Licence 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 EU Habitats Directive 92/43/EEC.

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

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Executive Summary

Seaweed harvesting plays an important role in the development of regional economies in the west of Ireland, where there are often fewer opportunities for employment or income. A report in 2010 entitled "Irelands Ocean Economy" estimates the seaweed & marine biotechnology industry in Ireland as having a net worth of €18 million and employing 185 people full time. In their "Sea Change" report in 2006, the Marine Institute estimate that the seaweed production and processing sector will be worth €30 million per annum by 2020. However, for Ireland to achieve these targets sustainably in the long term, there are two primary challenges. The first is to implement appropriate systems of sustainably harvesting seaweeds such as *A. nodosum*, in a manner which does not impact upon the ecosystem. Secondly, the capacity to create novel, value-added products from seaweed must be developed to a higher level in Ireland to ensure competiveness in worldwide markets.

At present, there is little or no official supervision over *A. nodosum* hand harvesting in Ireland. However, Ireland has an obligation under EU Law to ensure that designated SACs and SPAs are protected. As *A. nodosum* seaweed grows largely in SACs, Ireland must ensure that harvesting does not negatively affect these environs. In particular, the National Parks and Wildlife Service (NPWS) recommend that continuous disturbance of marine community types should not exceed an approximate area of 15% covering: Shingle, Reef, *Zostera* Community, Maerl Dominated community, Fine Sands Dominated by *Nephtys cirrosa* community, Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex and Mudflats & sandflats not covered by seawater at low tide. BioAtlantis Ltd. is in the process of building a long term business and environmental compliance will be a key part of this process.

Seaweed processing is relatively underdeveloped in Ireland. This is due to a lack of investment in R&D, with notable exceptions including BioAtlantis Ltd. and a small number of other indigenous Irish companies who have been innovative and have added value to the resource. At present, a large proportion of harvested *A. nodosum* seaweed is sold for processing abroad. Such produce lacks any discernible added value and local economic benefits are not being maximised. In the budget statement of 2015, the Minister of Finance stated that "The government has prioritised the marine as a key area for further growth under the Harnessing Our Ocean Wealth Strategy, with a target of doubling the value of the blue economy by 2030". To ensure growth in the Irish seaweed industry, seaweed-based products must add value to the seaweed in Ireland as opposed to mass export for processing abroad. Creating added value products in Ireland through science and innovation will ensure that increased revenue generated will remain in Ireland

BioAtlantis is one of the few indigenous Irish companies who produce scientifically-based, value-added products from seaweed. The company has grown at an average rate of 45% per annum since 2007. Central to this success has been the company's strong focus on R&D and

product innovation. In addition to having fully automated facilities for extracting and isolating molecules from seaweed, the company has 3 patents filed, one of which is granted on monogastric health and immunity (WO2007057873A3). The company has a proven track record in scientific leadership and are currently collaborating with >26 universities and research institutes worldwide, whilst also leading an EU project on animal health (www.thriverite.eu). BioAtlantis are currently working to develop scientifically validated natural alternatives to in-feed antibiotics in animal production and products which can reduce fungal infection and increase crop yields.

As an Irish company poised to emerge as a world leader in their field, BioAtlantis require security over the supply of their main raw material, *Ascophyllum nodosum*. To achieve this, BioAtlantis Ltd. wishes to apply for an exclusive license to sustainably develop the seaweed industry in the Clew Bay region of Co. Mayo. BioAtlantis require ~12,900 wet tonnes of *A. nodosum* per annum. A team of research scientists and engineers are in place in BioAtlantis to ensure that EU requirements for protecting the environment are adhered to in a traceable, monitored and validated fashion. This document describes the hand harvesting system in considerable detail, playing close attention to the EU conservation objectives for Clew Bay SAC.

BioAtlantis have developed a hand harvesting system with strong mitigation measures designed to prevent any significant impact on the Clew Bay SAC. In the immediate and short term, the system will provide a mechanism for traditional hand harvesters to continue working, but without negatively affecting the SAC. The system ensures the long term viability and sustainability of hand harvesting as it prevents overharvesting or damage to protected species and habitats. The system is centred on a Code of Practice, which merges traditional methods of hand harvesting with robust planning, monitoring, oversight and auditing. A summary of the proposed system is outlined as follows:

- Continuous disturbance of marine community types will not exceed an area of 15%.
- Sensitive species & marine habitats are protected by specific mitigation measures.
- Activities will not significantly interact with existing or planned operations.
- Mitigation measures prevent the spread of *Didemnum vexillum* in Clew Bay.
- Appropriate methodologies and training ensures protection of the *A. nodosum* biotope.
- Activities are planned and monitored to prevent overharvesting and ensure site recovery.
- Non-compliances are identified and corrective actions issued to prevent issues recurring.
- Quarterly and annual auditing of the entire harvesting system ensures standards are met.

The benefits of the BioAtlantis system for harvesters and the economy are as follows:

- Hand harvesting continues in a traditional way but with improved working conditions.
- Employment: 20 full time jobs or 32 part-time plus 4 full-time.
- Harvesters can grow their business as employees or subcontractors of BioAtlantis.
- Foreshore rights: The BioAtlantis licence will not affect existing private foreshore rights.

- Training: Health & Safety and the environment - how to supply and harvest without damaging the SAC and taking unnecessary risks.
- Private individuals: Private, small-scale harvest for personal use will not be affected.

The BioAtlantis system ensures sustainability of Clew Bay harvesting in the short and long term and meets requirements for protecting the SAC. An exclusive licence to BioAtlantis will allow the company to continue on its strong growth trajectory and become one of the major players in added-value seaweed nutraceutical and biostimulant markets worldwide. As such, BioAtlantis will contribute to meeting Ireland's targets for the blue economy by 2030. BioAtlantis have a proven track record as high achievers in science and innovation and commit to implementing an effective harvesting system in Clew Bay, one which respects the environment, traditional methodologies, harvesters and economic drivers alike.

Preface

This application was originally submitted to the Dept. of the Environment Heritage and Local Government (DOEHLG) on 20/01/2014. The application was revised and re-submitted on 31/10/2014 following request from the Department and the National Parks and Wildlife Service (NPWS) for additional information (30/07/2014). BioAtlantis Ltd. have assessed the issues raised by NPWS in relation to cited deficiencies in the submitted Natural Impact Statement (NIS) and the additional inform

ation requested. The application has been updated accordingly. The main points raised by NPWS are outlined in the table below. The locations in the revised NIS and main application documents where these points have been addressed are also provided.

No	NPWS points raised in letter on 30/07/14	Location in the revised document where points have been addressed	
		NIS	**Application document**
1	**Continuous disturbance must not exceed an approx. area of 15%.**	See foreword & associated sections.	• Section 3.4 of main document. Also: – Appendix 4 (revised)
2	**Holistic examination of the nature, extent & impact of harvesting**	See foreword & associated sections.	Main document: • Section 1.3.2 • Section 1.3.3 a(i), a(ii) • Also discussed in Section 3.5.2
	The spatial extent of harvesting techniques and activities:		
	(a) Management of expansive and prolonged operations		
	(b) Numbers of personnel and exploitation levels		
	The potential interaction effects of seaweed harvesting	See foreword and associated sections.	• Section 3.5.3 (a, b, c, d, e, f, g) of main document. • Appendix 4 (Code of Practice) has been updated accordingly.
	(a) Targeted removal of species		
	(b) Non-targeted removal of species		
	(c) Disturbance and displacement of species & habitats		
	(d) Changes in community structure		
	(e) Changes in hydrodynamics and water quality		
	(f) Potential disturbance of marine fauna		
	(g) Potential Interactions with coastal habitats		
3	**Cumulative and in Combination effects**	See foreword & associated sections. Also see: Appendix 7 of application.	• Section 3.6 of main document. Also: – Appendix 4 (revised) – Appendix 7 (new)
	Existing Operations		
	Planned Operations		
	Potential of harvest activities to spread invasive species		
No	**Clarification provided by NPWS during recent consultations between 26/08/14 and 30/10/14.**		
i	Importance of demonstrating that continuous disturbance of each community type does not exceed an approx. area of 15%.	As for No.1 above	As for No.1 above
ii	The importance of addressing the potential for cumulative effect on community types to ensure that interactions do not lead to effects exceeding the 15% figure.	As for No.3 above	As for No.3 above
iii	The importance of demonstrating how the Code of Practice will be secured and monitored.	• Section 3.1.1. Also: – Appendix 4 – Appendix 8 of application	• Section 1.3.3 (b & c) of main document. Also: – Appendix 4 (revised) – Appendix 8 (new)

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Appendices

Abbreviations:

A. nodosum	*Ascophyllum nodosum*
ASM	Atlantic salt meadows
ANOVA	Analysis of variance
B	Biological hazard
C	Chemical hazard
Cert.	Certificate
cSAC	Candidate Special Area of Conservation
Dir.	Directive
DOEHLG	Dept. of the Environment Heritage and Local Government
E	East
e.g.	Example
FP7	EU's Seventh Framework Programme
GMP+	Good Manufacturing Practices
GRN	Goods Received Note
HWM	High water mark
IFI	Inland Fisheries Ireland
IRF	Incident Report Form
Isd	Island
I-WeBS	The Irish Wetland Bird Survey
kg	Kilograms
m^2	Meters squared
Mm	Millimetres
MSO	Marine Survey Office
N	North
NCR	Non-Conformance Report Form
No.	Number
NIS	Natura Impact Statement
NPWS	National Parks & Wildlife Service
OSM	Ordinance Survey Map
P	Physical hazard
pers. comm.	Personal communications
pg.	Page
Pt.	Point
QC	Quality Control
R&D	Research and Development
Rd	Road
Ref	Reference
S	South
SAC	Special Area of Conservation
SOPS	Standard Operating Procedures
Sp.	Species
SPA	Special Protection Areas
T	Tonnes
W	West
~	Approximately
º	Degrees Latitude or Longitude

Section 1: Description of Plan/Project, and local site or plan area characteristics

1.1 Background

1.1.1 Purpose of the Plan

The Irish seaweed industry represents a rapidly growing indigenous exporting sector. Factors influencing the success of this burgeoning industry have included innovation, substantial R&D investment and co-operation between academia and business. However, the growth of the industry globally is very much dependent on having control over the supply of high quality raw materials. BioAtlantis Ltd. aims to sustainably develop the seaweed industry in the Clew Bay region of Co. Mayo, a county which boasts the second largest reserves of *Ascophyllum nodosum* species of seaweed in the country, but has thus far failed to reap the potential economic rewards. In line with our already strong scientific and engineering platform, BioAtlantis aim to implement a hand harvesting system in Clew Bay which has a strong basis in good environmental and management principals. In keeping with Ireland's obligations towards ensuring protection of designated SACs, the current proposal to harvest *A. nodosum* will work to ensure that there will be no significant effects on marine biodiversity in the Clew Bay region. BioAtlantis will have a long term commitment to these goals.

A. nodosum is a large, intertidal brown seaweed which grows in abundance on sheltered, rocky shores in the west coast of Ireland and other temperate parts of northern Europe. Reproduction of this species occurs both sexually and asexually. While sexual reproduction maintains genetic diversity within populations, vegetative (asexual) reproduction plays a crucial role in maintaining the size of the *A. nodosum* population, most notably by generating shoot growth and subsequent increases in biomass for years thereafter. Frond growth can continue for years while the holdfast can reproduce vegetatively for decades. Given the importance of vegetative growth to maintenance of *A. nodosum* population size, it is essential to incorporate data on regeneration rates into harvesting strategies where possible. The plan presented in this application draws upon such data, in particular, those presented by Kelly L. *et al.*, (2001) in a study which assesses the impact of hand harvesting of *A. nodosum* on regeneration and biodiversity in Clew Bay and Connemara. BioAtlantis will implement a sustainable approach which requires that 200-300mm (8-12 inches) of *A. nodosum* material is left behind post harvest, with cutting less than 200mm (8 inches) being strictly forbidden. This approach will be minimally destructive to *A. nodosum* and other species within this biotope, thus allowing for shorter recovery periods post-harvest. Moreover, harvest will not exceed 20% of the available harvestable *A. nodosum* per site per annum. This will ensure sustainability of *A. nodosum* harvest year-on-year, whilst simultaneously minimizing any impact on this important SAC.

According to a study by the Marine Institute, Ireland has the potential to sustainably yield in excess of 74,000 tonnes (T) of *A. nodosum* per annum (Hession C, *et al.*,

1998). The majority of these resources are found in Galway, Mayo and Donegal and it has been estimated that 37,470, 16,600 and 16,430 potential wet tonnes per annum may be harvested sustainably from each respective county. However, the annualized potential yield of *A. nodosum* has been relatively under-harvested in recent times. Co. Mayo has experienced a considerable lack of development in the seaweed resource, an issue long recognised as having negatively impacted on employment in the region. Thus, the true potential of *A. nodosum* as a natural and renewable resource in Ireland has yet to be realized.

Provided that harvesting programmes are designed to allow for sufficient periods of regeneration, hand-harvesting has an almost negligible impact on levels of cover and biodiversity. The regenerative ability and productivity of Irish *A. nodosum* beds post-hand harvest was recognised as far back as 1949. Baardseth E (1949 and 1955) measured the re-growth of "patches" left behind by cutters and determined that sustainable harvesting was possible once an adequate level of material is left behind, as reviewed by Guiry, M. and L. Morrison (2013). In recent times, environmental impact assessments have been carried out at sites at Clew Bay and Connemara and both have demonstrated almost complete recovery of *A. nodosum* cover in the following 11 and 17 months post-hand harvest respectively (Kelly L. *et al.*, 2001). Provision of a 4-5 year window for recovery of *A. nodosum* post-harvest remains the current consensus. In light of the study of Kelly L. *et al.*, (2001), the cautious 3-5 year fallowing time-frame preferred by decision makers would appear quite sufficient to ensure recovery of this seaweed species in areas harvested. 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.

1.1.2 Reasons for locating to Clew Bay

BioAtlantis have a requirement ~12,900 wet tonnes of *A. nodosum* per annum. *A. nodosum* is currently sourced from Arramara Teoranta in Kilkieran Co Galway. The recent sale of Arramara to Acadian Seaplants of Canada by Údarás na Gaeltachta threatens our supply of raw material. As Acadian Seaplants are a significant competitor to BioAtlantis in international markets, it is not therefore prudent for BioAtlantis to have one of our major competitors as our sole supplier of raw material. Otherwise, this would threaten the supply of quality raw materials which are vital to the success of our business, while also providing Acadian Seaplants with a significant competitive advantage. Therefore, it has become necessary for BioAtlantis to look for an alternative source of raw material of sufficiently high quality to allow for the further processing necessary for BioAtlantis to continue to produce high quality, value-added products for sale on the global market.

In 2007, BioAtlantis began production of biostimulants and feed additives from our facility in Kanturk. Since then, BioAtlantis have achieved year on year sales growth of 45%. With a continued focus on R&D of new products and an increased market penetration, it is projected that these growth rates will continue over the next 5 years. As a result, it has become imperative that BioAtlantis secure the supply of high quality *A. nodosum*. The study completed by Hession C, *et al.*, (1998) indicates that Co. Mayo has the potential to sustainably yield 16,600 tonnes of *A. nodosum* seaweed per annum, the majority of which located in Clew Bay. This is sufficient quantity to provide the necessary security of supply that is required for the continued growth of the business in Ireland.

As the Clew Bay Complex is protected as a Special Area of Conservation (SAC Site Code 1482) under the EU Habitats Directive (92/43/EEC), harvesting must be carried out in a manner which does not negatively affect the biological environs. By applying hand harvesting techniques known to be environmentally friendly (Kelly L. *et al.*, 2001 and Guiry, M. and L. Morrison, 2013) and incorporating their use within a sustainable best practise approach, BioAtlantis aims to develop a sustainable mode of seaweed harvesting in Clew Bay, one which will be in accordance with the guidelines and objectives specified by the National Parks & Wildlife Service (NPWS).

1.1.3 Status & Local Investment: Stand-alone plan Vs. larger program of development

Building a seaweed industry in Co. Mayo will have significant impacts on the local economy. At present, the only facility for drying and distribution of seaweed is located in Kilkieran in Galway some 80km from Clew Bay. Subject to obtaining a licence to harvest in Clew Bay, BioAtlantis will create employment for up to 20 full-time staff in Clew Bay to service both the existing and future production requirements. This will include 16 full time or 32 part-time hand harvesters from the region (see Table 1). The harvesters will ideally be people who have previous experience or whose families have farms or fishing interests in the area. BioAtlantis will work with the harvesters to apply sustainable methods of harvesting, collection and conservation of the resource, paying close attention to the requirements as described by the NPWS (NPWS, 2011A and NPWS, 2011B). In addition, a Resource Manager will be directly employed to manage activities in the area. Three people with responsiblity for transporting harvested seaweed will also be employed. The employment of 21 people currently employed by BioAtlantis will also be secured. The licence will also allow for the expansion of the operation in the BioAtlantis factory from 21 to 30 jobs. The local investment will have immediate effects in terms of securing and creating employment. Given the sustainable design of the hand harvesting system, the investment in Clew Bay will have long term stability.

Year	BioAtlantis Total Requirement	No. full-time hand harvesters	Income to Clew Bay area (at €40/wet tonne)
	Wet tonnes		
2015	5,000*	6	€200,000
2016	5,000 - 12,900*	16	€518,000
2017	12,900	16	€518,000
2018	12,900	16	€518,000
2019	12,900	16	€518,000

Table 1: Projected economic impact of *A. nodosum* harvesting by BioAtlantis on the Clew Bay area

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* Over the first few years of harvesting in Clew Bay, the total harvest available may need to be reduced to allow time for areas that have been harvested in the recent past to fully recover.

1.2 Investigation / Development Phase

1.2.1 Size of the area to be directly impacted in this phase.

The most comprehensive study of *A. nodosum* resources in Clew Bay to date was published by Hession C, *et al.,* (1998). To verify the quantities of *A. nodosum* available in Clew Bay further, a number of sites in the complex were visited and studied by BioAtlantis science and engineering personnel during the developmental phase (September, 2013). A detailed report describing the results and methods employed is attached as Appendix 1. The scope of the study area assessed included the following sites, either via direct measurements on the ground or by means of visual inspection from boat:

- Inishdaff
- Inishcottle
- Inishlyre
- Collan More
- Collan Beg
- Inishgort
- Inishbee
- Derrnish / Derrnish West
- Inishgowla
- Calf Island
- Inishlaughil
- Inishcuill
- Inishcoragh
- Illannambraher
- Illanmaw
- Inishfeis
- Rockfleet Bay / Roigh Pier

1.2.2 Different types of operations/activities associated with the investigation/development phase.

There are five main components to the investigation/development phase:

1) Biomass Determination & Risk Assessment.
2) Development of Management & Implementation systems.
3) Development of monitoring systems.
4) Consultations.
5) Natura Impact Statement (NIS).

1. Biomass Determination & Risk Assessment:

Biomass levels were determined as follows:

- Desk study: the total available biomass in the area was calculated through use of the published reports of Hession C, *et al.*, (1998), Kelly L. *et al.*, 2001, combined with aerial photographs and satellite images.
- Direct measures in Clew Bay, as described in Appendix I.

Risk assessments of Clew Bay SAC were carried out by BioAtlantis Ltd. in order to develop the sustainable harvesting system, prior to seeking outside consultation. This is described in detail in Section 2 and 3 of this document. This was followed by a Natura Impact Statement (NIS) to inform Appropriate Assessment, carried out by Ecofact Environmental Consultants Ltd. Following consultations with NPWS between 26/08/14 and 30/10/14, further risk assessments were carried out by BioAtlantis Ltd. This was followed up with a revised NIS. The NIS is attached to this application as a stand-alone document. The objectives and methodology employed by BioAtlantis in conducting the risk assessments, are summarized as follows:

a) Literature review & data gathering.

