
Have harvesters worked to ensure:		
1. Cutting of *A. nodosum* >200mm above holdfast	☐	☐
2. No more than 20% of area is harvested	☐	☐
3. Activities only take place at approved sites	☐	☐
4. Health and safety requirements are adhered to	☐	☐

In the event of failure of quality check:

a) Non-conformance is reported to: _____

b) Management decide the appropriate action depending on the severity of the non-conformance.

Comments:_____
_____
_____
_____
_____
_____

Comments/Incidents:_____
_____
_____
_____

Goods Received By: _____ **Checked By:** _____

Please attach delivery docket and send to main office

OFFICE USE ONLY

Payment approved: Yes ☐ No ☐ Payment date & Ref. no.: _____

BioAtlantis Ltd., Kerry Technology Park, Tralee, Co. Kerry, Ireland. Tel: +353 (0) 66 7118477 Fax: +353 (0) 66 7119802
Email: info@bioatlantis.com Website: www.bioatlantis.com

Registration No 377737 VAT No.: IE 6397737B

BioAtlantis

Non-Conformance Report (NCR) Form (G012)

Date: _____

Time of incident: _____

Time incident reported: _____

Reported by: _____

Description of Incident: _____

Cause of Incident: _____

_____

_____

_____

Corrective Action? _____

_____

Preventative Action? _____

_____

Reported By: _____ Date: _____

Incident Complete: _____ Date: _____

Resource Manager: _____ Date: _____

BioAtlantis Ltd., Kerry Technology Park, Tralee, Co. Kerry, Ireland. Tel: +353 (0) 66 7118477 Fax: +353 (0) 66 7119802
Email: info@bioatlantis.com Website: www.bioatlantis.com

Registration No 377737 VAT No.: IE 6397737B

BioAtlantis

Incident Report Form (IRF, G008)

Date: _____

Time of incident: _____

Time incident reported: _____

Reported by: _____

Description of Incident: _____

Cause of Incident: _____

_____

_____

_____

Corrective Action? _____

_____

Preventative Action? _____

_____

Reported By: _____ Date: _____

Incident Complete: _____ Date: _____

Resource Manager: _____ Date: _____

BioAtlantis Ltd., Kerry Technology Park, Tralee, Co. Kerry, Ireland. Tel: +353 (0) 66 7118477 Fax: +353 (0) 66 7119802
Email: info@bioatlantis.com Website: www.bioatlantis.com

Registration No 377737 VAT No.: IE 6397737B

APPENDIX 4 BioAtlantis Code of Practice

License Application for Sustainable hand-harvesting of *Ascophyllum nodosum* at Clew Bay (SAC Site Code 1482). In accordance with National Parks & Wildlife Service conservation objectives for marine and coastal habitats and species, and the EU Habitats Directive 92/43/EEC.

Appendix 4:
Code of Practice for *A. nodosum* harvest activities in Clew Bay SAC.

Prepared by: BioAtlantis Ltd.
Date of submission: 20/01/2014
Date of revision: 04/11/2014

BioAtlantis Ltd,
Kerry Technology Park,
Tralee,
Co. Kerry.

Contents

SECTION 1: SUSTAINABLE HAND HARVEST OF A. NODOSUM 138

1.1. INTRODUCTION 138
1.2 SECURING THE CODE OF PRACTICE DURING THE OPERATION PHASE 138
1.3 THE CODE OF PRACTICE FOR HARVESTING *A. NODOSUM* SUSTAINABLY 140
Management 140
Resource Database 141
Certificate to harvest 141
Navigation to harvest sites 141
Equipment 141
Harvest Records: 142
Accident and Incident Reporting: 142
Harvest of A. nodosum: 142
Completion of harvest and subsequent pick-up: 144
Quality Check: 144
Assessment of harvest operations 145
By-catch: 145
Harvest Quantity 145
BioAtlantis batch code 145
Health and safety: 145
Communicating with BioAtlantis: 145

SECTION 2: PROTECTION OF THE HARBOUR SEAL, BIRDS & OTTERS 146

2.1 INTRODUCTION 146
2.2 THE CODE OF PRACTICE 146
General Measures: 147
Site Specific measures: 147
2.3 WORKING SUMMARY OF THE CODE OF PRACTICE: 148
Harbour Seals 148
Birds (Breeding and Wintering) 149
Otters 149
Preventing interactions with tourism & recreation: 150

SECTION 3: ENVIRONMENTALLY SAFE NAVIGATION 153

INTRODUCTION: 153
THE CODE OF PRACTICE FOR PROTECTING MUDFLAT, SANDFLAT, INTERTIDAL SANDY MUD, FINE-SAND, ATLANTIC SALT MEADOW, SHINGLE AND REEF AREAS. 153