- Objective: to assess peer-reviewed literature and datasets relating to:
  - *A. nodosum* biomass levels in Irish and other coasts of the North Atlantic.
  - Regional variability in *A. nodosum* biomass levels in Ireland.
  - Hand harvesting and its potential impact on *A. nodosum* regeneration and associated species within this biotope.
  - Communities and biological environments protected as part of the SAC (marine and coastal zones).
- Methods:
  - Mapping: Assessments of the admiralty chart, Ordinance Survey Discovery series map (OSM), NPWS Ariel photography and NPWS site synopsis.
  - Literature review: Study of environmental impact assessments and surveys of the area.

b) Electronic Mapping:

Electronic maps were created using the latest OSM of the region. These were inserted into Auto-Cad and the details of the harvest areas overlaid. Any additional information on the protected biological and environmental areas are identified on these maps. The length of the coastline of each island and the harvestable coastline of the mainland was measured from the maps. Satellite images, tidal information and aerial photographs were then used to estimate the coverage of each site. This data was then used to calculate the total biomass available from each site.

c) <u>Continuous disturbance of each community type</u>:

Continuous disturbance of each community type in Clew Bay should not exceed an approximate area of 15%. In order to assess adherence to these limits, BioAtlantis requested marine community type datasets for Clew Bay. The shapefile was provided by courtesy of NPWS and engineering personnel at BioAtlantis calculated (a) the total area (m2) in Clew

Bay SAC of each Annex I Habitat, (b) the area affected by harvest activities/annum (m2 and percentage). The results are presented in Section 3.4 and demonstrate adherence to these limits.

d) Visits to the site:

A survey was undertaken on the 26/09/2013 with the aims of assessing the level of *A. nodosum* resources and associated biodiversity in Clew Bay SAC. The detailed report can be found in Appendix 1. A key finding from this survey is that there is a level of *A. nodosum* harvest activities currently ongoing within the complex. Moreover, the techniques employed are quite variable in terms of extent and severity. A number of positive correlations between *A. nodosum* biomass and important canopy species were observed. This study provided an important source of data in which to develop the BioAtlantis Plan for hand harvesting in this area. A brief excerpt of the report (i.e. abstract) is provided as follows with the document provided in full in Appendix 1:

Title: Assessment of *A. nodosum* resources & associated biodiversity in Clew Bay.

Authors: Guinan KJ*, Fanning B* and O'Sullivan JT*†

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Abstract: The aim of this survey was to assess the levels of *A. nodosum* biomass within the Clew Bay complex and associated biodiversity within this biotope. In brief, measures were taken at eight sites within Clew Bay, including islands in the northern (Illannambraher, Inishcuil, Inishdaff), central (Inishcottle, Derrinish, Collan More) and southern (Inishlyre) regions of the complex, the entire survey taking place on the 26/09/2013 and analysis continuing over the following week. *A. nodosum* density was found to vary considerably between different sites, ranging from 1.34kg/m^2 in Inishcottle to 11.46kg/m^2 in Illannambraher. Evidence for recent hand harvest activities were found at several sites within the complex. Two harvest techniques appear to be employed which both involve the cutting of *A. nodosum* close to the holdfast and removal of (a) approximately 25% of plant or (b) >90% of the entire plant, the former representing the least invasive approach. *A. nodosum* density levels were lower than expected in a number of areas, including Collanmore. A trend towards reduced *A. nodosum* yield in areas of increased *Fucus sp*. cover was observed throughout the study, however this was not statistically significant (p-value = 0.106). Assessment of biodiversity demonstrates positive correlations between the quantity of *A. nodosum* and the numbers of winkles and limpets beneath the *A. nodosum* canopy per m^2 (p-values = 0.046* and 0.084$^{\#}$ respectively). In contrast, negative correlations between percentage *Fucus sp.* cover and winkle and limpet numbers were observed, however, these associations were not statistically significant (p-values = 0.058$^{\#}$ and 0.197 respectively). In conclusion, this study confirms the presence of substantial resources of *A. nodosum* in the Clew Bay complex, and points to a level of variability likely attributable to harvest activities which are currently ongoing in the area. In order to ensure maintenance of the complex relationships between *A. nodosum* and understory species, hand harvest activities must be performed in a manner which does not lead to extensive damage to the biotope.

e) Risk assessment, control measures, monitoring & corrective actions:

The following approach was taken by BioAtlantis staff in order to assess the potential risks associated with harvesting of *A. nodosum* in Clew Bay SAC (see Section 2 & 3 of for detailed description):

- Assessment of the extent of conservation requirements for species and habitats of qualifying interest.
- Identification of potential hazards (biological, chemical and physical).
- Risk of hazard occurring (probability 'X' severity), on a scale 1 – 25.
- Control measures to prevent hazards from occurring:
  - Exclusion of sites from harvest plan during sensitive times of the year (e.g. seal breeding, moulting and resting; bird wintering and breeding).
  - Mitigation measures:
    - High risk hazards which require mitigation (i.e. risk ≥15) and therefore, a Natura Impact Statement (NIS).
    - Low-moderate risk hazards (i.e. risk <15) requiring control measures and potentially mitigation and a NIS.
  - Determination of means in which to minimize impact on protected environs within the harvest areas, where applicable.
- Action limit/non-conformance: determine levels at which control measures are deemed to be breached or close to being in breach.
- Analytical procedure: determine methods used to determine whether or not action limits have been exceeded.
- Duties: personnel assigned with responsibility for assessing conformance with control measures and limits.
- Monitoring schedule: determine frequency at which conformance with control points and action limits are assessed.
- Corrective actions: determine means in which to counteract non-conformances or ensure that problems are not repeated.
- Verification: determine means of assessing the validity of control measures and associated analytical procedures and schedules in order to ensure that potential hazards are prevented from occurring.
- Natura Impact Statement (NIS): Assess whether or not an NIS is required in the event of not being able to rule out the risk of hazards affecting Annex I or Annex II species and habitats.

2. Development of Management & Implementation systems.

Management:

- Defining the resource management team – See Figure 1 below:

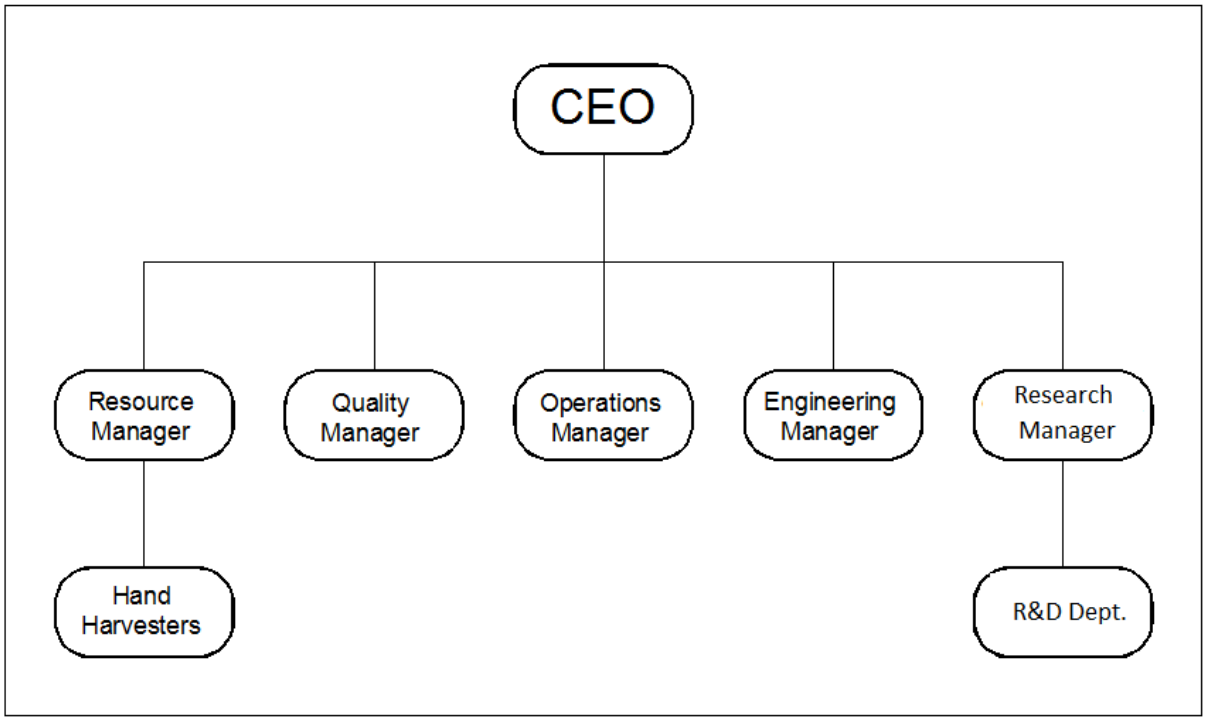

Figure 1 : Resource Management Team

Implementation Systems:

- Compliance and Record Forms (see Appendix 3): The following forms have been developed to ensure that systems are in place to assess harvest activities and report incidents and non-conformances on an ongoing basis:
  - Goods Received Note (GRN) form
  - Non-Conformance Report (NCR) form (G012)
  - Incident Report (IRF), form (G008)
- Code of Practice: mitigation measures have been developed by BioAtlantis (Appendix 4) to ensure that significant direct, indirect and cumulative effects on qualifying interests of Clew Bay SAC do not occur. These measures are considered as effective by Ecofact Environmental Consultants Ltd (see NIS attached).
- Quarterly and annual audits: As part of the Code of Practice, regular audits will be required to monitor quality standards (see Appendix 8 for Clew Bay audit template).
- Standard Operating Procedures (SOPs) will be put in place to ensure that the harvest activities are carried out in a clearly defined manner which does not impact on the protected communities and species within the SAC region. These procedures will be implemented along with regular training, assessment and supervision by members of the Resource Management Team at BioAtlantis Ltd., which is comprised of Engineering, Scientific and Quality personnel.

3. Development of monitoring systems.

- Quantifying *A. nodosum*: Methods of quantifying the *A. nodosum* resource are required to ensure that hand harvesting takes place in a sustainable and controlled manner. During the developmental stage, a number of methods were under review, under optimisation or being trialled. One such trial was carried out on the 26/09/2013 and involved the development of visual and direct on-site measurement approaches, along with inspection of site quality (see Appendix 1).
- Fallowing and harvesting requirements: Measurements of *A. nodosum* biomass and/or site recovery will be incorporated into a functioning database which includes measures of biomass in calculations aimed at determining future fallowing and harvest requirements, on a site-by-site basis. See Tables 3 & 5 for details.

4. Consultations:

From initial visits to Clew Bay, BioAtlantis has detected a considerable appetite and a level of enthusiasm for seaweed harvesting, primarily from a commercial and sustainable viewpoint. The region has a history of hand harvesting of *A. nodosum* and other seaweeds, but this has suffered in recent times due to a lack of investment in this area. The BioAtlantis plan will work to integrate in accordance with the needs and wishes of the Clew Bay region and provide important employment for those wishing to work in the area. To achieve these goals, BioAtlantis will engage with key groups including local hand harvesters, landowners, Mayo County Council and a number of local business interests in the area. Consultations such as these represent a key component of the BioAtlantis plan to develop the industry in Clew Bay. In this process, BioAtlantis will explain our objectives in an open, clear and approachable manner. In doing so, BioAtlantis hope to gain public, governmental and business approval for a management plan which we believe will provide a substantial economic benefit to the area, whilst also guaranteeing that the objectives for this SAC are met. Consultations have already taken place with hand harvesters in Clew Bay in which BioAtlantis explained the plan and took on board all concerns and suggestions by the hand harvesters as to how the system could work for them. Consultations undertaken during the developmental phase are outlined below.

Meeting #1: Dept. of the Environment Heritage and Local Government (DOEHLG): Pre-application meeting (Wexford; 19_06_2013).

- In Attendance: representatives from DOEHLG and from BioAtlantis (Dr. Kieran Guinan, Research Manager, John T. O'Sullivan, CEO).
- Recommendations: advice on mechanism in which to construct and proceed with application.

Meeting #2: NPWS, Pre-application meeting (04/07/2013; Dublin)

- In Attendance: representatives from NPWS and from BioAtlantis (Dr. Kieran Guinan, Research Manager & John T. O'Sullivan, CEO).
- Recommendations: Develop application document further and sent document to NPWS for scoping comments, paying close attention to requirements for harbour seals.

Meeting #3: NPWS, Scoping Meeting (13/11/2013; Galway).

- In Attendance: representatives from NPWS, BioAtlantis (Dr. Kieran Guinan, Research Manager, Brian Fanning, Engineering Manager & John T. O'Sullivan, CEO) and Ecofact Environmental Consultants Ltd.
- Recommendations: Further amendments to be made to the application, including the incorporation of breeding and wintering bird data and re-structuring in order to ensure compliance with Natura format.

Inland Fisheries Ireland

A letter has been sent to Inland Fisheries Ireland (29/11/2013) outlining the plan. Acknowledgment of receipt was received on 05/12/2013. Official response and views of IFI received on 20/12/2013 (letters attached to this application).

Meeting #4: (08/07/2014; Houses of the Oireachtas)

BioAtlantis provided a submission document outlining our views to the committee on "Licensing and Harvesting of Seaweed in Ireland". BioAtlantis also prepared a powerpoint presentation to explain our plan to hand harvest in Clew Bay.

Meeting #5: Meeting with hand harvesters (28/07/2014; Newport)

In Attendance: Clew Bay hand harvesters and BioAtlantis (Dr. Kieran Guinan, Research Manager, Brian Fanning, Engineering Manager and John T. O'Sullivan, CEO).

NPWS: Consultations between 26/08/14 and 30/10/14

Consultations via email took place between NPWS and BioAtlantis between 26/08/14 and 30/10/14. This provided clarity on obligations for ensuring that key measures of conservation status are adhered to. Risk assessments were updated and the NIS and other application documents were revised accordingly.

5. **Natura Impact Statement:**

The initial risk assessment carried out by BioAtlantis (described in Section 2 & 3) formed an important component in the development of the management plan. However, as a number of moderate risks were identified by BioAtlantis, it was deemed necessary to liaise with independent consultants, Ecofact Environmental Consultants Ltd., in order to assess whether or not a Natura Impact Statement (NIS) was required. The NIS is enclosed as a separate stand alone document with this application.

1.2.3 Locations & months in which operations/activities will take place.

Table 2 summarizes operations/activities undertaken during developmental phase, May 2013-Dec 2013. It also includes operations and activities taking place following initial submission of the application in January 2014.

No.	Operation/activity	Details			
1.	**Biomass Determination & Risk Assessment**	**Date**	**Location**	**Status**	**Ref.**
(a)	Literature review & data gathering.	May –Aug. 2013	BioAtlantis Ltd.	Complete	n/a
(b)	Electronic Mapping:	May –Aug. 2013	BioAtlantis Ltd.	Complete	Appendix 2
(c)	Visits to the site	26/09/2013	Clew Bay	Complete	Appendix 1
(d)	Risk assessment, control measures, monitoring & corrective actions	May-Dec. 2013	BioAtlantis Ltd.	Complete	Section 3 & Appendix 5, 6 & 7
(e)	Updates to the above as required by DOEHLG and based on NPWS comments	July-Oct 2014	BioAtlantis Ltd.	Complete	Current document, NIS & associated appendices
2.	**Development of Management & Implementation systems**	**Date**	**Location**	**Status**	**Ref.**
(a)	Defining the management team.	Oct 2013	BioAtlantis Ltd.	Complete	Figure 1
(b)	Compliance & Record Forms (GRN, NCR, IRF)	Oct 2013	BioAtlantis Ltd.	Complete	Appendix 3
(c)	Code of Practice for protecting Clew Bay	May-Dec 2013	BioAtlantis Ltd.	Complete	Appendix 4
(e)	Standard Operating Procedures (SOPs).	Dec 2014	BioAtlantis Ltd.	Incomplete	---
(f)	Updates to the above as required by DOEHLG and based on NPWS comments	July-Oct 2014	BioAtlantis Ltd.	Complete	Current document, NIS & associated appendices
3.	**Development of monitoring systems**	**Date**	**Location**	**Status**	**Ref.**
(a)	General Systems	May-Oct	BioAtlantis Ltd. & Clew Bay	Complete	Section 1 & 3 & Appendix 4
(b)	Quantifying *A. nodosum*	May-Oct	BioAtlantis Ltd.	Complete	Appendix 1
(c)	Fallowing and harvesting requirements	May-Oct	BioAtlantis Ltd.	Complete	Section 1.3.2, Tables 4 & 5
(d)	Updates to the above as required by DOEHLG and based on NPWS comments	July-Oct 2014	BioAtlantis Ltd.	Complete	Current document, NIS & associated appendices
(e)	Monitoring the Code of Practice: Quartely and annual auditing system	Oct 2014	BioAtlantis Ltd.	Complete	Current document, NIS & associated appendices
4.	**Consultations:**	**Date**	**Location**	**Status**	**Ref.**
(a)	Department of the Environment, Heritage and Local Government	19_06_2013	Wexford	Pre-application meeting	n/a
(b)	National Parks & Wildlife Service (NPWS)	04_07_2013	Dublin	Pre-application meeting	n/a
(c)	National Parks & Wildlife Service (NPWS)	13_11_2013	Galway	Scoping Meeting	n/a
(d)	National Parks & Wildlife Service (NPWS)	20th Nov – 3rd Dec, 2013	Via email	Datasets obtained & analyzed	Appendix 6
(e)	BirdWatch Ireland	15 – 27th Nov 2013	Correspondence via email	Datasets obtained &	Appendix 6

				analyzed	
(f)	Inland Fisheries Ireland (IFI)	29/11/2013	Letter sent via email	Response received 20/12/2013	Letters enclosed with application
(g)	Ecofact Environmental Consultants Ltd.	Oct 2013 –Jan 2014	BioAtlantis & Clew Bay	NIS completed (09/01/2014). Revision in Oct 2014	NIS attached to application
(h)	Houses of the Oireachtas: "Licensing and Harvesting of Seaweed in Ireland".	08/07/2014	Dublin	BioAtlantis Plan for Clew Bay explained to Committee	www.oireachtas.ie
(i)	Harvesters	28/07/2014	Newport	Explained plan to harvesters	n/a
(j)	DOEHLG	30/07/2014	Via email	Additional information requested	Application and NIS updated accordingly (Oct 2014)
(k)	National Parks & Wildlife Service (NPWS)	26/08/2014 - 30/10/14	Via email	Recommendations taken on board. Application and NIS revised accordingly	Current document & associated appendices (Oct 2014)
(l)	Landowners	Dec 2014*	Not completed		
(m)	Mayo County Council & other parties	Dec 2014*			

Table 2 : Summary of operations/activities undertaken during developmental phase (May 2013-present).

*Subject to the issuing of a hand harvesting license.

1.3 Operational Phase

1.3.1 Area to be directly impacted: Overview

BioAtlantis plans for harvesting *A. nodosum* from Clew Bay have been designed based on sustainability. Based on our own assessment and the study of the area by Hession C, *et al.*, (1998), we propose to harvest *A. nodosum* from a region that extends from Rosmurrevagh point on the north of Clew Bay to White Strand in the south, including the islands within the Bay. This is identified more clearly in Appendix 2, Maps.

The study by Hession C, *et al.*, (1998) concluded that Co. Mayo had the potential to sustainable yield 16,600 wet tonnes of *A. nodosum* per annum, out of a maximum total of 66,400 tonnes per annum, the majority of which located in Clew Bay. Through use of data obtained from the studies of Guinan KJ *et al.*, (2013, Appendix 1), Hession C, *et al.*, (1998) and maps and aerial photographs of the region, we have calculated the current maximum yield *A. nodosum* from the Clew Bay to be of the order 65,060 wet tonnes. This equates to an annual sustainable harvest of wet 13,012 tonnes. Table 3 lists the sites that will be harvested and the estimated available biomass in each case.

To manage the harvest activities, BioAtlantis will hire an experienced person who has a captain's licence, preferably an environmental science degree and/or with previous experience in the fishing industry. This person will fulfil the role of Resource Manager and will be responsible for the management of the harvesting area and in ensuring the sustainability of hand harvester activities. The Resource Manager will report directly to the CEO and work as part of the Resource Management Team.

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:

(a) Determine sites which require a fallowing period to allow for adequate recovery from recent activities.
(b) Determine rotation requirements (i.e. extrapolation and calculation of the duration or fallowing period required prior to a particular area 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 & when.

Moreover, this database will represent a central, working component of the BioAtlantis Code of Practice (Appendix 4) for harvesting *A. nodosum* which require:

(a) Development of pre-harvest plans in advance of harvest activities.
(b) A cap of 20% on the level of biomass which can be harvested from a given site per annum.
(c) *A. nodosum* cannot be cut below 200mm in height. At least 200-300mm (8-12 inches) material must be left behind.

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
		CZ 3.4	12914	4.35	100%	56.2 T	11.2 T	2583	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	Island No.	Name / Area
		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 1.1	40653	6	100%	243.9 T	48.8 T	8131	0
1		IS 1.2	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
4	Illannambraher		57901	19	96%	1053.2 T	210.6 T	11086	494

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	Island No	Name / Area
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
35	Illanmaw		74045	0	66%	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	Island No.	Name / Area
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
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

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	Island No.	Name / Area
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	0	0
75		IS 75.2	1107	6.75	100%	7.5 T	0.0 T	0	0
75		IS 75.3	5463	6.75	100%	36.9 T	0.0 T	0	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	0	0
75		IS 75.6	10649	6.5	100%	69.2 T	0.0 T	0	0
75		IS 75.7	1649	6.5	100%	10.7 T	0.0 T	0	0
75		IS 75.8	9495	6.5	100%	61.7 T	0.0 T	0	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
81	Roeillan		16126	15	100%	241.9 T	48.4 T	3225	0
	Totals						**12900 T**		

Table 3 Areas & quantities to be harvested

***** 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.

1.3.2 The spatial extent of harvesting: limiting disturbance levels to <15%.

NPWS recommend that continuous disturbance of each community type should not exceed an approximate area of 15%. Using marine community type datasets shapefile obtained from NPWS, BioAtlantis have calculated (a) the total area (m2) in Clew Bay SAC of each Annex I Habitat and (b) the area affected by harvest activities/annum. The only areas to be affected are reef and shingle. As summarised in Table 4 below, these levels fall below the 15% limit. For further details on this analysis, see Section 3.4. The marine community types in the Clew Bay SAC that will be affected by hand harvesting activities are reef and shingle. The area of shingle and reef affected annually by hand harvest activities is shown to be 12.7% and 4.9% respectively. It is considered therefore, that continuous disturbance of each of the community types does not exceed 15%, thereby complying with the EU Commission. The BioAtlantis 'Code of Practice' for *A. nodosum* harvest activities in Clew Bay SAC has been developed to ensure that management work within these 15% limits (see Appendix 4). Moreover, BioAtlantis have assessed the potential for interactions with other existing and planned activities, to mitigate against interactions with potential to significantly increase disturbance beyond the 15% limit (Appendix 7). A detailed description of the results of this assessment and mitigation of risks, is provided in Section 3.6. A summary outlining the extent of different in-combination and cumulative effects on marine community types, Annex I and II species and habitats, are also provided in Tables 14 and 15.

Marine community type	Total Area in the Clew Bay SAC	Maximum Annual area affected by hand harvest activities (m^2)	
	(m^2)	(m^2)	%
Reef	26,870,000	1,331,699	4.96%
Shingle	1,855,000	235,549	12.7%

Table 4 Marine community types affected by hand harvesting in Clew Bay

1.3.3 Different types of operations/activities

There are four main types of activities associated with the operational phase, as follows:
a) Operation/Activity No. 1: Management and Implementation.
b) Operation/Activity No. 2: Monitoring, recording and reporting.
c) Operation/Activity No. 3: Verification & Analysis.
d) Operation/Activity No. 4: Long term assessment of biomass and community structure

These operations/activities are described in detail throughout this section.

(a) Operation/Activity No. 1: Management and Implementation

The sustainable harvest system consists of several key management and implementation components. These include activities relating to:

(i). Managing expansive and prolonged operations.
(ii). Managing personnel and exploitation levels.
(iii). Planning and scheduling of harvesting activities.
(iv). Data recording and analysis.
(v). Navigation to and from harvest sites.
(vi). Communication.
(vii). Hand-harvest methodology, guidelines and Codes of Practice.
(viii). Health and safety measures
(ix). Preventing spread of invasive species

The details of how BioAtlantis proposes to manage these activities are as follows.

(i). Managing expansive and prolonged operations

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 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 a collection vessel ensures ease of access by the Resource Manager to the sites. The Resource Manager will manage operations throughout the complex. 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 the harvester's times is spent on cutting and not hauling seaweed ashore. This avoids potential for coastal damage that could be caused by bringing in large quantities of seaweed ashore at inappropriate locations.

(ii). Managing personnel and exploitation levels

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 0.4 acres per person per day, for approximately 6-8 hours per day. Small-medium sized islands will require approximately 2-4 harvesters. 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% will represent a relatively constant figure and will not be exacerbated due to significant levels of *A. nodosum* mortality due to partial or complete holdfast removal.

(iii).Planning & scheduling of harvesting activities

During a recent survey of the region, evidence for a substantial level of unlicensed harvesting of *A. nodosum* within the SAC region of Clew Bay was observed (see Appendix 1 for associated report). To properly manage the extensive coastline of Clew Bay, BioAtlantis will create a database of all islands and coastal areas in the region. This will contain information as to the length of coastline, density of *A. nodosum* and coverage percentage, along with details of each harvest. 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, we can establish the dates and quantities of the most recent harvests for each island & coastal zone. This data can then be used to decide when a region will be next available for harvest.

Once the data from the most recent harvest has been established, this will be entered in the database as shown in Table 5, in the highlighted columns. The maximum harvest available from each Island or coastal zone has been established from surveys and previous studies. The nominal recovery time is generally accepted to be 3-5 years from a complete harvest. BioAtlantis propose a maximum harvest of 20% of the total available *A. nodosum* biomass per site per annum to ensure sustainability. The figure of 20% refers to the percentage of the total available *A. nodosum* biomass harvested per site per annum.

Adaptive Management: BioAtlantis will implement an Adaptive Management Approach. This will ensure continual improvements to the harvesting plan during its implementation and ensuring its effectiveness into the future. For example, BioAtlantis will also work to include local knowledge as to best practice when approaching sites.

Number	Island Name	Total Seaweed on Island (Tonnes)	Maximum Annual Harvest per Island (Tonnes)	Date of Last Harvest (Sample dates used)	Quantity of Previous Harvest		Predicted Fallow Period (Years)	Date of Next Harvest
					Weight (Estimated for Table)	Percentage of Available Biomass		
31	Freaghillan West	194.8	39.0	August, 2013	34	17.45%	0.9	June, 2014
32	Innishcannon	138.5	27.7	September, 2013	27	19.49%	1.0	August, 2014
36	Freaghillan East	115.6	23.1	October, 2013	10	8.65%	0.4	March, 2014
37		23.6	4.7	November, 2013	0	0.00%	0.0	November, 2013
38	Inishcuill West	1348.2	269.6	December, 2013	200	14.83%	0.7	August, 2014
39	Mauherillan	217.5	43.5	January, 2014	42	19.31%	1.0	December, 2014
40	Inishfesh	685.8	137.2	February, 2014	137	19.98%	1.0	January, 2015
41	Inishmolt	425.1	85.0	March, 2014	20	4.70%	0.2	May, 2014
42	Inishloy	669.4	133.9	March, 2014	25	3.73%	0.2	May, 2014
43	Inishdaff	1452.9	290.6	March, 2014	100	6.88%	0.3	July, 2014
44	Inishbollog	273.9	54.8	April, 2014	25	9.13%	0.5	September, 2014

Table 5 : Planning of Harvest Activities

* The sample data entered above is for illustration purposes only.

Once the re-harvesting date for each island is established, this information will be used to plan the next seasons harvesting. When planning future harvests, some islands and sites will be marked as unavailable for certain times of the year. This is to ensure that known seal breeding, moulting, resting and sensitive bird breeding and wintering sites are avoided. It also ensures avoidance of a number of sites where significant in-combination effects could occur at certain times of the year. The Resource Manager will be responsible for ensuring that these sites are avoided. A complete list of sites and their exclusion requirements in accordance with time of year, the presence of seals, breeding and wintering bird populations and potential for in-combination effects in general, is provided in Table 8 of this document. The list of restricted sites and site-specific measures is described further in Appendix 4 and broken down on the basis of specific harbour seal and sensitive bird sites.

The Resource Manager will be required to verify that each site has fully recovered prior to re-harvesting. This will be done by via on-site assessments and updating the plan as necessary with the results of this analysis.

Duty: BioAtlantis Hand Harvest Management Team & Resource Manager

Harvesting Flow Chart

The flow chart shown in figure 2, describes the harvesting process and the pre- and post-harvest checks that are in place to ensure that the correct procedures are followed.

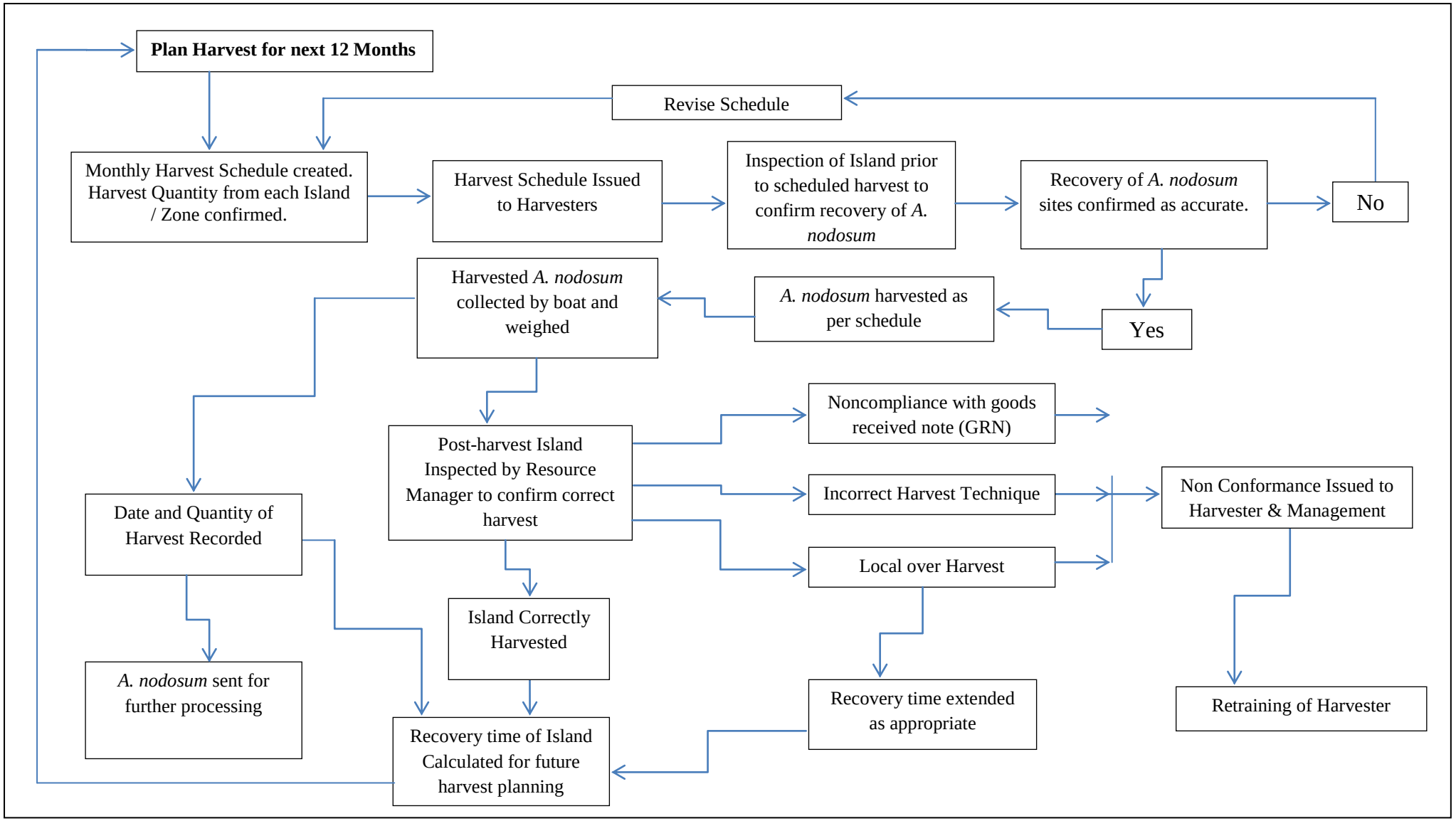

Figure 2: Harvesting Flow Chart

(iv). Data recording & 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 Notes" (GRN, see Appendix 3)" to record the harvest from each site. This will include the following data:

- Name of harvester
- Date & time of harvest
- Pick-up location
- Location of site, name of island / coastal sector and if appropriate, zone or additional location information.
- Description of the site:
  - Quantity of harvest
  - Quality of harvest: is seaweed free of the following:
    - Sand, gravel, stones or debris
    - *A. nodosum* holdfasts.
    - Other species (e.g. *Fucus*)
  - Assessment of harvest operations: Have harvesters worked to ensure:
    - Cutting of *A. nodosum* 200-300mm (8-12 inches) above holdfast.
    - No more than 20% of the available *A. nodosum* biomass is harvested.
    - Activities only take place at approved sites.
    - Health and safety requirements are adhered to.

After receipt of the *A. nodosum* in the factory, these details will be uploaded into the main database. The quality of the supplied *A. nodosum* will be assessed by production staff and/or Quality Control (QC) team and details of any deviations from the specified requirements will be recorded. Regular auditing of the harvest records (e.g. GRN and production logsheets) will be carried out to ensure compliance with all BioAtlantis SOPs to ensure that communities and species within the Clew Bay SAC are protected. The procedures for reporting non-conformances are:

- The personnel concerned are advised of the non-conformance and re-trained if necessary.
- Where there is continued/repeated non-conformances, management will decide on appropriate action, depending on the severity of the non-conformance.
  (See Appendix 3, for standard NCR Forms)

Computerised data will be maintained of all harvest records and non-conformances. Once the production planning and schedule for each year has been completed and prior to recommencing harvesting, each site will be visited by the Resource Manager to ensure the validity of the data relating to projected regeneration times and site recovery. Planned harvesting activities will be adjusted accordingly in the event of any inaccuracies in the projections.

Duty: Implementation, monitoring & analysis by Engineering, IT, Production, Quality personnel and Resource Manager.

(v). Navigation to and from 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 using a boat or through use of existing routes. 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 as required by management.

(vi). Communication

The number of harvesters operating for BioAtlantis will be approximately 16 full time or 32 part-time. 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.

Duty: Communication by the BioAtlantis Resource Management Team. Implementation by hand harvesters.

(vii). Hand-Harvest methodology, Guidelines and Codes of Practice.

- **Selection of a harvest methodology suited to Clew Bay:**

  There are several different harvest methods employed throughout the world, including sickle/knife hand-harvesting and 'rake'-type methods. Each method has varying degrees of efficacy and safety and some may be better suited a particular environment than others. This is particularly the case in Clew Bay, whereby the coastal substrate is a heterogeneous mixture of small rocks, small stones & pebbles, classified as reef by NPWS with stated objectives for maintenance. As increased removal of holdfast by-catch can occur due to the presence of underlying friable substrate (ref: paragraph. 3, page 19, Vandermeulen *et al.,* 2013), it is critical that the harvest systems in Clew Bay mitigate against such effects. On assessment of the literature and by considering Clew Bay's unique *A. nodosum* substrate, management at BioAtlantis have selected a methodology which minimizes the risk of:

  (a) Disturbing or displacing substrate during hand harvest
  (b) Damaging holdfast material
  (c) Removal of holdfast material and associated *A. nodosum* mortality.

The methodology involves use of the sickle/knife method at low tide which provides harvesters with full view of the cutting process, taking care not to disturb the substrate, not harvest too low or damage holdfast. For more details, please see Section 3.5.3 (c) and the Code of Practice in Appendix 4.

- **Guidelines and Codes of Practice:**

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 SAC can be found in Appendix 4. SOPs will also cover the following areas:

- Environmentally sensitive navigation methods, i.e. to prevent damage to mudflats, sandflats, clean/fine sand areas. Navigation in these areas will be at high tide.
- Determining suitability of harvest areas, i.e., fronds which are too short will not be harvested.
- Method for using sickle or knife to cut fronds of *A. nodosum* between 200-300mm (8-12 inches) above the base, without damaging holdfast or underlying substrate and method for bagging of cut *A. nodosum* in nets.
- Method for automatic weighing and transfer of weed to boat.
- Method for filling out GRN.
- Methods for loading and transporting of cut weed to BioAtlantis via suitable piers.
- Method for communicating with BioAtlantis.
- Method for reporting incidents to BioAtlantis.

Training will also be provided to ensure competence in navigation and use of electronic and health and safety equipment.

Duty: Teaching provided by Science, Engineering & Quality personnel

(viii). 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 (MSO). Duty: Health and Safety Manager.

(ix). Preventing spread of invasive species

Hand harvesting has potential to act as a vector in the spread of invasive species, e.g. *Didemnum vexillum*. To ensure that harvest activities do not lead to the spread of *Didemnum vexillum*, BioAtlantis require that the main collection vessel and harvester boats be painted once a year with appropriate anti-fouling paint. Harvester 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 will be cleaned with sodium hypochlorite on delivery to production facilities and returned to harvesters in a clean condition.
Duty: Resource Manager, Production Manager & hand harvesters.

b) Operation/Activity No. 2: Monitoring, recording and reporting

The sustainable harvest system consists of several monitoring, recording and reporting components. These include:

(i). Core Requirements.
(ii). Monitoring the *A. nodosum* resource: initial and continual assessments
(iii). Maintenance of Harvest Database.
(iv). Accurately plan harvest periods.
(v). Quality Control (QC).
(vi). Quotas.
(vii). Monitoring & reporting of other activities.
(viii). Quarterly and annual audits of the harvesting system

Details of how BioAtlantis proposes to manage these activities are as follows.

(i). Core requirements

Activities in this region must be sufficiently monitored and recorded using appropriate techniques and reported in a manner which allows for continual assessments, statistical analyses and verification of controls measures which are in place. This includes continuous monitoring of the *A. nodosum* resource, maintenance of a non-conformance reporting system and maintenance of a database containing the following information:

- Harvester details: name, date and time of harvest.
- Location of harvest site and pick-up point.
- Quantity harvested at site.
- Quality parameters (i.e. contaminants such as sand, stones, holdfasts, debris, other species, etc).

Duty: The above information will be cross-checked by QC and Production staff at BioAtlantis Ltd. Maintenance of the database will allow for continuous monitoring and analysis of harvest of the *A. nodosum* resource.