SECTION 4: WORKING IN THE VICINITY OF TOURISM AND RECREATION FACILITIES 154

SECTION 5: WORKING IN THE VICINITY OF AQUACULTURE SITES 154

SECTION 6: WORKING IN THE VICINITY OF ANGLERS 155

SECTION 7: OTHER HARVESTING ACTIVITIES 155

SECTION 8: PREVENTING THE SPREAD OF INVASIVE SPECIES 155

REFERENCES 156

SECTION 1: Sustainable hand harvest of A. nodosum

1.1. Introduction

The following rules and best practice guidelines have been developed on the basis of findings from the peer reviewed literature, best scientific knowledge and previous surveys carried out in the Clew Bay Complex. See Section 3.3.5 of the main text document (BioAtlantis Foreshore Licence Application, 2014) for more details. The guidelines described here must be adhered to by all staff and harvesters supplying *A. nodosum* to BioAtlantis Ltd. and management within the company. The Code of Practice must be followed to ensure that the objectives for protecting the Clew Bay SAC are adhered to in an effective manner.

1.2 Securing the Code of Practice during the operation phase

- **Step 1: On-site survey & schedule** (Start date: Month 1. Duration: 1-2 weeks).
  The first step in securing and implementing the hand harvesting system is to verify the accuracy of the production plan. This will involve time spent on the ground for approximately 1-2 weeks, to establish which sites have been harvested recently and which require a fallowing period in order to recover. A schedule will then be agreed between BioAtlantis and the harvesters to meet SAC and production requirements.

- ***Step 2: Recruitment of personnel*** (Completed by end of month 1).
  The majority of personnel will be in place by the end of month 1. In parallel with Step 1 above, hand harvesters will be hired. They will initially assist in establishing which sites have most recently been harvested. During this time, the harvesting system and plan will also be explained to harvesters. A Resource Manager and some of the staff/sub-contractors involved in transport will also be hired during this time.

- ***Step 3: Training*** (Start date: month 1. Duration: 3 months)
  On completion of the on-site survey above, figures will be verified and revised accordingly. From here, training of harvesters will begin. This will initially involve theoretical training (1-2 days) to explain the system and requirements of the harvesters on the ground to ensure that the SAC is protected according to the Code of Practice. Training will be carried out by scientific personnel, biologists and engineers in BioAtlantis using detailed training material. Once theoretical training is complete, practical on-site training will take place. This will involve harvesters performing supervised hand harvest tasks according to the harvesting schedule. BioAtlantis staff will monitor and assess the technique employed by staff to verify that the correct technique is in use and that the correct steps are being taken. In the event that hand harvesters encounter any difficulties, BioAtlantis staff will provide further training. Staff will finally receive certification to confirm that they have recieved training and are verified in having a full understanding of the system.

- ***Step 4: Verification of systems*** (Start date: month 1. Duration 3 months)
  During the initial 3 months of the operational phase, all software, communications, transport and quality system will be optimized and verified as being effective. This will ensure that systems are fully operational and in place when commercial harvesting begins.

- ***Step 5: Full implementation*** (Start date: month 4. Duration: lifetime of the licence)
  Once staff are verified as having sufficient training and understanding of the system, commercial hand harvesting will begin in accordance with the schedule. This will be managed by the Resource Manager who will report directly to BioAtlantis management. A key requirement in implementing and securing a functioning system for sustainably hand harvesting of *A. nodosum*, are effective control measures, reporting and monitoring systems. These are set out in this Code of Practice document and form a key framework for managing and ensuring that the system is being adhered to in a precise, correct, seamless and traceable manner. A key component to ensuring that the systems are being adhered to will be a strong and robust auditing system. BioAtlantis will conduct audits covering the items listed below:

  (a) Quarterly Audit:
  - Audit Part A: Records, Forms & Documents
    Step 1: Forms: receipt of training & verification of understanding
    Step 2: Completed Training Certs & Permits (obtained through training above.)
    Step 3: Records, forms & documents (general)

  - Audit Part B: Quality Assessment (documentation)
    Step 1. GRNs (Clew Bay)
    Step 2. Production Logsheets (Production Facilities)
    Step 3. Incident Reports
    Step 4. Non-conformance Reports
    Step 5. Software Systems

  (b) Annual Audit (on-site):
    Step 1. Site Quality (inspection of harvested sites)
    Step 2. Harvest methods (inspection of techniques)
    Step 3.Collection vessel

A draft of the Clew Bay Audit form is attached as Appendix 8. Additionally, please see Tables 10, 11, 12 and 16 of the main text document for details on: control measures, Action Limits/non-conformance, Analytical Procedures, Monitoring Schedule, (Frequency), Corrective Actions and Verification. In addition, the harvesting system will be an reviewed annually to assess and verify the control measures and determine areas in need of improvement.