(ii). Monitoring of the *A. nodosum* resource: initial and continual assessments

- Initial assessment: 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 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.

- Continual Assessment: The Resource Manager will monitor *A. nodosum* levels 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.

  Duty: Resource Manager, Engineering Manager, QC.

(iii). Maintenance of Harvest Database.

Immediately following harvest, *A. nodosum* will be bagged and weighed automatically on the collection vessel. Details will be recorded on the GRN, thus allowing for accurate recording of the locations and quantities of *A. nodosum* harvested. The Resource Manager will be responsible for uploading the data 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.

(iv). Accurately plan harvest periods.

Locations and periods of harvest must be planned in a manner which ensures that (a) there is no damage to the environs of the SAC, (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 are through analysis of datasets as they emerge. In this way, staff at BioAtlantis will make decisions which are informed by knowledge of the rates of *A. nodosum* regeneration and site recovery. Data relating to biomass levels and site recovery will be incorporated into the main database (see Tables 3 & 5) for use in planning harvest periods.

(v). Quality Control (QC):

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 which we manufacture. Therefore, the QC 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 SAC.
- Assessment of quality control checks to ensure recording is conducted appropriately (GRN, etc).
- Implementation of corrective actions where necessary. Liaise with BioAtlantis Resource Management Team on non-conformance issues should they arise.
- Utilization 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 R&D 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.

(vi). Quotas:

The quota for each island is a sustainable harvest of 20% of the available *A. nodosum* per site per annum (See Table 3 for estimation at each site). If quota is exceeded, a Non-Conformance Report (NRC) will be issued. Harvesters will undergo re-training if required. The Resource Manager will routinely inspect sites post-harvest to ensure compliance of harvesters with sustainable hand harvest methods. An NCR will be filed and re-training provided if deemed necessary. In the event of continual non-compliance, the contract with any such individual may be terminated.

(vii). Monitoring & reporting of other activities:

In the event that harvesters contracted by BioAtlantis cut excess amounts of *A. nodosum* and/or sell material to unlicensed operators, BioAtlantis will investigate and if necessary take disciplinary procedures.

(viii). Quarterly and Annual audits of the harvesting system

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. BioAtlantis will conduct quartely and annual audits of standards covering the areas below. The Clew Bay audit template is attached as Appendix 8.

(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

c) Operation/Activity 3: Verification, Analysis and System updates

The harvest system must be continually assessed to ensure the validity, efficacy, fitness for purpose of its various components. Central to ensuring the system works as a whole, there will be regular audits of all systems and robust follow-up to ensure that standards, codes of practice and mitigation measures are adhered to. The 3 key features of this system are as follows:

(i). Verification
(ii). Analysis
(iii). Updating the system

Details of how BioAtlantis proposes to manage these activities are as follows.

(i). Verification

Control measures will be required in order to ensure that processes involved in harvesting are not detrimental to the Clew Bay SAC. The following systems will be put in place to verify the effectiveness of the systems and control measures:

- Annual review of the harvesting system.
- Assessment and confirmation of the conformance of harvesters to the sustainable hand harvesting system.
- Annual review of the QC system to ensure the company is operating according to the harvesting plan.
- Quartely review of hand harvesting records (i.e. GRNs).
- Quarterly review of records for deviations and corrective actions.
- Validation of limits set for implementation of control measures and confirm that they are adequate to prevent any non-conformances.
- Validation of the Harvesting Plan, including on-site review.
- Review of any modifications to the Harvesting Plan.
- Verification of the accuracy and effectiveness of the system will be conducted:
    - Quarterly, in order to assure potential non-conformances are under control (i.e. via Internal Audit).
    - When concerns emerge regarding environmental non-conformances or damage.
    - To confirm that changes have been implemented correctly after the Harvesting Plan has been modified.
    - To assess whether the Harvesting System should be modified due to any changes in EU Law or Irish Law should they arise.

(ii). Analysis

- On-going and annual assessments of the validity of the current controls used to ensure protection of biological communities in the Clew Bay Complex.
- Analysis of data obtained during implementation of harvest by means of Mapping Software (e.g. CAD) or statistical methods.
- Utilization of this knowledge in the preparation, scheduling and allocation of resources for harvesting.

(iii). Updating the system

During regularly quarterly and annual audits and meetings, it may be determined that improvements are necessary to refine the harvesting system. Any significant changes will be documented. For example, it may be necessary to avoid hitherto unknown sensitive sites. On review of quality checks on Good Received Notes (GRNs) and on review of incidents that arise on a week-by-week basis (Incident Report Forms), it may be necessary to improve systems or copper fasten mitigation measures to ensure maximum compliance with standards for protecting the SAC. It may also be necessary to allow certain sites extended re-growth periods, due to the potential for localised or regional variability in growth rates. This 'Adaptive Management Approach' will ensure the optimal performance if the system in the short and long term.

d) Operation/Activity 4: Long term assessment biomass and community structure

BioAtlantis have invested considerably in R&D throughout its history and are currently involved in several internationally recognised research collaborations (see Figure 3). This research focus will continue, with additional emphasis placed on assessing the long term impact of hand harvesting on *A. nodosum* biomass recovery and community structure. BioAtlantis will build on the findings of Kelly *et al.*, (2001) and continually assess the impact of *A. nodosum* harvesting in Clew Bay, throughout the life-time of the licence. This approach will allow scientists and engineers at BioAtlantis to continually validate and improve the methodology 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 over a longer time period beyond the relatively short timeframe assessed by Kelly *et al.,* 2001. This will be important in ensuring that conservation objectives are met continually into the future. For more details as to how assessments will be carried out, the experimental design and the parameters measured, please see below. Additionaly, the potential impacts of hand harvesting on community structure are discussed in Section 3.5.3 (d).

Experimental design and methodology:

A pilot study to measure biodiversity has already been performed in Clew Bay (see Appendix 1). The experimental design will be further developed to include important parameters, techniques and measurements as summarised below:

- Designation of experimental sites to facilitate comparisons between non-harvested areas and harvested areas. The chosen control sites will not be subjected to commercial harvest activities. 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 appropriate statistical packages.
- Assessments will be performed on an annual basis to allow for monitoring over an extended time-period, ideally between 5-10 years.

Annual reports and datasets will be made available to NPWS and others if requested. This will be important in ensuring that conservation objectives are met continually into the future. Research scientists and statisticians at BioAtlantis have strong expertise in the biological sciences and excellent publication records. These levels of expertise will ensure that the assessments and analyses are carried out to high standards. This work will also ensure that scientific knowledge of the potential impact of hand harvesting in Clew Bay is increased beyond the timeframe assessed by Kelly *et al.*, 2001.

Duty: Research Manager, Chief Plant Molecular Biologist and Engineering Manager

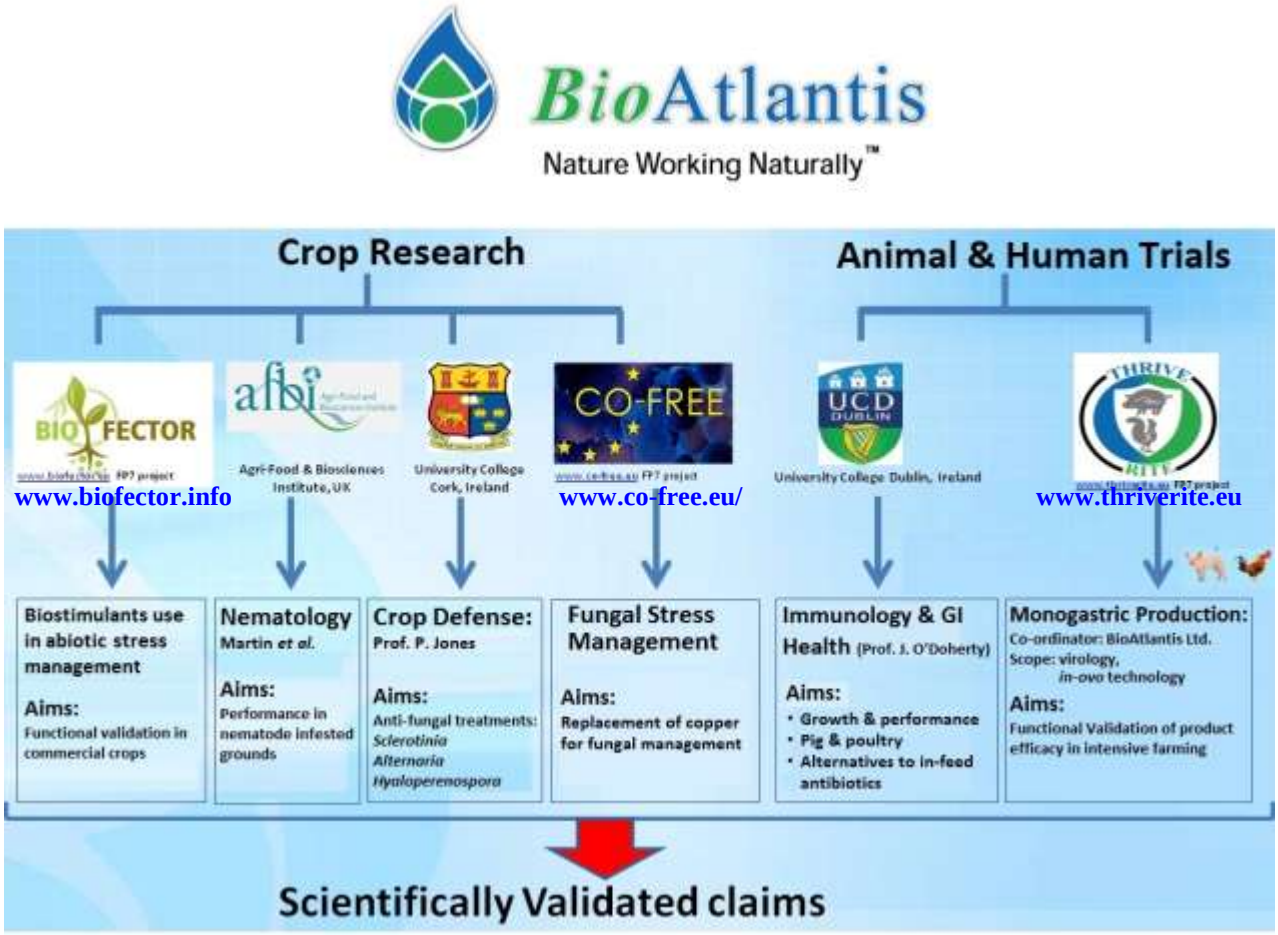

Figure 3: BioAtlantis Current Research Programmes

1.3.4 Locations in which operations/activities will take place.

1.3.4.1 Harvest zones

Initially in Clew Bay, BioAtlantis will identify areas which have been shown to have been subjected to a substantial level of recent harvesting. These areas will be given an appropriate fallowing period to facilitate recovery. A duration of 3-5 years is generally considered a time-frame effective in ensuring re-growth of *A. nodosum* (Kelly L. *et al.*, 2001 and Guiry, M. and L. Morrison (2013). Overall, this approach will ensure that effects on fauna and microflora are minimized, whilst maintaining the regenerative capacity of the macroflora. The density of *A. nodosum* in Clew Bay ranges from 0.2 – 37 Kg/m^2 (Kelly L. *et al.*, 2001). Densities within other regions of the North Atlantic are given in Table 6 below. From our assessment, we estimate that an average density of 10.4Kg/m^2 for Clew Bay. From a total available harvest of 64,759 Tonnes (see Table 7) and based on the BioAtlantis sustainable harvest methodology of a 20% harvest per site per annum and cutting of 200-300mm (8-12 inches) above the holdfast, there is an annual sustainable harvest of ~12,900 Tonnes (Table 7).

Region	**Yield(kg/m^2)**	**Reference**
Canada	7.1	Ugarte R & Sharp GJ (2011A)
Iceland	5.0 - 8.0	Valsdóttir P (2011)
Ireland (Clew Bay)	0.2 -37.0	Kelly L. *et al.*, (2001)
Norway	4.0 - 7.0	Steen H (2009)
Scotland (Western Isles)	4.6- 24.1	Minch Project (1995)

Table 6 : Yields of *A. nodosum* in five regions of the North Atlantic

***A. nodosum* Hand Harvesting Zone**	Average Seaweed Density (kg/m^2)	Total Available Harvest (Per Annum)		Sustainable Annual Harvest (Tonnes Per Annum)*
		Kg	Tonnes	
Coastline	1.83	8752817	8,753	1,751
Northern Islands	13.46	15738415	12,846	2,569
Mid Islands	16.96	29302494	29,302	5,860
Southern Islands	7.96	13857656	13,858	2,720
			64,759 Total	**12,900 Total**

Table 7 : Available harvest of *A. nodosum* in designated zones of Clew Bay

* Harvest will not exceed 20% of the available harvestable *A. nodosum* per site per annum

1.3.4.2 Access to harvesting sites

Access to the islands will be by boat, according to methods which minimise potential impacts on the SAC (e.g. harbour seals, mudflats & sandflats, wintering and breeding birds, etc; see Appendix 4 for Code of Practise). Access to the coastline will be via existing routes or boats as required. In the case of the pick-up vessel, launch to islands will be made from existing piers. Individual harvesters will access sites via existing methods. The harvested seaweed will be collected immediately in nets at the shoreline; these nets will then be collected by the pick-up boat using a hoist arm and delivered to a pier for onward transport. The size of the shore area covered by an individual net will be approximately 8 m^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 harvesting took place. Final pick-up points will be at established piers and harbours, particularly in Westport and Newport. The following provides a summary of piers and quays which will be used as the main collection points for transport to the processing plant:

- Northern Islands & Northern coast — Rockfleet pier
- Mid Islands & Coastline — Ardkeen Quay
- Mid Islands & Coastline — Ardkeen Quay / Rosmoney Quay
- Mid and South Islands & coastline — Rosmoney Quay
- South Islands & South Coastline — Westport Harbour

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.

Harvesting will be carried out in a manner which does not negatively impact on fishing and sea angling in the complex. Several sites which are documented to be of relevance to fisheries and sea angling have been identified and will not be negatively affected by harvest activities (see correspondence with IFI enclosed with this application). The operational areas of seven charter skippers in Clew Bay have also been identified and will not be impacted by harvest activities. Harvesters will work to ensure that angler's space will be respected at all times.

1.3.4.3 Facilities to cope with biological and industrial waste

There will be no biological waste generated from this process. All of the material harvested will be transported to BioAtlantis manufacturing facilitites in Kanturk, Co. Cork where it will be used as raw material for extraction of bioactives for the agricultural industry. BioAtlantis Ltd. production facilities are certified in the EU by GMP+ International B.V (Cert No.

1102/960983, www.gmpplus.org), granting the company permission to produce and trade seaweed extract destined for use in highly regulated markets of Northern Europe. The production facilities are located in Kanturk, Co. Cork and are fully licensed and compliant with all necessary regulations.

1.3.5 Months in which operations/activities will take place.

Harvesting operations will take place all year round. Harvesters will work with the tide to ensure that they arrive in boats in appropriate conditions. Time-frames in which harvesters will work at islands will vary per site. Small-medium sized islands will require approximately 2-4 harvesters. Medium to large islands may require between 4-6, while larger islands will likely require approximately 6-10 harvesters. The known moulting & breeding sites of the harbour seals will be avoided during the months of May to September. In table 8, 'x' denotes the exclusion of a site at a particular time of year due to the presence of protected harbour seals and/or bird species of interest, thus ensuring that no negative impacts occur. See Appendix 4 for "Code of Practice" and site specific details for protected seal and bird species. On the advice of NPWS, BioAtlantis will work to incorporate any islands currently unlisted as having relevance for harbour seals, e.g. unlisted moulting sites, etc. In addition, table 8 also incorporates sites known to be of relevance to protected avian species (*pers. comm. 03/12/2013).* Similar to harbour seals, these sites are avoided at sensitive times of the year, i.e. during breeding and wintering seasons. Further site-specific details for protected bird species are provided in Appendix 6. Sites where significant risks of seasonal in-combination effects due to potential interactions with existing operations or planned operations, will also be avoided as appropriate. For example, Collanmore exhibits substantial human activity during peak tourist season (May-August). Roman Island and Wesport Harbour are being targeted by Mayo County Council for increased recreational tourism activitity. These sites will also be avoided during peak tourist season between May-August (see Code of Practice for details).

Island No.	Name / Area	Harvesting Zone ID	Harvest Control Measures											
			Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
	Bartraw - Westport	CZ 1.1	X	X	X							X	X	X
		CZ 1.2												
		CZ 1.3												
		CZ 1.4												
		CZ 1.5												
		CZ 1.6												
		CZ 1.7												
		CZ 1.8												
		CZ 1.9												
		CZ 1.10												
		CZ 1.11												
		CZ 1.12												
		CZ 1.13												
		CZ 1.14												
		CZ 1.15												
		CZ 1.16												
†	Roman Island, Wesport Quay	CZ 1.17 †					X	X	X	X				
†		CZ 1.18 †					X	X	X	X				
†	Westport - Rosmoney	CZ 2.1 †					X	X	X	X				
		CZ 2.2												
		CZ 2.3												
		CZ 2.4												
		CZ 2.5												
	Pigeon Point	CZ 2.6	X	X	X							X	X	X
		CZ 2.7	X	X	X							X	X	X
		CZ 2.8												
		CZ 2.9												
		CZ 2.10												
		CZ 2.11												
		CZ 2.12												
		CZ 2.13												
		CZ 2.14												
		CZ 2.15												
		CZ 2.16												
		CZ 2.17												
	Rosmoney - Moyna Strand	CZ 3.1												
		CZ 3.2												
		CZ 3.3												
		CZ 3.4												
		CZ 3.5												

Island No.	Name / Area	Harvesting Zone ID	Harvest Control Measures											
			Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
		CZ 3.6												
		CZ 3.7												
		CZ 3.8												
	Rostoohy Pt - Newport	CZ 4.1												
		CZ 4.2												
		CZ 4.3												
		CZ 4.4												
		CZ 4.5												
		CZ 4.6												
		CZ 4.7												
		CZ 4.8												
		CZ 4.9												
		CZ 4.10												
		CZ 4.11												
		CZ 4.12												
		CZ 4.13												
		CZ 4.14												
	Newport - Mallaranny Pier	CZ 5.1												
		CZ 5.2												
		CZ 5.3												
		CZ 5.4												
		CZ 5.5												
		CZ 5.6												
		CZ 5.7												
		CZ 5.8												
		CZ 5.9												
		CZ 5.10												
	Rosturk	CZ 5.11	X	X	X							X	X	X
		CZ 5.12	X	X	X							X	X	X
		CZ 5.13	X	X	X							X	X	X
		CZ 5.14	X	X	X							X	X	X
	Rossmurrevagh	CZ 5.15	X	X	X							X	X	X
		CZ 5.16	X	X	X							X	X	X
		CZ 5.17	X	X	X							X	X	X
1	Forillan, Illanavrick Etc	IS 1.1												
1		IS 1.2												
2	Kid Isd East													
3	Roslynagh						X	X	X					
4	Illannambraher													
5	Inishdasky						X	X	X					
6	Inishquirk													
7	Inishtubrid		X	X	X	X						X	X	X

Island No.	Name / Area	Harvesting Zone ID	Harvest Control Measures											
			Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
8	Inishlim													
9														
9	Beetle Isd North													
9	Inishbobunnan													
10														
10	Inishgowla													
10	Beetle Isd South													
11	InishKeel	IS 11.1												
11		IS 11.2												
11		IS 11.3												
11		IS 11.4												
12	Black Rock													
13	Moynish More		X	X	X	X	X	X	X			X	X	X
14	Moynish Beg				X	X	X	X	X	X	X			
15	Inisherkin													
16	Inishnacross													
17	Inishilra						X	X	X					
18	Inishcooa													
19	Roeillaun				X	X	X	X	X	X	X			
20	Inishdeashbeag		X	X	X	X	X	X	X	X	X	X	X	X
20	Adjacent island/skerry		X	X	X	X	X	X	X	X	X	X	X	X
20	Inishdeashmore		X	X	X	X	X	X	X	X	X	X	X	X
21	Inishcorky				X	X	X	X	X	X	X			
22	Inishcarrick						X	X	X					
23	Inishcoragh													
24	Muckinish						X	X	X					
25	Inishdaweel						X	X	X					
26	Rabbit Isd													
26	Adjacent island/skerry													
27	Illanascrraw						x	x	x					
28	Freaghillanluggagh						X	X	X					
29	Inishkee													
30	Unnamed													
31	Freaghillan West													
32	Innishcannon													
33	Carricklahan													
34	Carrickachorra													
35	Illanmaw													
36	Freaghillan East													
37	unnamed													
38	Inishcuill & Inishcuill West		X	X	X	X						X	X	X
39	Mauherillan				X	X	X	X	X	X	X			

Island No.	Name / Area	Harvesting Zone ID	Harvest Control Measures											
			Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
40	Inishfesh													
41	Inishmolt													
42	Inishloy													
43	Inishdaff													
44	Inishbollog													
45	Inishlaughil													
46	Inishgowla													
47	Inishoo													
48	InishTurk	IS 48.1												
48		IS 48.2												
49	Illannaconney													
50	Inishakillew	IS 50.1								X	X			
50	Adjacent island/skerry	IS 50.2								X	X			
51	Trawbaun													
51	Carrigeenglass North													
51	Moneybeg													
51	Inishcottle													
52	Calf Island													
53	Inishbee, Derrinish & Dernish West													
54	Freaghillan	IS 54.1												
54		IS 54.2												
54		IS 54.3												
55	Clynish													
56	llaunnamona													
57	Rabbit Island, Island More &Quinnsheen Island	IS 57.1												
57		IS 57.2												
57		IS 57.3												
57		IS 57.4												
58*	Collan More, Carrigeenglass South & Collan Beg	IS 58.1					X	X	X	X				
58		IS 58.2					X	X	X	X				
58		IS 58.3					X	X	X	X				
59	Inishgort													
60	Inishlyre													
61	Illanataggart & Crovinish													
62	Inishgowla South + Carrickwee						X	x	x	X	X			
63	Forilan									X	X			
64	Carrickawart	IS 64.1	X	X	X	X				X	X	X	X	X
64	Adjacent island/skerry	IS 64.2												
65	Inishlaghan													
66	Dorinish More & Dornish Beag				X	X	X	X	X	X	X			
67	Inishimmel				X	X	X	X	X	X	X			

Island No.	Name / Area	Harvesting Zone ID	Harvest Control Measures											
			Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
68	Inishleauge													
69	Inishdaugh													
70	Inishraher													
71	Inisheeney		X	X	X							X	X	X
72	Finnaun Island						x	x	x	x	x			
73	Corillan	IS 73.1								x	x			
73	Adjacent island/skerry	IS 73.2												
73	Adjacent island/skerry	IS 73.3												
73	Adjacent island/skerry	IS 73.4												
74	Carricknamore	IS 74.1								x	x			
74	Adjacent island/skerry	IS 74.2												
74	Adjacent island/skerry	IS 74.3												
75	Adjacent island/skerry	IS 75.1	X	X	X	X	X	X	X	X	X	X	X	X
75	Adjacent island/skerry	IS 75.2	X	X	X	X	X	X	X	X	X	X	X	X
75	Adjacent island/skerry	IS 75.3	X	X	X	X	X	X	X	X	X	X	X	X
75	Stony Island	IS 75.4	X	X	X	X	X	X	X	X	X	X	X	X
75	Adjacent island/skerry	IS 75.5	X	X	X	X	X	X	X	X	X	X	X	X
75	Adjacent island/skerry	IS 75.6	X	X	X	X	X	X	X	X	X	X	X	X
75	Adjacent island/skerry	IS 75.7	X	X	X	X	X	X	X	X	X	X	X	X
75	Adjacent island/skerry	IS 75.8	X	X	X	X	X	X	X	X	X	X	X	X
76	Green Islands	IS 76.1	X	X	X	X	X	X	X	X	X	X	X	X
76	Adjacent island/skerry	IS 76.2	X	X	X	X	X	X	X	X	X	X	X	X
76	Adjacent island/skerry	IS 76.3	X	X	X	X	X	X	X	X	X	X	X	X
77	Carricknacally													
78	Monkellys Rock													
79	Inishweela													
80	Illanroe													
81	Roeillan													

Table 8 : Months in which Islands are unavailable for Harvest due to presence of sensitive species.

'X' denotes the importance of a site at a particular time of year to harbour seals, protected wintering or breeding bird species or sites with exceptionally high levels of recreational/tourism activity. See Code of Practice in Appendix 4 for details.

*denotes sites where interactions of harvesting with **existing operations** has potential to give rise to significant in-combination effects at times of the year indicated by 'X'. n

†denotes sites where interactions of harvesting with **planned operations** has potential to give rise to significant in-combination effects at times of the year indicated by 'X'.

1.4. Description of receiving environment

Clew Bay is a wide, relatively sheltered bay on the west coast of Co. Mayo. The Bay is characterised by a drumlin landscape which was formed during the last ice age as a result of sediment deposition and shaping by the advancing ice. Over 100 islands or 'drowned drumlins' were formed due to the subsequent rising sea levels, thus forming the unique 'basket of eggs' topography. The geomorphology of the area is quite complex with numerous interlocking bays of varying degrees of shelter and exposure giving rise to a high degree of variability in habitats and species for such a relatively small geographical area. As Clew Bay has been designated an important SAC (site Code: 001482), there are several conservation objectives specified for many of these habitats and species (see Section 2 of this document for details). An overview of the various habitats and species in Clew Bay is provided as follows, based largely on the site synopsis provided by the NPWS:

Shallow bays: Throughout the complex, there are many shallow bays with varying sediment substrate which are associated with a rich biodiversity, summarised as follows:

- Subtidal sediments
  - Fine sand: bivalve communities in fine sand (*Chamelea striatula* and *Ensis* sp.).
  - Muddy sand: polychaete worm *Euclymene* and the bivalve *Thyasira flexuosa.*

- Intertidal sediment communities:
  - Mid-shore: Polychaetes and bivalves in the mid-shore.
  - Low shore: sand mason worm *Lanice conchilega*.

- Infaunal communities in maerl areas: Areas which contain a substrate of dead maerl debris with low levels of live mearl, typically host a range of infaunal species which are characteristic of coarse sand and medium sand. This includes bivalves (*Timoclea ovata*, *Spisula* sp.), and polychaetes (*Nepthys cirrosa* and *Glycera lapidum)* associated with in coarse-type sand and bivalve (*Ensis* sp.) and polychaetes (*Lanice conchilega*, *Scoloplos armiger* and *Sthenelais boa)* associated with medium type sand. There are also beds of live maerl (*Lithothamnion corallioides)* in some areas.

- Gravels and medium sands areas: These areas are typified by *Timoclea ovata*, *Tapes rhomboids (bivalves)* and the *Branchiomma bombyx* and *Glycera lapidum* (polychaetes).

- Muddy sand areas: Characterised by *Abra alba, Corbula gibba*, *Thyasira flexuosa* and *Mysella bidentata (bivalves)* and *Euclymene* (polychaete).

Intertidal communities: These communities are present on sheltered shores along the edges of the inner part of Clew Bay, with habitats characterised by a mixed substratum of boulders, gravel, sand and mud. Communities of hydroids, sponges and solitary sea squirts are present in sheltered areas of shallow water of little sand scour. Diversity is notably high in gravel/mud mixed sediment areas.

Shingle: Reserves of shingle in Clew Bay are substantial. Shingle and sand dunes are widespread in the complex with annual vegetation of drift lines including several species: Common Scurvygrass *(Cochlearia officinalis),* Red Fescue *(Festuca rubra),* Sea Campion

(Silene vulgaris subsp. maritima), Spear-leaved Orache *(Atriplex prostrata),* Sea Mayweed *(Matricaria maritima),* Sea Sandwort *(Honkenya peploides)* and Thrift *(Armeria maritime).*

Species of interest:
In addition to the important sub-tidal and intertidal species summarized above, Clew Bay is also host to several important populations of the harbour seals, otters, and range of important birds and wintering waterfowl. These species are listed on Annex II of the E.U. Habitats Directive and Annex I of the E.U. Birds Directive (2009/147/EC). A brief description of these species and their distribution and conservation requirements can be found in Section 2.2 and 2.4 of this document. Site-specific details relating to important breeding and wintering species of birds are described in Appendix 6 as provided by NPWS (*pers. comm.* 03/12/2013).

General areas of interest:
Lough Furnace is a rare example of a saline lagoon, located in the north-east of Clew Bay. This lake and others in the vicinity form an important component of the Burrishoole catchment area. The Rossmurrevagh area is located along the northern shore of Clew Bay and contains a diverse range of species within habitats including the seashore, dunes, coastal grassland, saltmarsh, bog and fen. For more details describing Lough Furnace and the Rossmurrevagh area, see Section 2.5 of this application.

The maps associated with this application highlight the area directly and indirectly impacted by the proposed plan or Project, summarized as follows:

- Location of plan relevant to the surrounding regional and local environment (inc. Maps).
- Likely location of Annex I habitats.
- Annex II (Harbour Seals) species hosted in the receiving area.
- Sites of relevance to wintering and breeding bird species (Annex I, E.U. Birds Directive)
- Operations/activities already existing in the receiving environment.

Section 2: Qualifying interest and conservation objectives (prepared by BioAtlantis Ltd.)

2.1. Introduction

This section describes several important aspects to the Clew Bay SAC, focusing primarily on the protected species, qualifying interests and conservation objectives of the NPWS. In addition, several other important aspects to the Clew Bay Complex are described including species and habitats within the region in general and those within the *Ascophyllum nodosum* biotope. Details of habitats and species and conservation objectives where applicable, are outlined throughout this section. On this basis, a risk assessment was carried out by science and engineering personnel at BioAtlantis. This allowed for the development of a harvesting system which ensures minimal impact on protected species and habitats in the SAC. Details of this assessment and associated control measures, monitoring and corrective actions are provided in Section 3 As a number of moderate risks were identified, it was also deemed necessary to assess whether or not a Natura Impact Statement (NIS) and mitigation was required. The NIS was subsequently prepared by Ecofact Environmental Consultants Ltd and is attached as a stand alone document to this application.

The conservation objectives for qualifying interests in Clew Bay as identified by BioAtlantis are summarized below, along with details for other relevant habitats and species.

1 Protected species & habitats.

In accordance with the NPWS and Annex I & II of EU Habitats Directive 92/43/EEC, there are 6 main conservation objectives and targets relevant to Clew Bay, covering both marine and coastal areas, summarised as follows:

Marine habitats and species.

- Objective 1: To maintain the large shallow inlets and bays in the Clew Bay Complex SAC (ref: pg. 12-13, NPWS, 2011A).
- Objective 2: To maintain the favourable conservation condition of Mudflats and Sandflats not covered by seawater at low tide (ref: pg. 14, NPWS, 2011A).
- Objective 3: To maintain the favourable conservation condition of harbour seal in Clew Bay Complex SAC (ref: pg. 15, NPWS, 2011A).

Coastal habitats.

- Objective 1: To maintain the favourable conservation condition of Perennial vegetation of stony banks (1220; ref: pg. 6, NPWS, 2011B).
- Objective 2: To restore the favourable conservation condition of Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*; 1330; ref: pg. 9, NPWS, 2011B).
- Objective 3: To maintain and/or restore the conservation conditions of sand dune habitats (ref: pg. 15, NPWS, 2011B).
  a) Annual vegetation of drift lines (1210): To maintain the favourable conservation condition
  b) Embryonic shifting dunes (2110): To restore the favourable conservation condition.
  c) Shifting dunes along the shoreline with *Ammophila arenaria* (2120): To restore the favourable conservation condition.

Otters and birds:

Otter (Annex II of the E.U. Habitats Directive)
Several wintering and breeding bird species. (Annex I of the E.U. Birds Directive, 2009)

2 Species & habitats of general interest.

There are many important habitats and species of general interest in the Clew Bay Complex for which EU-specified conservation objectives may not specifically apply. Amongst these include the Rossmurrevagh area and Lough Furnace.

3 *Ascophyllum nodosum* biotope and species therein

The *Ascophyllum nodosum* biotope is species rich and contains many flora and fauna of interest, for which conservation objectives may not apply. These are described in detail in Section 2.6. The *A. nodosum* biotope is of considerable interest given its growth on intertidal reef substrate and that *A. nodosum* will be subject to harvest.

2.2 Conservation objectives: Protected Marine habitats and species.

This section provides a detailed description of the distribution, extent and conservations objectives for protected marine habitats and species in Clew Bay.

Objective 1: To maintain the large shallow inlets and bays in the Clew Bay Complex SAC.

1. **Permanent habitat area:** Encompasses all Annex I habitats in Clew Bay SAC.
   Conservation requirements: These areas must be maintained at favourable conservation conditions to ensure stability of the permanent habitat area (Ref: Target 1 of Objective 1, NPWS, 2011A, page 12)

2. **Zostera, Maerl:** there are extensive beds of eelgrass, *Zostera marina*, in the southern part of the Clew Bay Complex SAC, often occurring in combination with maerl (Merc Consultants, 2006, NPWS, 2011A). There are also a large number of species associated with *Zostera* dominated community, with much of the in fauna species dominated by species within the order Amphipoda. Large patches are found from southern section to the south of Inishlyre, north and east of Crovinish and SE of Inishgort, with small patches located from Westport harbour between Green islands and Carricknamore (Figure 3a and 3c of NPWS, 2011A). Beds of live maerl, *Lithothamnion corallioides, Phymatolithon calcareum* are present in a number of areas, most notably within the southern part of the complex (Merc Consultants, 2006, NPWS, 2011A). Large patches of maerl are found from the main navigation channel leading into Westport Harbour. Other areas containing maerl include: East of Inishlyre and South of Inishraher, the Channel east of Inishleague, the channel leading to east of Inishgort lighthouse, Ilaanmore Harbour. Maerl also occurs in areas of strong current flow, e.g. between islands. Several species of Algae, sea anemones and crab also co-occur within Maerl dominated communities. Mearl typically occurs in the southeast of the site in coarse, mixed, sandy mud and sand sediments (NPWS, 2011A).
   Substrate: *Zostera* is found in sandy environs. Mearl is found in coarse, mixed, sandy mud and muddy sand sediments.

Conservation requirements: Maintain natural extent of *Zostera* & maerl dominated communities, high quality of *Zostera* dominated communities, and high quality of maerl dominated communities (Ref: Targets 2-4 of Objective 1, NPWS, 2011A, pages 12, 13).

3. **Polychaetes and bivalves, *Nephtys cirrosa* and *Tubificoides benedii* and *Pygospio elegans* communities:** Polychaetes and bivalves community complex are widespread where soft sediment or sandy mud is present. This community occurs both intertidally and subtidally. The distribution of different species (e.g. *Melinna palmate, Thyasira flexuosa*, *Prionospio sp.* and *Mysella bidentata*) is quite variable between different regions such as in the North West, Westport and Newport bay. *Nephtys cirrosa* community typically occurs on fine and clean sand at the boundary of the Clew Bay site and the outer-reaches of Westport Bay to Inisheany, with associated communities including *Moerella donacina* and the amphipod *Bathyporeia guilliamsoniana*. *Tubificoides benedii* and *Pygospio elegans* community complex are found on intertidal sandy mud on shores from Trawoughter strand (northwest) to White strand (south). Recorded in Newport Bay, Westport Bay and Islands including Inishcottle, Inishbee and Clynish.
   Substrate: soft sediment(sandy mud), fine/clean sand and on Intertidal sandy mud.
   Conservation requirements: Maintenance of the following communities: 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 (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13).

4. **Reef and shingle:** Reef occurs intertidally on most coasts of the bay and most islands as a mixed substrata of pebbles and cobbles whilst occurring sub-tidally as boulders and cobbles (extensive in western margin with smaller patches at Newport Bay). Associated species in these areas include several fucoid species such as *Ascophyllum nodosum*. Characteristics of the *A. nodosum* biotope are described in greater detail in Section 2.6. Shingle occurs throughout the region and on the islands in particular and on the upper shore often behind fucoid dominated reef.
   Conservation requirements: Maintenance of the following communities: Shingle, reef (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13).

Objective 2: To maintain the favourable conservation condition of Mudflats and Sandflats not covered by seawater at low tide.

1. **Mudflats and Sandflats:** These occur intertidally between mean low water mark and mean high water mark. Large expanses of sandflats occur on the North shore from Trawoughter Strand to Roskeen Pt. and also along shore of Westport. Small areas of mudflat and sandflat occur in Newport Bay and embayments on the eastern shore, while small patches are generally found around islands.
   Conservation requirements: The permanent habitat area is stable or increasing, subject to natural processes (Ref: Target 1 of Objective 2, NPWS, 2011A, page 14)

2. **Important sediment communities:**
   Fine sand dominated by *Nephtys cirrosa* community typically occurs on clean sand at the boundary of the Clew Bay site and the outer-reaches of Westport Bay to Inisheany, with associated communities including *Moerella donacina* and the amphipod *Bathyporeia guilliamsoniana*.
   Intertidal sandy mud with *Tubificoides benedii* and *Pygospio elegans* community complexes are found on shores from Trawoughter strand (northwest) to White strand (south). Recorded in Newport Bay, Westport Bay and Islands including Inishcottle, Inishbee and Clynish. Sandy mud with polychaetes and bivalves community is widespread where soft sediment is present. This community occurs both intertidally and subtidally. The distribution of different species (e.g. *Melinna palmate, Thyasira flexuosa, Prionospio* sp. and *Mysella bidentata*) is quite variable between different regions such as in the North West, Westport and Newport bay.
   Substrate: *Nephtys cirrosa* communities occur clean sand; *Tubificoides benedii* and *Pygospio elegans* community complex occur in intertidal sandy mud).
   Conservation requirements: Maintenance of *Nephtys cirrosa* community, *Tubificoides benedii* and *Pygospio elegans* community complex and polychaetes and bivalves community (Ref: Target 2 of Objective 2: NPWS, 2011A, page 14).

Objective 3: To maintain the favourable conservation condition of harbour seal (Annex II species) in Clew Bay Complex SAC.

1. **Species range:** 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).
   Conservation requirements: Species range should not be restricted by artificial barriers to site use (Ref: Target 1 of Objective 3, NPWS, 2011A, page 15).

2. **Breeding sites:** 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.
   Conservation requirements: breeding sites should be maintained in a natural condition (Ref: Target 2 of Objective 3, NPWS, 2011A, page 15).

3. **Moulting sites:** 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.
   Conservation requirements: moult-out sites should be maintained in a natural condition (Ref: Target 3 of Objective 3, NPWS, 2011A, page 15).

4. **Resting sites:** There are 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.
   Conservation requirements: haul-out sites should be maintained in a natural condition (Ref: Target 4 of Objective 3, NPWS, 2011A, page 15).

5. **Human activities:** Man-made energy such as underwater noise or light, etc., or activities which deteriorate resources (e.g. water quality, feeding), can have a negative impact on natural behaviours and resources of harbours seals.
   Conservation requirements: human activities should occur at levels that do not adversely affect the harbour seal population at the site (Ref: Target 5 of Objective 3, NPWS, 2011A, page 16).