1.3 The Code of Practice for harvesting *A. nodosum* sustainably.

Management

- BioAtlantis Management must ensure that continuous disturbance of each community type does not exceed an approximate area of 15%. This is recommended by NPWS to ensure adherence to the EU commissions' requirements. Working within this limit is critical to ensure compliance with the European Commission Article 17 reporting framework which considers disturbances of >25% of an area in an Annex I habitat to represent an unfavourable conservation status. The area affected by harvest activities/annum is provided in Table 1 below.
- BioAtlantis Management are responsible for all aspects of commercial harvesting.
- To prevent in combination effects from occuring, large-scale unlicensed harvesting will not be tolerated. BioAtlantis staff must document and record any incident of such activities.
- Depending on the severity, these issues will be reported to the Department of the Environment. This is to ensure compliance with the conservation objectives for the site, and to ensure adequate record keeping, monitoring of the resource and access to sensitive sites at particular times of the year.
- Permit low scale removal of <0.5 tonnes, for personal usage. This will be reviewed in the case of abuse.
- Any commercial user having small requirements of >0.5 tonnes per annum (e.g. hotels, health Spas), will be approached by BioAtlantis to discuss their requirements and assess whether there are potential in combination effects. Appropriate action will be taken on a case-by-case basis, to ensure that potential in combination effects are avoided.
- Any large-scale harvesting must be managed by BioAtlantis.

Table 1: list of marine habitat types in the Clew Bay SAC and the area affected by hand harvest activities

Marine community types (Clew Bay SAC)	**Total Area in Clew Bay SAC (m^2)**	**Area affected by harvest activities/annum**	
		(m^2)	**(%)**
Zostera Community	1,423,891	0	0.0%
Shingle	1,855,000	235,549	12.7%
Reef	26,870,000	1,331,699	4.9%
Maerl Dominated community	2,878,607	0	0.0%
Fine Sands Dominated by *Nephtys cirrosa* community	2,950,308	0	0.0%
Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex	7,817,100	0	0.0%
Mudflats & sandflats not covered by seawater at low tide	12,541,069	0	0.0%

Resource Database

Clew Bay has in excess of 90 islands and 100Km of coastline that contain harvestable quantities of *A. nodosum*. For the effective management of this area, BioAtlantis will create a database of the islands and coastal areas. This database is required to:

- Determine sites which require a fallowing period to allow for adequate recovery from recent activities.
- Determine rotation requirements (i.e. extrapolation and calculation of the duration or fallowing period required prior to a particular areas being fit for re-harvest).
- Prevent harvest activities that would lead to a decline in yield.
- Record the details of each harvest, how much, by whom & when.

Certificate to harvest

Harvesters cannot supply *A. nodosum* to BioAtlantis Ltd., unless they have been fully trained in methods which ensure *A. nodosum* recovery and regeneration post-harvest. Training will be provided by BioAtlantis Ltd., prior to harvesters gaining certification for engaging in hand harvest activities in Clew Bay.

Navigation to harvest sites

Harvesters must always follow pre-planned harvest schedules. Schedules will be provided by BioAtlantis in advance of harvest. This will ensure no entry into protected areas of the SAC at times which are inappropriate or damaging to species and habitats in the complex. Should any confusion arise, the Resource Manager should be contacted.

Equipment

Several key items should be in the harvesters boat in order to complete duties, both safely and effectively. Each harvester should ensure that the vessel is equiped with the following items before departure:

- An efficient marine outboard engine capable of manoeuvring the vessel safely ahead and astern, and steering the vessel at its maximum speed in the fully loaded condition within the limits of the intended area of operation;
- A suitable pair of oars and rowlocks;
- Adequate seating or thwarts for all persons on board;
- A suitable bailer;
- A suitable anchor with rope of length at least equal to four times the length of the boat;
- A permanently rigged suitable painter which shall not exceed the length of the boat and which may also be used as a tow rope;
- Two approved hand-held distress flares or a portable horn;
- A suitable boat hook;
- A suitable waterproof torch

- Carry an approved lifejacket or approved personal flotation device for each person the vessel is declared to carry and shall be worn at all times when on board
- Communication device(s),
- Navigation maps and Compass,

Harvesting equipment

- Sharp blade cutters.
- Measuring tape
- Binoculars (for assessing presence/absence of harbour seals or mudflats, sandflats or intertidal sandy mud areas in the vicinity of the harvest site).
- Harvest Nets
- Hi visability Bouys

Harvest Records:

The 'Goods Received Note (GRN)' is a vital form and it must be completed by the Resource Manager prior to receiving goods. Without a completed GRN, harvested *A. nodosum* may not be accepted.

Accident and Incident Reporting:

Sites must be harvested in accordance to the in depth schedule. This ensures that all relevent sensitive sites (e.g. harbour seal and bird sites) are avoided. It also ensures that sensitive sandflats or intertidal sandy mud areas are avoided. However, all accidents, incidents and near misses must be recorded immediately and reported to the Resource Manager. The Resource Manager will record the details in the Incident Report Form (see Appendix 3). Incidents which should be reported include:

- Health and safety accidents or near misses
- Incidents relating to disturbance of seals during navigation (e.g. , e.g. flushing into the water)
- Incidents relating to disturbance or damage to any mudflat, sandflat, intertidal sandy mud fine sand areas during navigation.