2.3 Conservation objectives: Protected Coastal habitats.

Coastal habitats also fall under the SAC status of Clew Bay. Similar to marine habitats and species, the NPWS have developed a set of standards to minimise human interference and damage these areas of Clew Bay (Ref: NPWS, 2011B). This covers the following four coastal habitats:

- Perennial vegetation of stony banks (1220)
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (1330)
- Annual vegetation of drift lines (1210)
- Embryonic shifting dunes (2110)
- Shifting dunes along the shoreline with *Ammophila arenaria* (2120)

Objective 1: To maintain the favourable conservation condition of Perennial vegetation of stony banks (1220; ref: pg. 6, NPWS, 2011B).
Defined as vegetation found at or above the mean high water spring tide mark on shingle beaches. Widespread in distribution both along the mainland and the islands of Clew Bay (Moore and Wilson, 1999; Ryle *et al.*, 2009)

Objective 2: To restore the favourable conservation condition of Atlantic salt meadows (ASM; *Glauco-Puccinellietalia maritimae*; 1330; ref: pg. 9, NPWS, 2011B).
ASM are stands of vegetation which occur along sheltered coasts. They are flooded periodically by the sea, restricted to an area between mid-neap tide level and high water spring tide level. Only one of the four types of salt marshes listed under Annex I of EU Habitats Directive (92/43/EEC), are listed as a "Qualifying Interest" for Clew Bay SAC, namely ASM. Salt marsh habitats are widespread in their distribution in Clew Bay, with ASM accounting for an estimated 38.86ha. Substrate: mud or sand.

Objective 3: To maintain and/or restore the conservation conditions of sand dune habitats (ref: pg. 15, NPWS, 2011B).

- **Annual vegetation of drift lines**: Distributed along the high tidal mark of Clew Bay and consists of a number of annual species. Contains tidal litter, including marine algae remains, faunal material and seeds.

- **Embryonic shifting dunes (2110):** Distributed above the strandline and represent a key primary stage of dune formation. Important species within this environment includes salt-tolerant sand couch (*Elytrigia juncea*) and lyme grass (*Leymus arenarius*).

- **Shifting dunes along the shoreline with *Ammophila arenaria* (2120):** Occurs in areas in which sand accumulates at a rapid rate. Marram grass (*Ammophila arenaria*) represents a key species in this biological environment, acting to invade and initiate transition of sand accumulation to mobile dunes. Growth of this species is actively stimulated by sand accumulation. These areas are dynamic and unstable.

2.4 Conservation objectives: Otters and Birds.

This section describes the distribution, extent and conservations objectives for otter and bird species in Clew Bay.

1. Otters *(Lutra lutra)*

Otters are widespread in Ireland in freshwater and coastal habitats. While the otter has declined in Ireland since the 1980s (NPWS, 2007), the species is still considered widespread and healthy compared to most European countries (current range covers 75 % of the total area of Ireland, Marnell *et al.,* 2011). Four out of five sites assessed from a total of 119.9km^2 area of river basin district in Clew Bay, were found to be positive for the presence of the otter (Bailey and Rochford 2006). Otters may feed to some extent on fish within the *A. nodosum* biotope (Kelly L. *et al.,* 2001). However, otters are more driven to habitats conducive to obtaining an adequate food source, for example, a positive relationship has been found between otter numbers and angling sites in Ireland (Bailey and Rochford, 2006). While otters are somewhat tolerant to human presence, the species is considered to be in decline in many parts of Europe with significant risks including roads, fishing nets and lobster pots (NPWS, 2007). Organochlorine pesticides are also widely accepted as having severely reduced otter population sizes in the UK (Jones and Jones, 2002). In terms of extent and distribution of the species in Clew Bay, otters utilize a wide number of habitats and areas (NPWS, 2011C), summarized as follows:

- **Freshwater aquatic & terrestrial:** Otters occupy freshwater rivers from source to estuary. There are several rivers, lakes and lagoons of relevance to the otter in Clew Bay including: Lough Furnace (inc. the mouth of the lake), four locations along the southern coast and three along the eastern coast. In addition, Inishgowla south contains a small freshwater terrestrial habitat, located towards the eastern shore of the island (NPWS, 2011C and references therein). The extent of freshwater habitats in Clew Bay typically include a 10m terrestrial buffer zone around the shoreline (above HWM and along river banks).
- Otter habitats typically develop in a linear fashion, with many habitats observed at river catchments. There are extensive linear habitats in the vicinity of Lough Furnace and the Burrishool catchment area.
- **Marine aquatic and terrestrial:** Otters have potential to forage within 80m of the shoreline. Their extent is likely to encompass the entire SAC, including the islands. Commuting zones between island and coastlines are also considered to be extensive.

Otters require that marine and freshwater habitats be maintained to levels which facilitate a broad array of biological imperatives including foraging, breeding and resting.

Conservation requirements:

In accordance with NPWS, 2011C, the conservation objectives for Otter (Lutra lutra; 1355) are to restore the favourable conservation condition of Otter in the Clew Bay Complex SAC, as defined by the following list of attributes and targets:

Target 1: No significant decline in distribution (i.e. positive survey sites).

Target 2: No significant decline in extent of terrestrial habitat.
Target 3: No significant decline in extent of marine habitat.
Target 4: No significant decline in extent of freshwater (river) habitat.
Target 5: No significant decline in extent of freshwater (lake/lagoon) habitat.
Target 6: No significant decline in number of Couching sites and Holts (minimize disturbance)
Target 7: No significant decline in fish biomass available.
Target 8: No significant increase in barriers to connectivity.

2. Birds:

Clew Bay SAC is not designated as a Special Protection Area (SPA). Nonetheless, it is important to assess the potential impact(s) associated with hand harvesting of *A. nodosum* on protected bird species in Clew Bay given that:
(a) the complex is known to support a number of breeding and wintering bird populations of national importance.
(b) there are a number of important SPAs located near to Clew Bay, including such as Owenduff/Nephin Complex SPA/SAC (site Code 000534) to the north and Clare island SPA (site code 004136) to the west.
Species listed on Annex I of the E.U. Birds Directive (2009/147/EC): the Common Tern, Arctic Tern, Little Tern, Barnacle Goose, Great Northern Diver and Bartailed Godwit (as indicated on NPWS Site Synopsis for Clew Bay).
Species which reach important numbers in Clew Bay: Red-breasted Merganser, Ringed Plover, Barnacle Geese (present on islands in winter), Great Northern Diver, Brent Goose, Shelduck, Wigeon, Teal, Mallard, Oystercatcher, Cormorant, Dunlin, Bar-tailed Godwit, Curlew, Redshank, Greenshank and Turnstone (as indicated on NPWS Site Synopsis).
Distribution: Protected bird species and their distribution in Clew Bay is described in detail in Appendix 6. Datasets were obtained from the following sources:

- **The Irish Wetland Bird Survey (I-WeBS):** data describing the broad distribution of winter bird species within four subsites of Clew Bay (personal correspondence with BirdWatch Ireland).
- **NPWS:** data describing specific breeding and wintering sites of relevance to important bird species within Clew Bay (dara obtained on 03_12_2013)

Conservation requirements: none specified by NPWS 2011A or 2011B. Clew Bay is not an SPA. However, there are a number of important sites in the complex which support protected species of breeding and wintering birds (NPWS, *pers. comm.* 03/12/2013). Site-specific details are outlined in Appendix 6.

2.5 Species & habitats of General Interest

This section describes the conservation requirements, where applicable, for species and habitats of general interest in Clew Bay.

1. **Fish species:**
The Burrishoole Catchment area of Clew Bay represents an important habitat for migratory fish species such as trout and salmon, and is regarded as a major European and World Index site. In particular, sea trout and salmon smolts enter the sea at Clew Bay, while post-smolt and adult sea trout also feed within the bay. Other fish species may use *A. nodosum* zones for purposes which include feeding, reproduction or sheltering (Kelly L. *et al.*, 2001 and references therein).
Conservation requirements: none specified by NPWS 2011A or 2011B.

2. Lough Furnace:
A rare deep, permanently stratified, saline lake lagoon located at the north-eastern corner of Clew Bay. Species on its exterior include: Common Reed (*Phragmites australis*), Common Club-rush (*Scirpuslacustris*), Small patches of Great Fen-sedge (*Cladium mariscus*) and Bottle Sedge (*Carex rostrata*). Other important flora and fauna within this environment includes: two rare amphipods (*Lembos longipes* and *Leptocheirus pilosus*), *Neomysis integer*, *Jaera albifrons, J. ischiosetosa* and *J. nordmanni*, Irish species of tasselweed (*Ruppia maritima* and *R. cirrhosa*), eel, flounder, mullet, mallard nest and black-headed Gull.
Conservation requirements: none specified by NPWS 2011A or 2011B.

3. The Rosmurrevagh area:
Contains a diverse range of species within habitats including the seashore, dunes, coastal grassland, saltmarsh, bog and fen. These are summarized as follows: Bog/fen type vegetation: Bog Asphodel and Cuckooflower (*Cardamine pratensis*), Bog Mosses, sedges, Bog-myrtle (*Myrica gale*), Irish Heath, Soft Rush (*Juncus effusus*), Water Mint (*Mentha aquatica*) andYellow Iris (*Iris pseudacorus*).
Coastal grassland species: Common Ragwort (*Senecio jacobaea*), Daisy (*Bellis perennis*), Dandelion (*Taraxacum officinale*), Heath Wood-rush (*Luzula multiflora*), Ribwort Plantain (*Plantago lanceolata*) and Yarrow (*Achillea millefolium*).
Saltmarsh vegetation (5 m wide): Common Saltmarsh-grass (*Puccinellia maritima*), Common Scurvygrass, Thrift and 'turf fucoids' (diminutive forms of brown algae).
Conservation requirements: salt marshes, sand dunes (NPWS 2011B)

2.6 A. nodosum Biotope and species therein

This section provides a summary of the species residing within the *A. nodosum* biotope. The *A. nodosum* biotope in Ireland supports a diverse epibiota including members of the Animalia, Plantae, Chromalveolata Families and several Phyla therein. This includes sessile epibiota attached to *A. nodosum*, mobile fauna and predatory animals (fish, birds, otters). The impact of hand harvesting of *A. nodosum* in Clew Bay on the biodiversity within the *A. nodosum* biotope has been assessed by Kelly L. *et al.,* (2001). This data provides a strong framework in which to assess the potential impacts of the plans by BioAtlantis to hand harvest *A. nodosum* on this biotope. The study by Kelly L. *et al.,* (2001), is detailed in its scope and includes the following:

- Kingdom *Animalia*
  - Phylum Mollusca (Winkles, Limpets)
  - Phylum Arthropoda (Barnacles)
  - Phylum Cnidaria (Hydroid. e.g. *Dynamena pumila Linnaeus*)
  - Phylum Porifera (Sponges, e.g., *Leucosolenia sp. Bowerbank, Halichondria panicea Pallas* and *Hymeniacidon perleve Montagu*)
  - Phylum Chordata (Sea squirts, e.g. *Ascidiella*)
  - Phylum Arthropoda (Amphipods, isopods crabs, *Chironomida*, *Halacaridae*, *Ostracoda*).
  - Phylum Platyhelminthes (e.g. *Turbellaria*)
  - Phylum Annelida
  - Phylum Foraminifera
  - Phylum Nematoda

- Kingdom Plantae
  Phylum Rhodophyta (Red algae, e.g.: *Polysiphonia lanosa (Linnaeus) Tandy*, *Mastocarpus 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: *Lomentaria articulata (Hudson) Lyngbye*; *Membranoptera alata (Hudson) Stackhouse*).

- Kingdom Chromalveolata
  Phylum Heterokontophyta (*Ascophyllum nodosum*, *Fucus vesiculosis Linnaeus* and *Fucus serratus Linneaus*)

Summary of species residing within the *A. nodosum* biotope:

- Barnacles and limpets (e.g. Semibalanus balanoides *Linnaeus*, *Elminius modestus Darwin* and *Patella vulgata Linnaeus*).
- Winkles (e.g. *Littorina obtusata Linnaeus* and *Littorina littorea Linnaeus*; snails which graze some epiphytes from *A. nodosum* surface).
- Red algae *Polysiphonia lanosa (Linnaeus) Tandy* (epiphyte of *Ascophyllum nodosum*)
- *Fucus vesiculosis Linnaeus* and *Fucus serratus Linneaus* (occurs alongside *Ascophyllum*).
- Other seaweed species: *Lomentaria articulata* (Hudson) *Lyngbye* and *Membranoptera alata (Hudson) Stackhouse*, occur under tidal swept conditions.
- Hydroid (*Dynamena pumila Linnaeus*; may be found on tips of *A. nodosum*).

- Red algae *Mastocarpus stellatus (Stackhouse) Guiry*, *Chondrus crispus Stackhouse* and *Corallinaceae* (located beneath the canopy).
- Ephemeral green algae (e.g. *Cladophora rupestris (Linnaeus) Kützing*, *Ulva sp. Linnaeus* and *Enteromorpha* sp. Link; low densitites).
- Sponges (e.g., *Leucosolenia* sp. *Bowerbank*, *Halichondria panicea Pallas* and *Hymeniacidon perleve Montagu*; occur on steep surfaces and under boulders in areas of strong tidal currents).
- Ascidians (e.g. *Dendrodoa grossularia van Beneden* and *Ascidiella scabra O.F. Müller*; occur on steep surfaces and under boulders in areas of strong tidal currents).
- Mobile species: Amphipods, isopods crabs, *Annelida*, *Chironomida*, *Foraminifera*, *Halacaridae, Mollusca*, *Nematoda*, *Ostracoda*, *Turbellaria*.

Conservation requirements: As part of the SAC, it is important to assess the potential impacts that hand harvesting could have on the *A. nodosum* biotope, particularly given the presence of the biotope on intertidal reef substrate and that *A. nodosum* will be harvested.

2.7 Continual disturbance, broad, cumulative and in combinational effects and spread of invasive species.

From assessment of conservation requirements for Clew Bay and through consultations with NPWS, it has been established that greater details are required in order to assess the potential impacts of harvesting in terms of: continual disturbance levels, broader effects of harvesting, in combination and cumuliative effects and potential spread of invasive species. Key aspects of these requirements are summarised below:

(a) Continual disturbance levels:

NPWS recommend that continuous disturbance of each community type should not exceed an approximate area of 15% (NPWS 2011A), covering:

- Shingle
- Reef
- *Zostera* Community
- Maerl Dominated community
- Fine Sands Dominated by *Nephtys cirrosa* community
- Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex
- Mudflats & sandflats not covered by seawater at low tide

(b) Broad, holistic examination of effects:

It is required that a broader, holistic examination of the effects of hand harvesting be carried out with respect to:

1. The spatial extent of harvesting techniques and activities:

- Management of expansive and prolonged operations.
- Numbers of personnel and exploitation levels.

2. The potential interaction effects of seaweed harvesting:
   - Targeted removal of species.
   - Non-targeted removal of species.
   - Disturbance and displacement of species and habitats.
   - Changes in community structure.
   - Changes in hydrodynamics and water quality.
   - Potential disturbance of marine fauna.
   - Potential interactions with coastal habitats.

(c) Cumulative and in-combinational effects

1. Existing Operations: Potential cumulative, in-combination effects and interactions:
   - Unlicensed, traditional and casual harvesting of seaweed.
   - Recreation & Tourism.
   - Aquaculture and fisheries activities.
   - Harvesting of invertebrates.

2. Planned Operations: Potential cumulative, in-combination effects and interactions:
   - Other planned harvest activities.
   - Recreation & Tourism.
   - Aquaculture and fisheries activities.
   - Harvesting of Invertebrates.

3. Vector potential of harvest activities in the spread of invasive species.

Section 3: Assessment of likely effects of the proposed plan (prepared by BioAtlantis Ltd.)

3.1 Identification of likely effects of proposed plan or project:

3.1.1 Introduction

The Impact Assessment described in this section was carried out by scientific and engineering personnel at BioAtlantis Ltd. rather than through use of outside consultants. This was to ensure that staff were fully informed of the potential risk(s) associated with hand harvesting of *A. nodosum* on Clew Bay. The initial assessment by BioAtlantis formed a key foundation in the development of the management plan and the harvesting Code of Practice (Appendix 4). In assessing the potential impacts of the plan to hand harvest *A. nodosum* on the conservation objectives of the Clew Bay SAC, BioAtlantis applied a conservative, precautionary approach and in the case of uncertainty, it was assumed that the effects have potential to be significant. This allowed for the development of a plan based on best scientific knowledge to ensure that any potentially negative impact(s) of hand harvesting of *A. nodosum* on the biological environs of this region are prevented or minimized. This assessment was also used to develop a management system with appropriate control measures, monitoring and corrective actions for potential hazards (see Tables 10, 11 and 12 in Section 3.3.6; Table 16 in Section 3.6.6).

On identification of a number of potential hazards, BioAtlantis proceeded to contact Ecofact Environmental Consultants Ltd. in order to assess whether or not a Natura Impact Statement (NIS) was required. The NIS is attached as a separate stand alone document to this application and validates the mitigation measures and Code of Practice developed by BioAtlantis in ensuring that the sustainable harvest management plan does not negatively impact on species and habitats of the SAC. During this process, NPWS provided recomendations on 30th July 2014, as to areas in need of improvement in the NIS. The NIS and plan was updated accordingly, as presented in this current application document and associated appendices.

3.1.2 Data sources:

Clew Bay is part of an ecological network of protected areas in the EU, known as 'Natura 2000'. Article 6, EU habitats Directive (92/34/EEC), states:
"Any plan or project not directly connected with or necessary to the management of the [Natura 2000] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subjected to appropriate assessment of its implications for the site in view of the site's conservation objectives".

In accordance with NPWS requirements (NPWS, 2012) and EU Law, the likelihood of this plan affecting Clew Bay SAC must be assessed based on:

(a) preliminary consideration of the likely impacts of a proposed activity and

(b) determination of whether there is a risk that the effects identified could be significant.

In assessing the potential impact of hand harvesting of *A. nodosum* in Clew Bay, all direct, indirect and cumulative effects have been considered by BioAtlantis through use of all available information. This includes the peer-reviewed literature, exisiting datasets and environmental impact reports undertaken in the area. The biodiversity within Clew Bay and the impacts of hand harvesting of *A. nodosum* on these environs, has been examined extensively since the mid-1990s. In particular, Annex I and II of EU Habitats Directive 92/43/EEC Marine habitats and protected species and communities therein have been assessed in Clew Bay in several surveys and reports (BioMar, 1995, Dúchas, 1999, Anon, 2002, Merc Consultants, 2006, NPWS, 2011A). Data from early work in this area (BioMar, 1995, Dúchas, 1999) has been built upon and in some cases has also been used to identify and confirm holding species in sites of interest. Unlike Galway Bay and some other SAC complexes, a large amount of broadscale habitat mapping data is available for Clew Bay SAC via the Broadscale Mapping Project of this region (Anon, 2002). The data outputs derived from this work was built upon by Merc Consultants (2006) and this has provided a more accurate interpolation of the likely distribution and extent of these biological systems and species within the Clew Bay Complex SAC (Merc Consultants, 2006 and NPWS 2011A). A total of 1796 georeferenced data points were recorded in the site which constituted a significant amount of data in which to determine the distribution and extent of sensitive subtidal communities. Based on this and other data, the NPWS have developed a set of guidelines to minimise human interference and damage to important areas and species within this SAC (Ref: NPWS, 2011A).