Harvest of* A. nodosum*:

Once a site has been approved for harvest according to the schedule, harvest can take place. Harvest can only occur at sites which contain high density of *A. nodosum* and which have been approved by BioAtlantis Ltd. This will be determined initially by the Science and Engineering teams at BioAtlantis Ltd. However, on arrival, the harvesters must determine whether or not the site is suitable for harvest. This may be determined through use of binoculars from the boat but in most cases this will require direct landing, followed by visual inspection. Harvesters will

receive training by BioAtlantis as to the criteria required in conducting the assessment. Several important details will be recorded during harvest and will cover the following areas:

- Date & time of harvest, site name and location within the site (i.e. northern shore, etc). This information is required for completing the GRN.
- When cutting *A. nodosum*, work to ensure that at least 200-300mm (8-12 inches) of material is left behind. Cutting less than 200mm above the holdfast is expressly forbidden. This limit will be inspected by the Resource Manager as it is essential in order to:
  - Avoid extensive removal of *A. nodosum* canopy coverage.
  - Avoid dormant or resting species positioned at the base of the *A. nodosum* canopy, e.g. periwinkles.
  - Prevent by-catch of benthic species.
  - Prevent by-catch of slow moving, sessile species and even some mobile species may not leave the rocky shoreline at low tide.
  - Avoid occurrence of overharvesting which could impact on the ecosystem in general, e.g. animals resident in the intertidal zone, coastal habitats, etc.
  - Avoid severe reductions in canopy coverage which could otherwise lead to changes in community structure or biodiversity stasis.
  - Ensure sufficient biomass coverage to allow free living forms of L. Littorina and other species settle and establish at the canopy base.
  - Avoid *A. nodosum* plants which contain periwinkle egg masses. This is important to prevent harvest of viable eggs.

- The holdfast of the *A. nodosum*, must be left fully intact and attached to the underlying rock, stone or growth substrate so as to allow for recovery and re-growth in subsequent years. Presence of holdfast will not be accepted by management. Levels exceeding >1% at harvest will represent a severe non-conformance. The Resource Manager will initially assess for evidence of holdfast content on the boat. The Production Manager will also perform spot checks on harvested seaweed for evidence of stones and holdfast as such contaminants may also damage production equipment. Non-conformances may be issued by the Production Manager, depending on the severity of the incident. This limit on holdfast content is essential in order to:
  - Prevent mortality of *A. nodosum*.
  - Prevent injury to *A. nodosum* holdfast.
  - Prevent severe removal of habitat for understory species
  - Avoid physical disturbance of dormant or resting species at the base of the canopy.
  - Avoid occurrence of overharvesting which could impact on the ecosystem in general.
- Ensure that no other types of seaweed other than *A. nodosum* are harvested and/or placed into harvest nets. Inspections will be carried out at both the pick-up point in Clew

Bay and also at production facilities in Kanturk, Co. Cork. The presence of these contaminants may result in potential non-payment, re-training or disciplinary action, depending on the severity of the non-conformance. In particular, harvesters must limit *Fucus* content of harvested *A. nodosum* to <1%, thus preventing removal of an additional canopy source which supports periwinkles, limpets and other species.

- When cutting the weed and filling the harvest nets, ensure that there is absolutely no sand, shingle, pebbles, stones or *A. nodosum* holdfasts inadvertently included. As indicated above, penalties may be incurred due to such non-conformances.
- Harvest must be limited to 20% of the total available *A. nodosum* biomass per site per annum, in order to allow for sufficient regrowth. The limitation at 20% avoids overharvesting which could impact on the ecosystem in general, and reduces the removal of species such as hemiparasitic *Polysiphonia lanosa* (Linnaeus) *Tandy*,which commonly grows on *A. nodosum.*
- To reduce the potential for anthropogenic impacts (e.g. intensity of trampling) on the biotope, no more than 2-4 harvesters are permitted on small-medium sized sites. Medium to large islands may require between 4-6, while larger islands will likely require approximately 6-10 harvesters. The Resource Manager and scientific or engineering personnel may inspect sites for brief periods. Other personnel are not permitted. Low numbers of individual working along the foreshore in this way, will ensure that BioAtlantis work within the limit of 15% disturbance limit.
- Harvest must not take place in areas within 50m of sewage outfalls or other source of pollution. This will ensure that stressed *A. nodosum* growth is not exacerbated further by harvest activities.

Completion of harvest and subsequent pick-up:

The following must be recorded on the GRN. :

- Date:
- Harvester Name / No.:
- Pick-up location:
- Harvest Location
    - Site name
    - Region (i.e.. northern shore)

For a copy of the GRN, see Appendix 3 of BioAtlantis Foreshore Licence Application, 2014.

Quality Check:

Is seaweed free of the following:

- Sand, gravel, stones or debris
- *A. nodosum* holdfasts
- Other species (e.g. *Fucus, <1% max.*)

Assessment of harvest operations

Have harvesters worked to ensure:

1. Cutting of *A. nodosum* >200mm above holdfast
2. No more than 20% of the total available biomass per site per annum is harvested
3. Activities only take place at approved sites
4. Health and safety requirements are adhered to

By-catch:

- Seaweed must be harvested in nets with mesh space large enough to allow for Amphipods, isopods or other by-catch to escape. Typically, 2 hours will be available for animals to migrate out of the nets before transfer to the collection vessel.
- Inadvertent co-removal of periwinkles, amphipods, isopods or other Animalia identified on the collection vessel must be collected and returned to the water.

Harvest Quantity

Quantity of harvest (no. bags and weight per bag).
Time and data of harvest

BioAtlantis batch code

Inspection check (pass: Y/N)

Health and safety:

All necessary health and safety equipment must be maintained by harvesters. Adherence to health and safety practices will be checked by the Resource Manager and noted in the GRN.

Communicating with BioAtlantis:

BioAtlantis require harvesters to keep in regular contact and report their activities as required. In most cases reporting to BioAtlantis will be via the Resource Manager and GRN. However, harvest plans will be communicated regularly over the phone or via email or post to designated harvesters by the Resource Manager.

SECTION 2: Protection of the Harbour Seal, Birds & Otters

2.1 Introduction

It is well established that harbour seals are highly sensitive to human behaviour. Therefore, the key objective of the BioAtlantis Code of Practise for hand harvesting of *A. nodosum* is to ensure that "Disturbance events" do not occur. In addition, certain species of breeding and wintering birds can also be disturbed by human presence. Some bird species and otters may also be sensitive to alterations of food source and supply. Therefore, this Code of Practise will also work to ensure that behaviour and food supply to these protected species is also unaffected by harvest activities.

2.2 The Code of Practice

The following rules and guidelines have been developed based on findings from the published peer-reviewed literature, NPWS guidelines and recommendations from organizations such as the Hampshire & Isle of Wight Wildlife Trust (Anon 2013). Furthermore, harvesters will receive in depth training on seal behaviour and requirements of otters and birds by biologists, engineering and QC personnel at BioAtlantis Ltd., prior to being deemed qualified to engage in hand harvest activities in Clew Bay. The code of practise is explained as follows:

Seasons: Harbour seals are present throughout the year on both aquatic and terrestrial habitats of Clew Bay SAC, including intertidal shorelines. As such, equal emphasis will be placed on not disturbing the behaviour throughout the year. Important aspects of the annual life cycle includes:

- Breeding (May-July approx.)
- Moulting (August-September approx.)
- Outside the breeding and moulting seasons (i.e., from October-April, 'resting sites').
- In addition, several species of breeding and wintering birds must not be disturbed at established sites during sensitive times. Harvesters will operate on the basis of known locations of established breeding, moulting and resting sites of harbour seals (NPWS, 2011A) and breeding and wintering sites of known relevance to important bird species.

Data Recording: Harvest vessels will not be permitted to land at breeding or moulting sites between May-July and August-September respectively. Harvest location and pick-up points will be recorded on GRNs (see Appendix 3 of BioAtlantis Foreshore Licence Application, 2014). GRNs will be checked by quality personnel by means of regular audits to ensure compliance. Harvesters must report any incidence of seal disturbance to the Resource Manager who will record this on the Incident Report Form (Appendix 3). Similar measures are in place to ensure bird breeding and wintering sites are avoided at sensitive times of the year.

Locations and Sites: The location of each seal haul out site has been identified on the maps In cases where haul out sites occur together in numbers, they may be distinguished and defined further by their geographical names or grouped together into single units. Bird wintering and breeding sites are also indicated.

Navigation: In order to minimise the effects of boats on the behaviour of seals in Clew Bay, best practice for boating activities will require that harvesters:

- Work in accordance with pre-planned schedules.
- Avoid stalling or slowing down unnecessarily en route to harvest locations or pick up points (pier, etc).

These measures will reduce the risk of being noticed by seals at haul out sites, not subject to harvest activities at a given time.

General Measures:

Sites which are not used by seals during breeding and moulting seasons may be accessed between May-September. Several of these sites lie in close proximity to breeding & moulting sites throughout the north of the complex. Harvest vessels must not enter within 100m of breeding and moulting sites during these sensitive times. Likewise, there are a number of established bird sites which cannot be entered at sensitive times of the year.