In the case of Coastal Habitats, BioAtlantis have also assessed the requirements outlined by the NPWS (2011B). The many surveys/reports undertaken in these areas provide an important basis for the targets which have been set. These include the National Shingle BeachSurvey (NSBS; Moore & Wilson, 1999), the Saltmarsh Monitoring Project (SMP; McCorry, 2007; McCorry & Ryle, 2009) and the Coastal Monitoring Project (CMP) (Ryle *et al.*, 2009). This has allowed BioAtlantis to assess potential risks to relevant biological environments and to develop a plan which minimizes and prevents any potential negative impact of *A. nodosum* hand harvesting activities on this region. This is outlined in the following pages, with specific reference to the objectives, targets and attributes described by the NPWS, 2011B.

Otters are listed as Annex II protected species within this SAC and a detailed list of conservation objectives are outlined by (NPWS, 2011C). Close attention was placed by BioAtlantis on major sites of relevance to otters, in particular, the Burrishoole Channel and Lough Furnace and other fresh water environs associated with the complex. While not a SPA, Clew Bay is host to a number of Annex I species protected under the EU Birds Directive. Site-specific data describing sites of relevance to important wintering and breeding bird species in Clew Bay were provided to BioAtlantis, courtesy of the NPWS (*pers. comm.* 03/12/2013). Additional datasets were provided courtesy of BirdWatch Ireland (*pers. comm.*, 15 – 27th Nov 2013).

3.1.3 Preliminary consideration of the likely impacts of a proposed activity:

With respect to NPWS requirements (NPWS, 2012) a number of potential effects which are relevant to the proposed plan have been identified and include:

1. Permanent habitat loss (e.g. sand, shingle, stones)
2. Displacement/exclusion of species (e.g. harbour seals)
3. Visual presence (e.g. harbour seals)
4. Noise disturbance (e.g. harbour seals)
5. Abrasion / Physical disturbance (e.g. *A. nodosum* growth substrate)
6. Selective extraction of target species (e.g. *A. nodosum*)
7. Selective extraction of nontarget species (e.g. *Fucus* sp.)
8. Suspended sediment (e.g. mudflats).
9. Changes in hydrodynamic regime*
10. Changes in nutrient levels (*A. nodosum* as a source of carbon)*
11. Introduction of non-native species *(Didemnum vexillum)*†

*covered in Section 3.5.3, part (e) and (g) respectively.
†covered in Section 3.6.4

Important potential effects which are deemed to have no relevance to this application include: Smothering, desiccation, changes in emergence regime, changes in water flow rate, changes in temperature, changes in turbidity, synthetic compound contamination, heavy metal contamination, hydrocarbon contamination, changes in salinity, changes in oxygenation, introduction of microbial, pathogens / parasites.

3.2. Risk Assessment (Scope & Methodology)

3.2.1. Scope of the Assessment

The scope of the risk assessment carried out by BioAtlantis Ltd. covers the following six categories:

- Impact on protected marine and coastal habitats & species in Clew Bay (according to Annex I & II of EU Habitats Directive 92/43/EEC; see Sections 3.3.1 – 3.3.3).
- Impact on species & habitats of general interest (Section 3.3.4).
- Impact on the *A. nodosum* biotope and species therein (Section 3.3.5).
- Continuous disturbance levels (not exceeding an area of 15%; see Section 3.4).
- Broad, holistic examination of the nature, extent and impact of hand harvesting (Section 3.5).
- Cumulative and in Combination Impacts (Section 3.6).
- Spread of invasive species (Section 3.6).

3.2.2. Methodology employed

The initial risk assessment by BioAtlantis involved:

(a) the identification of the nature of the potential hazard (i.e. biological, chemical or physical),

(b) calculation of the probability of such hazards occurring and

(c) determination of the severity of a given hazard as measured by their impact on the conservation objectives for the SAC region.

The pre-cautionary principal was applied in each calculation, with significance measured by means of 5x5 risk evaluation matrices. Data and information used in this assessment included all relevant environmental impact assessments in the Clew Bay area, the peer-reviewed scientific literature, NPWS requirements and information generated from an on-site survey by BioAtlantis, as outlined in Appendix 1 (see also Section 2 & 3.1 for further details). Mitigation measures were deemed absolutely necessary for risk ratings exceeding a score of 15. For moderate risks of 8-12, control measures were deemed necessary to ensure sufficient control and oversight over potential hazards. In such cases, it was deemed necessary to proceed with working in conjunction with independent environmental consultants to determine whether or not a full NIS was required. Where low risks were identified (1-6), control measures were developed where appropriate. This approach provided a framework for developing a management system (Sections 1.2 & 1.3) with clearly specified action/non-conformance limits, monitoring schedules and analytical procedures, coupled with robust corrective actions and verification methods (see tables in Sections 3.3.6 & 3.6.6). A Code of Practice for protection of sensitive species in the SAC was also developed and is provided in Appendix 4. The risk evaluation system and decision tree employed are described in detail in Appendix 5.

3.3. Results of Risk Assessment (Direct and indirect impacts):

The following section describes the findings of the risk assessment undertaken by BioAtlantis (see Table 9 for brief results summary). Detailed tables are provided in Section 3.3.6 and 3.6.6, which outline the results of the associated risk assessments along with control measures, action limits and monitoring and verification methods where applicable (See Tables 10, 11, 12, 16). The decision matrices used in calculating probability, severity and risk are also provided in Appendix 5, along with detailed explanations as to the scientific reasoning behind each decision made and scores assigned. In brief, risk ratings have been grouped into three categories:

15 – 25 High risk, requiring mitigation measure; NIS required.
8 - 12 Moderate risk, establish control procedures; NIS may be required.
1 – 6 Low risk, establish control procedures if appropriate; NIS may be required.

The potential risk level associated with hand harvesting of *A. nodosum* on (i) protected species and habitats, (ii) general species and habitats of interest, and (iii) those within the *A. nodosum* biotope, are provided in summary format in Table 9 below. The table also includes results from analysis of (iv) extent of continual disturbance, (v) broad examination of impacts and (vi & vii) potential in combination and cumulataive impacts and (viii) potential impacts on the spread of invasive species. See Table 10, 11, 12, 16 in Section 3.3.6 and 3.6.6 for a summary of control measures, monitoring & corrective actions. See Appendix 5 for details of the analysis.

No	(i) Marine & Coastal species & habitats (as protected under Annex I & II of EU Habitats Directive 92/43/EEC).	Risk
1	**Permanent habitat area**	Low- Moderate
2	**Seagrass, *Zostera* marina (and associated communities).**	Low
3	**Maerl Dominated communities**	Low
4	**Polychaetes & bivalves community complex (Sandy mud areas)** Distinguishing species: *Prionospio* sp., *Melinna palmate*, *Thyasira flexuosa*, *Mysella bidentata* Abra alba	Moderate
5	***Nephtys cirrosa* community (clean, fine sand areas)** Associated communities: *Moerella donacina* & the amphipod *Bathyporeia guilliamsoniana*	Moderate
6	***Tubificoides benedii* and *Pygospio elegans* community complex (Intertidal sandy mud areas)** Associated communities: *Tubificoides benedii*, *Pygospio elegans*, *Capitella* sp., *Nematoda* sp., *Hydrobia ulvae, Corophium volutator*	Moderate
7	**Shingle (pebbles and gravel)** Associated communities:Talitrid amphipods	Moderate
8	**Reef:** Associated communities: *Ascophyllum nodosum, Fucus vesiculosis, Laminaria hyperborea, Laminaria digitata, Alcyonium digitatum, Metridium senile, Esperiopsis fucorum, Myxilla fimbriata, Pelvetia canaliculata, Fucus spiralis, Laminaria saccharina, Saccorhiza polyschides, Cliona celata, Halichondria panicea, Aslia lefevrei, Pawsonia saxicola.* ***NOTE:*** *A. nodosum & associated communities were assessed separately in (iii) below.*	Moderate
9	**Mudflats and sandflats not covered by seawater at low tide.**	Moderate

	Associated communities: Not specified	
10	**Harbour seals: General**	Moderate
11	**Harbour seal:** Affects on Species range due restriction by artificial barriers to site use	n/a
12	**Harbour seal:** Breeding sites.	Moderate
13	**Harbour seal:** Moulting sites.	Moderate
14	**Harbour seal:** Resting sites.	Moderate
15	**Perennial vegetation of stony banks**	Low
16	**Atlantic salt meadows**	Low
17	**Sand dune habitats**	Low
18	**Otter *(Lutra lutra)***	Low
19	**Birds:** **Protected species:** Common Tern, Arctic Tern, Little Tern, Barnacle Goose, Great Northern Diver and Bartailed Godwit. **Unprotected species:** Red-breasted Merganser, Ringed Plover, Barnacle Geese (present on islands in winter), Great Northern Diver, Brent Goose, Shelduck, Wigeon, Teal, Mallard, Oystercatcher, Cormorant, Dunlin, Bar-tailed Godwit, Curlew, Redshank, Greenshank and Turnstone.	Low
No	**(ii) Impact on general species & habitats of Clew Bay.**	**Risk**
1	**Fish (Burrishoole Catchment area of Clew Bay)**	Low
2	**Lough Furnace habitat:** **Associated communities:** • Species on its exterior include: Common Reed (*Phragmites australis*), Common Club-rush (*Scirpuslacustris*), Small patches of Great Fen-sedge (*Cladium mariscus*) and Bottle Sedge (*Carex rostrata*). • **Other important flora & fauna:** two rare amphipods (*Lembos longipes* and *Leptocheirus pilosus*), *Neomysis integer*, *Jaera albifrons*, *J.ischiosetosa* and *J. nordmanni*, Irish species of tasselweed (*Ruppia maritima* and *R. cirrhosa*), eel, flounder, mullet, mallard nest and black-headed Gull.	Low
3	**Rosmurrevagh habitat:** Diverse range of species: • **Bog/fen type vegetation:** Bog Asphodel and Cuckooflower (*Cardamine pratensis*), Bog Mosses, sedges, Bog-myrtle (*Myrica gale*), Irish Heath, Soft Rush (*Juncus effusus*), Water Mint (*Mentha aquatica*) and Yellow Iris *(Iris pseudacorus).* • **Coastal grassland species:** Common Ragwort *(Senecio jacobaea),* Daisy *(Bellis perennis),* Dandelion *(Taraxacum officinale),* Heath Wood-rush (Luzula multiflora), Ribwort Plantain *(Plantago lanceolata*) and Yarrow *(Achillea millefolium).* • **Saltmarsh vegetation** (5 m wide): Common Saltmarsh-grass *(Puccinellia maritima),* Common Scurvygrass, Thrift and 'turf fucoids' (diminutive forms of brown algae).	Low
No	**(iii) Impact on the *Ascophyllum nodosum* Biotope and species therein**	**Risk**
1a	***A. nodosum***	Moderate
1b	***Fucus vesiculosis Linnaeus* and *Fucus serratus Linneaus***	Low
2a	**Red algae:** *Polysiphonia lanosa (Linnaeus) Tandy*	Low
2b	**Red algae:** *Mastocarpus stellatus (Stackhouse) Guiry*, *Chondrus crispus Stackhouse* and *Corallinaceae*	Low
2c	**Ephemeral green algae** (e.g. *Cladophora rupestris (Linnaeus) Kützing*, *Ulva sp. Linnaeus* and *Enteromorpha* sp. Link)	Low
2d	**Other seaweed species:** *Lomentaria articulata* (Hudson) *Lyngbye* and *Membranoptera alata (Hudson) Stackhouse*)	Low
3a	**Winkles**: (e.g. *Littorina obtusata Linnaeus* and *Littorina littorea Linnaeus*).;	Moderate
3b	**Limpets**	Moderate
3c	**Barnacles**	Low
3d	**Hydroid** (*Dynamena pumila Linnaeus*)	Low

3e	**Sponges** (e.g., *Leucosolenia* sp. *Bowerbank*, H*alichondria panicea Pallas* and *Hymeniacidon perleve Montagu*)	Low
3f	**Sea squirts** (e.g. *Ascidiella*)	Low
3g	**Other mobile species:** (Phylum Arthropoda (Amphipods, isopods crabs, *Chironomida*, *Halacaridae*, *Ostracoda*), Phylum Platyhelminthes (e.g. *Turbellaria*), Phylum Annelida, Phylum Foraminifera, Phylum *Nematoda*)	Low
No	**(iv) Continuous disturbance**	Risk
D1	**Shingle**	Moderate
D2	**Reef**	Moderate
D3	***Zostera* Community**	Low
D4	**Maerl Dominated community**	Low
D5	**Fine Sands Dominated by *Nephtys cirrosa* community**	Low
D6	**Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex**	Low
D7	**Mudflats & sandflats not covered by seawater at low tide**	Moderate
No	**(v) Broad, holistic examination of the nature, extent and impact of hand harvesting.**	Risk
e1	**The spatial extent of harvesting techniques and activities.**	
(i)	**Management of expansive and prolonged operations**	Moderate
(ii)	**Numbers of personnel and exploitation levels**	Moderate
e2	**The potential interaction effects of seaweed harvesting**	
(i)	**Targeted removal of species**	Moderate
(ii)	**Non-Targeted removal of species**	Moderate
e3	**Disturbance and displacement of species and habitats**	
(i)	**Reef**	Moderate
(ii)	**Amphipods and isopods**	Low-Moderate
e4	**Changes in community structure**	Moderate
e5	**Changes in hydrodynamics and water quality**	Low
e6	**Potential disturbance of Marine Fauna**	Low
e7	**Potential interactions with coastal habitats**	
(i)	**Atlantic salt meadows (ASM)**	Low
(ii)	**Sand dune habitats**	Low
No	**(vi) Existing Operations: potential in-combination effects and interactions.**	Risk
f1	**Unlicensed, traditional and casual harvesting of seaweed.**	Moderate
f2	**Recreation and Tourism.**	Moderate
f3	**Aquaculture.**	Moderate
f4	**Harvesting of invertebrates.**	Moderate
No	**(vii) Planned Operations: potential in-combination effects and interactions.**	Risk
g1	**Planned and other harvest activities.**	None identified
g2	**Recreation and Tourism.**	Moderate
g3	**Aquaculture.**	Moderate
g4	**Harvesting of invertebrates.**	None identified
No	**(viii) Invasive species**	Risk
h1	**Spread of *Didemnum vexillum***	Low

Table 9 : Summary of Results of Risk Assessment

3.3.1 Impact on protected marine habitats and species.

The results of the risk assessment, undertaken by BioAtlantis, on the potential impact of hand harvesting on protected marine habitats and species is described in this section, along with the control measures where applicable.

Objective 1: To maintain the large shallow inlets and bays (habitat code 1160) in the Clew Bay Complex SAC (ref: pg. 12-13, NPWS, 2011A)

Permanent habitat area: Encompasses all Annex I habitats in Clew Bay Complex SAC

- Risk of affecting site/species: Low-moderate risk of biological, chemical and physical hazards (range rating of 3-10, see Table 10(1) and Appendix 5(a1)).
- Explanation:
  - Biological: The likelihood of sand and rocks being removed along with harvested *A. nodosum* is low given that:
    (a) such materials may damage production equipment and training will be in place to ensure that harvesters use correct cutting, and loading techniques.
    (b) harvested *A. nodosum* will be collected in floating nets. This system ensures settlement to the seabed of any rarely occurring sand or rocks in the netting/harvested weed.
  - Chemical: It is highly improbable that a chemical hazard will occur given that no chemicals will be carried on board the boat, except for small quantities of standard cleaning material and fuel oil. Fuel oil is unlikely to leak as boat engines will be regularly maintained.
  - Physical: hazards in the form of debris being inadvertently deposited into the environment are unlikely to occur, as harvesters will receive general cleaning, hygiene and waste disposal training.
- Control measures (if applicable): 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). The Resource Manager will inspect the harvest on collection. Having the ability to trace the seaweed to a specific harvester will ensure that issues such as excessive sand, shingle or debris are identified and addressed effectively. Should excess material be observed in water, the separator or mill, the harvester will be re-trained or disciplined as required. Production Operators will inspect the incoming harvest and record details as to the quality of the harvested seaweed on production logsheets, including the presence or absence of contaminants such as *Fucus* sp., sand, stones and holdfast material, etc. For details on action limits, analytical procedures monitoring and corrective actions, see table 10(1) and Appendix 5(a1).

***Zostera* & Maerl**

- Risk of affecting site/species: Low risk *of potential biologi*cal hazard in the form of removal of habitat of rare & endangered species (risk rating=5). No chemical or physical hazards have been identified (see table 10(2, 3) and Appendix 5(a2-3)).
- Explanation: It is highly improbable that the distribution, abundance, diversity or area occupied by *Zostera* or maerl will be affected due to harvesting of *A. nodosum* given that: (a) *Zostera* and maerl dominated communities exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested and (b) *Zostera* and maerl growth substrates are insufficient *to su*pport growth of *A. nodosum* and thus, will not be affected by harvest activities.

- Control measures (if applicable): Harvest will not occur in these areas. For details on action limits, analytical procedures monitoring and corrective actions, see table 10(2-3) and Appendix 5(a2-3).

Polychaetes and bivalves communities (soft sediment/sandy mud areas):

- Risk of affecting site/species: Moderate risk of potential biological hazard in the form of removal of habitat of rare & endangered species (risk rating=10). No chemical or physical hazards have been identified (see table 10(4) and Appendix 5(a4)).
- Explanation: the probability of affecting the distribution, abundance, diversity or area of sandy mud occupied by polychaete & bivalve community complex due to harvesting of *A. nodosum* is reduced given that: (a) the sandy mud areas containing these communities exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested, (b) sandy mud areas are insufficient to support growth of *A. nodosum* and thus, will not be targeted for harvest activities and (c) accessing rocky shorelines that lie beyond mudflat/sandflat areas at low tide, is very difficult and would be avoided by harvesters by default.
- Control measures (if applicable):
  Boats shall only be operated at high tide when seeking to access rocky shorelines located beyond mudflat/sandflat areas. A code of practice will be put in place to ensure that under no circumstances will harvesters disrupt mudflat/sandflat areas, particularly in cases where harvest occurs in the Northern or Southern sections of Clew Bay (see Appendix 4).
  For details on action limits, analytical procedures monitoring and corrective actions, see table 10(4) and Appendix 5(a4).

***Nephtys cirrosa* community** (clean, fine sand areas)

- Risk of affecting site/species: Moderate risk of potential biological hazard in the form of removal of habitat of rare & endangered species (risk rating=10). No chemical or physical hazards have been identified (see table 10(5) and Appendix 5(a5)).
- Explanation: The probability of the distribution, abundance, diversity of fine sand communities dominated by *Nephtys cirrosa* being altered due to harvesting of *A. nodosum* is reduced given that: (a) the fine sand areas containing this community exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested and (b) fine sand areas are insufficient to support growth of *A. nodosum* and thus, will not be targeted for harvest activities and (c) accessing rocky shorelines that lie beyond fine sand areas at low tide in particular, is very difficult and would be avoided by harvesters by default.
- Control measures (if applicable): In areas of the south-west where fine sand areas dominated by *Nephtys cirrosa* community occur, boats shall only be operated at high tide to reach rocky shores beyond these areas. A code of practice will be put in place to ensure that under no circumstances will harvesters disrupt these clean, fine sand areas, (see Appendix 4). For details on action limits, analytical procedures monitoring and corrective actions, see table 10(5) and Appendix 5(a5).