Site Specific measures:

- **Inisherkin:**

  There are a number of breeding/moulting sites (e.g. Inishgowla, Inishnacross and Inishcooa) which lie in close proximity to resting sites at Inisherkin. Between October-April, seals will be resting at Inisherkin. Thus, harvest activities at nearby breeding/moulting sites could potentially impact on resting behaviour. To prevent effects on resting seals, the vessel will not be permitted within less than 100 meters of the resting sites at Inishskerkin.

- **Inishcull:**

  There are several islands (Inishpult, Inishfeis and Freaghhillaun-luggagh) and a number of small seal breeding sites surrounding the resting site at Inishcull. Between October to April navigation will not be permitted within 100 meters of Inishcull.

- **Inishturbid-Inishquirk:**

  Between these two island lies an important resting site for harbour seals. Navigation between October to April will not be permitted within 100 meters of this resting site.

- **Additional sites:**
  An important seal breeding site lies between Derrynish, Lanhoney, and Inishbarnagh. Access to the islands surrounding this breeding site will not be permitted within 100 meters during the breeding season. Several islands have been identified as important for sensitive breeding and wintering birds (pers. comm. NPWS). These are listed in Table 2, and similar to harbour seal sites, they will be avoided at sensitive times of the year.

- **Avoidance of sensitive locations:**
  The Burrishoole Catchment area and mouth of Lough Furnace are out of bounds for harvesters, as are all fresh water habitats. This will ensure that otters are unaffected.

2.3 Summary:

Harbour Seals

- Always follow pre-planned harvest schedules provided by BioAtlantis.
- Avoid stalling or slowing down unnecessarily en route to harvest locations or pick up points (pier, etc), as such actions will lead to alterations in nearby seal behaviour (flushing, etc). This is particularly relevant when operating within 100m of haul out sites.
- When navigating within 100m of haul out sites, a harvester should observe the sites from a distance using binoculars. If avoidance or disturbed behaviour is observed (e.g. rapid or frequent changes in direction away from the vessel), immediately increase distance between the vessel and the site if possible.
- Never approach seals in a 'bow on' manner. When in proximity to their sites approach from the side and maintain a constant speed.
- If a seal is observed in open water, slow down the vessel to less than 5knts or no-wake speed. To minimise disturbance, ensure that movements are steady and in parallel to the animal.
- In the event that a seal is encountered, ensure that an escape route is provided, avoid 'boxing-in' the animal or blocking narrow channels.

Harvest times (See table 2 for details)

- Seals are highly sensitive during moulting. Harvesting activities are prohibited at moulting sites between August-September, while permitted between October-July.
- Harvesting activities are prohibited at breeding sites between May-July, while permitted between August-April.
- Harvesting activities are prohibited at resting sites between October-April, while permitted between May-September.
- However, in cases where sites serve dual functions (e.g. breeding & moulting), avoidance times may be prolonged.

- In cases where sites serve triple functions of breeding, moulting & resting, these sites must be avoided all year around.
- During times in which a site is prohibited due to the presence of seals, navigation will not be permitted within 100 meters of these sites.
- In the event that seal disturbance is observed, the event must be reported in the Resource Manager, who will record the details in the Incident Report Form.
- Noise must be kept to a minimum, for example, avoid revving of engines or shouting.
- On rare occasions, seals can display curiosity towards humans. In the event that seals approach the vessel, maintain the course at constant speed or remain stationary. Do not approach the seal.
- In the rare event that a mother and her pup are encountered, leave the vicinity immediately and slowly.
- In the rare event that you encounter seals on a site not currently recognised as a seal haul-out site, leave the area promptly and quietly and report to the Resource Manager who will record the event in the Incident Report Form.

Birds (Breeding and Wintering)

- Always follow pre-planned harvest schedules provided by BioAtlantis.
- Harvesting activities are prohibited at a number of important breeding sites for certain periods during Spring/Summer (see table 2 for details).
- Harvest activitites are prohibited at a number of wintering sites during certain periods of autumn/winter (see table 2 for details).
- Sites which are out of bounds are indicated in Table 2 below.
- To minimise disturbance of birds, ensure that all activities on islands are maintained within the intertidal Ascophyllum nodosum zone.

Otters

- Always follow pre-planned harvest schedules provided by BioAtlantis.
- Harvest areas are defined by BioAtlantis (see Table 2 below)
- Harvest activities are prohibited within the Burrishoole Catchment.
- Harvest activities are prohibited at the mouth of Lough Furnace.
- All freshwater areas are prohibited from harvest activities (e.g. east side of InishGowla South).
- To minimise disturbance of interaction with otters, ensure:
    - All activities are maintained within the intertidal *Ascophyllum nodosum* zone.
    - Never interfere with otter couching sites, holts or access paths/routes.

Preventing interactions with tourism & recreation:

Hand harvest activities must not take place at harbour seal and bird sites at sensitive times of the year, thus preventing any in combination effects with tourism and recreation marine based activitites from occuring (e.g. Power Boat Trips, Sea Trampoline, Sit-On-Top Kayaking, Sea Kayaking, Dinghy Sailing, Stand Up Paddle Boarding, Keel Boat Sailing).

Island/site No.	Site Name	Harbour seals			Birds		Control measures	
		Breeding Site	Moulting Site	Resting Site	Breeding site	Wintering site	Avoidance	Attendance
3	Roslynagh	Yes					May to July	Aug to April
5	Inishdasky	Yes					May to July	Aug to April
7	Inishtubrid			Yes			Oct to April	May to Sept
13	Moynish More	Yes				Yes	Oct-July	Aug to Sept
14	Moynish Beg (L865938)				Yes		March to Sept	Oct to Feb
17	Inishilra	Yes					May to July	Aug to April
19	Roeillaun (L875930)				Yes		March to Sept	Oct to Feb
20	Inishdeashbeag	Yes	Yes	Yes			Avoid all year round	
20	Inishdeashmore	Yes	Yes				May to Sept	Oct to April
21	Inishcorky	Yes			Yes		March to Sept	Oct to Feb
22	Inishcarrick	Yes					May to July	Aug to April
24	Muckinish	Yes					May to July	Aug to April
25	Inishdaweel	Yes					May to July	Aug to April
27	Illanascrraw	Yes					May to July	Aug to April
28	Freaghillanluggagh	Yes					May to July	Aug to April
38	Inishcuill			Yes			Oct to April	May to Sept
39	Mauherillan (L920919)				Yes		March to Sept	Oct to Feb
50	Inishakillew		Yes				Aug, Sept	Oct to July
63	Forilan		Yes				Aug, Sept	Oct to July
62	Inishgowla South		Yes				Aug, Sept	Oct to July
62	Carrickwee	Yes	Yes				May to Sept	Oct to April
64	Carrickawart Island		Yes	Yes			Aug to April	May to July
66	Dorinish (L9086)				Yes		March to Sept	Oct to Feb

Island/site No.	Site Name	Harbour seals			Birds		Control measures	
		Breeding Site	Moulting Site	Resting Site	Breeding site	Wintering site	Avoidance	Attendance
67	Inishimmel (L908857)				Yes		March to Sept	Oct to Feb
71	Inisheeny (L920845)					Yes	Oct to March	April to Sept
72	Finnaun Island	Yes	Yes				May to Sept	Oct to April
73	Corillan		Yes				Aug, Sept	Oct to July
74	Carricknamore		Yes				Aug, Sept	Oct to July
75	Stony Island		Yes	Yes	Yes		Avoid all year round	
76	Green Islands	Yes	Yes	Yes	Yes		Avoid all year round	
Cz 2.6	Pigeon Pt. (L949850).					Yes	Oct to March	April to Sept
Cz 5.13	Rosturk (L869956),					Yes	Oct to March	April to Sept
Cz 5.17	Rosmurrevagh (L852958)					Yes	Oct to March	April to Sept
-	Mulranny Saltmarsh (L827963)					Yes	Outside of licence application area. No harvest will take place here.	
-	Carrowholly (L956850)					Yes	Oct to March	April to Sept
-	Bertraw (L903834).					Yes	Oct to March	April to Sept
-	Carrickwee (north east Clew Bay)	Yes					May to July	Aug to April
-	Burrishoole Channel						Avoid all year round to ensure no impact on catchment, connected lakes, fish and otters.	

Table 2: Sensitive ecological receptors within the study area and control measures implemented for mitigation.

SECTION 3: Environmentally safe navigation

Introduction:

The following rules and guidelines have been developed on the basis of NPWS objectives for ensuring protection of mudflat, sandflat, intertidal sandy mud, fine-sand and Atlantic Salt Meadow environs of Clew Bay. These guidelines must be adhered to by all harvesters supplying *A. nodosum* to BioAtlantis Ltd.

The Code of Practice for protecting mudflat, sandflat, intertidal sandy mud, fine-sand, Atlantic Salt Meadow, shingle and reef areas.

Harvesting *A. nodosum* along rocky shorelines located beyond mudflat, sandflat, intertidal sandy mud or fine-sand areas requires that work be done exclusively at high tide. Training will be provided to ensure that all harvesters are aware of their obligations towards protecting these areas and species residing within these habitats in the SAC. Important aspects to the code of practice is a follows:

- Advanced preparations will be necessary in advance of work in these locations. Always adhere to clearly defined harvesting schedules provided by BioAtlantis.
- It is essential not to enter into mudflat, sandflat, intertidal sandy mud or fine-sand areas during low tide. Entry into these areas at low tide will cause serious physical damage to these environs and the associated species. These areas will be indicated clearly in the maps provided.
- If mudflat, sandflat, intertidal sandy mud or fine-sand areas are entered into inadvertently, promptly leave and inform the Resource Manager of the incident who in turn, record the incident in the Incident Report Form.
- When approaching coastal areas in small boats, care must be taken in order to ensure that contact with reef or shingle is minimal. This will ensure that no damage is inflicted to either the vessel or reef or shingle habitat.
- In smaller boats, always approach the shore at slow pace so as to avoid intertidal reef (i.e. mixed substrate of pebbles and cobbles) or shingle. Along the western margin of Clew Bay there are small patches of subtidal boulders and cobbles which must be avoided.
- The harvest collection boat will be fitted with a depth sounder to ensure that contact with the reef is avoided. Hard substrate will be encountered between 2-14m and should be avoided. The sonar depth sounder must be in working order during all collection activities. This measure will ensure that displacement or disturbance of reef and species therein does not occur.

- In order to ensure that *A. nodosum* harvest does not negatively impact on the Atlantic Salt Meadow (ASM) habitat in general, *A. nodosum* must not be harvested at the fringes of these areas.

SECTION 4: Working in the vicinity of tourism and recreation facilities

Tourist and recreational activitites have potential to cause anthropogenic disturbances and disturb sensitive harbour seals and protected bird species. To prevent hand harvesting from interacting with these activitites, the following is required of hand harvesters:

- As a general policy, hand harvesters will avoid sites where tourism and recreation activitites are observed to be taking place. This will be determined on a case-by-case basis.
- Hand harvesters must not work within 50m of bases where tourism and recreation-related equipment or vessels are manually introduced in the water (e.g. dingy's kayaks). This ensures that no in combination effects occur, such as exacerbation of anthropogenic disturbance which could give rise to localized reductions in density of intertidal seaweed and the associated biotope.
- Harvest can only occur on Collanmore island between Sept-April. This will prevent in combination effects such as exacerbation of anthropogenic disturbance which may occur during peak tourist season between May to August.
- Harvest will not occur at Mulranny.
- Hand harvesters will not work at Roman Island or Westport harbour between May and August. This prevents any in combination effects from occurring during peak season.

SECTION 5: Working in the vicinity of aquaculture sites

To ensure that hand harvest activities do not exacerbate any negative effects associated with aquaculture in Clew Bay, the following code of practice must be followed.

- Harvest activities cannot take place at breeding, resting or mouting sites during sensitive times of the year. This includes an island identified by the Marine Institute which may be potentially affected by aquaculture activitites, namely, Inishcorky. Similar approaches must be taken with islands in close prxomimity to Inishcorky, namely Inishdeashmore, Inishdeasbeag, unnamed neighbouring island of Inishdeasbeag and Inishnacross (pg. 78, Marine Institute, 2014).
- The Code of Practice for environmentally safe navigation (sectin 3 above) must be followed to ensure no in combination effects which would damage mudflats and sandflats, i.e. areas where many aquaculture sites are located.

SECTION 6: Working in the vicinity of anglers

There are several sites of relevance to fisheries and sea angling in Clew Bay. Harvesters must work to ensure that angler's space is respected at all times.

SECTION 7: Other harvesting activities

BioAtlantis are responsible for all aspects of commercial harvesting, To assist in ensuring compliance with the conservation objectives for the site, the following is required of the Resource Manager:

- Any instance of large-scale unlicensed harvesting must be recorded as a non-conformance. The corrective action will be determined on a case by case basis, depending on the severity of the unlicensed acitvity.
- BioAtlantis will allow low scale removal of <0.5 tonnes, for personal usage only. This will be reviewed in the case of abuse.
- Any commercial user having small requirements of >0.5 tonnes per annum (e.g. hotels, health Spas), will be approached by BioAtlantis to discuss their requirements and assess whether there are potential in combination effects. Appropriate action will be taken on a case-by-case basis to ensure that potential in combination effects are avoided.
- All large scale harvesting must be managed by BioAtlantis.
- BioAtlantis will not harvest beyond Rossmurvagh, thus avoiding much of the Mulranny area. This avoids in combination effects which tourism/recreational excursions in the area,which may be focused on seaweed, e.g." "Seaweed harvesting discovery days".

SECTION 8: Preventing the spread of invasive species

To ensure that harvest activities to not act as a vector and lead to the spread of the invasive species, *Didemnum vexillum*, BioAtlantis will ensure the follows:

- The main collection vessel and harvester boats will be painted once a year with appropriate anti-fouling paint.
- The harvesters boats will not leave Clew Bay. In the rare case that they do leave Clew Bay, harvesters are required to implement a cleaning measure on land which will involve cleaning with sodium hypochlorite.
- All nets must be cleaned with sodium hypochlorite on delivery to production facilities and returned to harvesters in a clean condition.

REFERENCES

Anon (2013). Code of Conduct. Hampshire & Isle of Wight Wildlife Trust in partnership with Chichester Harbour Conservancy.
http://www.conservancy.co.uk/assets/assets/Code%20of%20Conduct.pdf.
Accessed 19/09/2013