***Tubificoides benedii* and *Pygospio elegans* communities (intertidal sandy mud areas):**

- Risk of affecting site/species: Moderate risk of potential biological and physical hazards in the form of removal of habitat of rare & endangered species or disruption of intertidal sandy mud (risk rating=10 respectively). No physical or chemical hazards have been identified (see table 10(6) and Appendix 5(a6)).
- Explanation: The probability of the habitat and species from intertidal sandy mud areas in Clew Bay being altered due to harvesting of *A. nodosum* is reduced given that:

(a) *A. nodosum* does not grow on intertidal sandy mud substrate, and therefore will not be subjected to harvest activities.

(b) in most areas, intertidal sandy mud areas exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested and

(c) accessing rocky shorelines that lie beyond intertidal sandy mud areas at low tide in particular, is very difficult and will be avoided by harvesters by default.

- Control measures (if applicable): Boats shall only be operated at high tide when seeking to access rocky shorelines located beyond intertidal sand mud areas. A code of practice will be put in place to ensure that under no circumstances will harvesters disrupt intertidal sandy mud, particularly in cases where harvest occurs in the Northern or Southern sections of Clew Bay (see Appendix 4). For details on action limits, analytical procedures monitoring and corrective actions, see table 10(6) and Appendix 5(a6).

Shingle:

- Risk of affecting site/species: Moderate risk of potential biological/physical hazards in the form of removal of habitat of rare & endangered species or (risk rating=10). No chemical hazards have been identified (see table 10(7) and Appendix 5(a7)).
- Explanation: It is unlikely that distribution, abundance, diversity or area of shingle will be altered due to harvesting of *A. nodosum* given that removal of shingle with seaweed would be considered contamination which would be detected on collection of harvest (i.e. GRN). Presence of contaminants such as shingle will also be assessed in production facilities as presence of shingle could damage extraction equipment.
- Control measures (if applicable): Training to ensure that harvesters are trained in safe boating and hand harvest techniques to ensure that holdfast, or friable, shingle-type substrate is not removed or disturbed. For details on action limits, analytical procedures monitoring and corrective actions, see table 10(7) and Appendix 5(a7).

Reef:

- Risk of affecting site/species: Moderate risk of potential biological/physical hazard in the form of removal of habitat of rare & endangered species or disruption or damage to reef (risk rating=10). No chemical hazards have been identified (see table 10(8) and Appendix 5(a8)).
- Explanation: It is unlikely that distribution, abundance, diversity or area of reef will be altered due to harvesting of *A. nodosum* as:

  (a) the majority of the reef in Clew Bay is not found along the shores where *A. nodosum* occurs.

  (b) in cases where reef does occur along the shores, contact will automatically be avoided in order to prevent damage to the harvesters sickle/blade and underlying growth substrate.

  (c) removal of reef with seaweed would be considered contamination which would be detected on collection of harvest (i.e. GRN).

  (d) damage to reef by boats is unlikely as harvesters boats will be small and the harvest collection boat will be fitted with a depth finding device to ensure that there is always sufficient water.
- Control measures (if applicable): Training to ensure that harvesters are trained in safe hand harvest and boating techniques along rocky shores (see Code of Practice, Appendix 4). For details on action limits, analytical procedures monitoring and corrective actions, see table 10(8) and Appendix 5(a8).

NOTE: *A. nodosum* and associated communities were assessed separately in Section 3.3.5 of this document, with results outlined in Table 12.

Objective 2: To maintain the favourable conservation condition of Mudflats and Sandflats not covered by seawater at low tide.

Mudflats and Sandflats:

- Risk of affecting site/species: Moderate risk of potential physical hazard in the form of disruption of intertidal sandy mud (risk rating=10). No biological or chemical hazards have been identified (see table 10(9) and Appendix 5(a9)).
- Explanation: the likelihood that mudflats and sandflats not covered by seawater at low tide will be physically affected due to harvesting of *A. nodosum* is low given that:
  (a) this substrate is not suitable for *A. nodosum* growth and will not be targeted for harvest activities and
  (b) in most areas, mudflats and sandflats exhibit little overlap with the rocky shorelines.
  (c) accessing rocky shorelines that lie beyond mudflats and sandflats at low tide in particular, is very difficult and would be avoided by harvesters.
- Control measures (if applicable): Boats shall only be operated at high tide when attempting to reach rocky shores which lie beyond the mudflats and sandflats (e.g. northern and southern shores of complex). A code of practice will be put in place to ensure that under no circumstances will harvesters disrupt intertidal sandy mud areas (See Appendix 4). For details on action limits, analytical procedures monitoring and corrective actions, see table 10(9) and Appendix 5(a9).

Overall impact on important sediment communities (clean/fine and sediment/sandy mud areas):

- Risk of affecting site/species: Low.
- Explanation: The chances of altering the distribution, abundance, diversity or area occupied by these communities due to harvesting of *A. nodosum* are extremely low given that (a) the clean/fine sand and soft sediment/sandy mud areas containing these species exhibit little overlap with the rocky shorelines in which *A. nodosum* will be harvested and (b) these substrates are insufficient to support growth of *A. nodosum* and thus, will not be affected by harvest activities.
  (c) access to these areas is difficult and in many cases can only be undertaken at high tide.
- Control measures (if applicable): In exceptional circumstances where there is overlap between these areas and the rock shoreline containing *A. nodosum* (e.g. northern shores), control measures and a code of practice will be in place to ensure that boats do not damage these areas (see Appendix 4).

Objective 3: To maintain the favourable conservation condition of harbour seal (Annex II species) in Clew Bay Complex SAC.

Introduction

It is well established that harbour seals are highly sensitive to human behaviour. Disturbance events are caused by factors which result in alterations to seal behaviour, particularly during

breeding, moulting and resting periods. This can culminate in significant numbers leaving haul-out sites during periods of time important to their life-cycle. Recent analysis of anthropogenic disturbances on seals in Clew Bay and other regions have provided an important platform in which to make informed management decisions which prevent harmful or potentially harmful activities from occurring. Assessments in Clew Bay are being undertaken by the NPWS on an ongoing basis as part of the "Harbour Seal Pilot Monitoring Project". The overall benefits of assessments of harbour seal behaviour is that they establish the impact of human activity on behavioural responses and in doing so, provide crucial practical information. In turn, they provide a platform for more informed management decisions which are based on both science and the practicalities of modern life. These studies often provide information relating to the:

1. Characterisation of human causes (human activities) and their effects on wildlife behaviour
2. Characterisation of long-term biological significance of short-term responses.

BioAtlantis have developed a Code of Practice (Appendix 4) 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). The Code of Practice in Appendix 4 ensures that harvesters are fully informed and equipped with best practice knowledge on how to ensure that disturbances of seal behaviour does not occur. Central to the Code of Practice are specific site-specific mitigation measures which are based knowledge of established breeding, moulting and resting sites, as determined by NPWS.

Important aspects of seal behaviour, sensitivity, tolerance, recovery and habituation are described as follows:

- **Sensitivity**

  The Harbour Seal Pilot Monitoring Project, 2010 (NPWS 2011C) has identified a number of activities which led to disturbance of the harbour seals in selected sites in Ireland, including: occupation of shorelines adjacent to hauled out seals (e.g. by shellfish harvesters), quad bike activity on sandflats, approach of a low-flying aircraft, wildlife tour vessels, sea kayak activity, presence of small inshore fishing vessels, people walking recreationally, passing small fishing/angling boats, horse riders and dogs. NPWS also recorded instances where even members of scientific survey teams impacted on seal behaviour. The effectiveness of reserves to prevent human-induced disturbances to harbour seal population were recently evaluated in the Anholt seal reserve of Denmark (Andersen et al., 2011 & 2012). In this study, harbour seals were found to be alerted by boats at a distance of 560–850m and pedestrians at a distance of 200–425m. Flight initiation was observed at 510–830m for boats and 165–260m for pedestrians. These studies highlight the sensitivity of harbour seals to human presence. However, harbour seal behaviour is highly complex and seals are known to exhibit varying levels of tolerance to human, depending on the nature of the contact and the time of year.

- **Varying levels of tolerance to human activities**

  Tolerance is defined as 'the intensity of disturbance that an individual tolerates without responding in a defined way' (Bejder et al., 2009 and references therein) and is measured over short term periods. Tolerance is distinct from processes of habituation or sensitisation which are only measurable over the long term. For example, during habituation, individual tolerance levels increase, while during sensitisation, tolerance levels will decrease (Bejder et al., 2009). Habituation may occur following repeated exposure to a specific stimulus. In the case of the harbour seal, several studies indicate varying levels of tolerance to human activities.

  Boat Traffic

  Henry et al., (2001) demonstrated that boat traffic in Métis Bay area of Canada have only a temporary effect on the haul-out behaviour of harbour seals. Several studies point to slow moving or stopped vessels such as kayaks as causing the most severe disturbance to seals (Johnson et al., 2007, Allen et al., 1984, Suryan and Harvey 1999, Henry and Hammill 2001). In particular, Johnson et al., (2007) demonstrate that seals were disturbed by kayaks and by stopped powerboats at distances of >91m from haul out sites, while being unaffected by moving powerboats approaching as close as 39m. Effects of kayak activities have also been reported in Ireland by the NPWS (2011C). This data suggests tolerance to brief and passing presence of vessels which do not pay attention to the seals themselves (Johnson et al., 2007), while disturbances are mainly caused by vessels that linger or move at slow pace (e.g. kayaks and stalled boats) along haul out sites. These effects were reported by Allen et al., (1984), Suryan and Harvey, 1999, Henry and Hammill, 2001. These findings indicate that boating activities themselves will have minimal impacts on seal populations, provided that boats refrain from running at low speed for prolonged durations or stall.

  Seasonal tolerance

  Henry et al., (2001) demonstrate that seals were less affected during August, potentially due to increased tolerance associated with hormonal and physiological changes which occur during moulting (Ashwell-Erickson et al., 1986). Greater motivation to remain hauled out was also observed during moulting periods. Seasonal tolerance was also observed in a study of the Anholt seal reserve of Denmark (Andersen et al., 2011 & 2012) in which an increased tendency to return to haul out sites following disturbance during the breeding season was identified. However, tolerance was not identified before or after the breeding period, therefore suggesting that the tolerance did not give rise to habituation. Harbour seals are also more sensitive to human activities during obligate resting periods (October to April).

  Recovery

  Data from Henry and Hammil, 2001, indicates a limited effect of disturbance on the recovery of seal numbers on haul out sites, to pre-disturbance levels. Johnson et al., 2007, also reported that seals quickly recover from disturbance, returning back to haul

out sites in less than 1 hour. In only 21% of disturbance cases did seal numbers not reach pre-disturbance levels.

Habituation or site-specific tolerance

There is some evidence for habituation of harbour seals to high traffic levels. In a study by Osborn (1985), of an area close to a busy harbour in Elkhorn Slough, Monteret Bay, California, 74% flushing was observed with disturbance at <30m. While habituation may explain these observations, findings such as these may be attributed to increased tolerance to human activities, such as during the breeding season.

On the basis of this information and data on sites of relevance to harbour seals in Clew Bay, a risk assessment was carried out with respect to conservation objectives for the SAC. This is outlined below:

Human Activities (General):

- Risk of affecting site/species: Moderate risk of potential hazards in the form of human presence or related activities (e.g. 'flushing out' and entering the water of seals, man-made energy (Ariel or underwater noise), deterioration of resources such as water quality or food source; risk rating=10; (see table 10(10) and Appendix 5(a10)).
- Explanation: The probability of negatively effecting the harbour seal population in Clew Bay due to human activity is reduced given that breeding, moulting and resting sites are designated as out of bounds during relevant stages of the year. Boats will also operate in a manner known to least affect seal behaviour.
- Control measures (if applicable): As a control measure, BioAtlantis will issue the code of practice for the protection of the harbour Seal (See Appendix 4), to ensure that harvesters:
  (a) Have full knowledge of the sites in Clew Bay known to be relevant the harbour seal.
  (b) Full knowledge of harbour seal sites which are out of bounds at relevant times of the year.
  (c) Understand the steps required to ensure that all contact with seals is prevented from day to day.
  (d) Operate boat according to practises which minimise impact on harbour seal.

Species range:

- Risk of affecting site/species: Extremely low risk of potential physical hazard in the form of restriction of the harbour seal species range. No biological or chemical hazards have been identified (see table 10(11) and Appendix 5(a11)).
- Explanation: 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.
- Control measures (if applicable): not applicable. Physical barriers which could block access to harbour seals and site of importance to their species will not be installed in Clew Bay.

Breeding Sites:

- Risk of affecting site/species: Moderate risk of potential biological hazard in the form of human presence or activities (risk rating=10 each respectively). No chemical of physical hazards have been identified (see table 10(12) and Appendix 5(a12)).

- Explanation: The probability of human presence or activities affecting harbour seals at known breeding sites of Clew Bay is reduced given that harvesters will not be permitted to harvest at these sites during the breeding period (May-July).
- Control measures (if applicable): As a control measure, the BioAtlantis code of practice for the protection of the harbour seal will be implemented (See Appendix 4) to ensure:
  - No disturbance events occur; e.g. no harvest at breeding sites during sensitive times of year, between May-July.
  - Navigation guidelines to ensure that seals are not disturbed to levels which would result in entry or 'flushing' into the water.

  For details on action limits, analytical procedures monitoring and corrective actions, see table 10(12) and Appendix 5(a12).

Moulting Sites:

- Risk of affecting site/species: Moderate risk of potential biological hazards in the form of human presence or activities (risk rating=10 each respectively). No chemical or physical hazards have been identified (see table 10(13) and Appendix 5(a13)).
- Explanation: The probability of human presence or activities affecting harbour 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 (Aug-Sept).
- Control measures (if applicable): As a control measure, The BioAtlantis code of practice for the protection of the harbour seal will be implemented (See Appendix 4) to ensure:
  - No disturbance events occur; e.g. no harvest at breeding sites moulting sites during sensitive times of year, between Aug-Sept.
  - Navigation guidelines to ensure that seals are not disturbed to levels which would result in entry or 'flushing' into the water.

  Of note, a recent survey of Clew Bay during moulting season found that maintenance of a constant boat speed, approximately 60m away from a single hauled out seal, proved sufficient to prevent any behavioural changes (See Appendix 1). For details on action limits, analytical procedures monitoring and corrective actions, see table 10(13) and Appendix 5(a13).

Resting Sites:

- Risk of affecting site/species: Moderate risk of potential biological hazards in the form of human presence or activities (risk rating=10 each respectively). No chemical or physical hazards have been identified (see table 10(14) and Appendix 5(a14)).
- Explanation: The probability of human presence or activities affecting harbour seals at known resting sites of Clew Bay is reduced given that harvesters will not be permitted to harvest at these sites during the obligate resting period (Oct-April).
- Control measures (if applicable): As a control measure, the BioAtlantis code of practice for the protection of the harbour seal will be implemented (See Appendix 4) to ensure:
  - No disturbance events occur (e.g. no harvest at resting sites during sensitive times of year, between Oct-April).
  - Navigation guidelines to ensure that seals are not disturbed to levels which would result in entry or 'flushing' into the water.

For details on action limits, analytical procedures monitoring and corrective actions, see table 10(14) and Appendix 5(a14).

3.3.2 Impact on protected coastal habitats.

The results of the risk assessment, undertaken by BioAtlantis, on the potential impact of hand harvesting on protected coastal habitats is described in this section, along with the control measures where applicable.

Objective 1: To maintain the favourable conservation condition of Perennial vegetation of stony banks (1220; ref: pg. 6, NPWS, 2011B).

- Risk of affecting site/species: Low risk of potential biological or physical hazards in the form of removal of habitat of rare & endangered species or disruption and damage to vegetation (risk rating=5 respectively). No chemical hazards have been identified (see table 10(15) and Appendix 5(a15)).
- Explanation: It is highly improbable that Perennial vegetation of stony banks in Clew Bay will be affected due to harvesting of *A. nodosum* given that:
  (a) established piers will be required to unload the boat. Use of banks for this purpose will be forbidden.
  (b) *A. nodosum* does not grow in these locations, and therefore will not be subject to harvest activities,
  (c) contamination with other materials may result in damaged production equipment and end product and
  (d) harvested weed will not be stored in these areas. This ensures no inadvertent co-removal of protected species such as perennial vegetation.

  The probability of physically impacting upon perennial vegetation of stony banks is exceptionally low given that harvesters will be trained to ensure that all transport activities will take place using established piers and roadways. Under no circumstances will transport be permitted to occur in these areas.
- Control measures (if applicable): Neither harvest or transport activities will take place in these areas. All harvest and pick up locations will be recorded on GRNs. For details on action limits, analytical procedures monitoring and corrective actions, see table 10(15) and Appendix 5(a15).

Objective 2: To restore the favourable conservation condition of Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*; 1330; ref: pg. 9, NPWS, 2011BB).

- Risk of affecting site/species: Low risk of potential biological or physical hazards in the form of removal of habitat of rare & endangered species or disruption and damage to vegetation (risk rating=5 respectively). No chemical hazards have been identified (see table 10(16) and Appendix 5(a16)).
- Explanation: It is highly improbable that Atlantic salt meadows (ASM) in Clew Bay will be affected due to harvesting of *A. nodosum* given that:
  (a) Established piers will be required to unload the boat. Use of ASM regions will be forbidden,
  (b) *Ascophyllum nodosum* does not grow at high density in these locations, and therefore will not be subject to harvest activities,
  (c) contamination with other material may result in damaged production equipment and product and
  (d) harvested weed will not be stored in salt meadow areas. This ensures no inadvertent co-removal of protected species characteristic of Atlantic salt meadows.

The probability of physically impacting upon ASM is low given that harvesters will be trained to ensure that all transport activities will take place using established piers and roadways. Under no circumstances will transport be permitted to occur in these areas.

- Control measures (if applicable): as described above for perennial vegetation of stony banks. For details on action limits, analytical procedures monitoring and corrective actions, see table 10(16) and Appendix 5(a16).

Objective 3: To maintain and/or restore the conservation conditions of sand dune habitats (ref: pg. 15, NPWS, 2011BB).

- Risk of affecting site/species: Low risk of potential biological or physical hazards in the form of removal of habitat of rare & endangered species or disruption and damage to annual vegetation of drift lines along the high tidal mark of Clew Bay, embryonic shifting dunes above the strandline or shifting dunes (risk rating=5). No chemical hazards have been identified (see table 10(17) and Appendix 5(a17)).
- Explanation: It is highly improbable that sand dune habitats in Clew Bay will be affected due to harvesting of *A. nodosum* given that:
  (a) Loading and transport activities will occur exclusively using established piers and road networks,
  (b) *Ascophyllum nodosum* does not grow at high density in these locations, and therefore will not be subject to harvest activities,
  (c) contamination with other material may result in damage to production equipment and end product and
  (d) harvested weed will not be stored in these areas. This ensures no inadvertent co-removal of protected species in sand dune habitats.
- Control measures (if applicable): as described above for perennial vegetation of stony banks and ASM. For details on action limits, analytical procedures monitoring and corrective actions, see table 10(17) and Appendix 5(a17).

3.3.3 Impact on Otters and Birds.

The results of the risk assessment, undertaken by BioAtlantis, on the potential impact of hand harvesting on protected otter and bird species is described in this section, along with the control measures where applicable.

Otters *(Lutra, lutra):*

- Risk of affecting site/species: There is a low risk of potential biological hazard in the form of affecting the distribution, extent of terrestrial, marine and freshwater habitats, number of couching sites and holts. There is low risk of disturbance at couching sites and holts. There will be no negative impacts upon available food resources such as species of fish (risk rating=5). There will be no barriers to connectivity. No chemical hazards have been identified (see table 10(18) and Appendix 5(a18)).
- Explanation:
  - Freshwater habitats are excluded from all harvest activities. In addition, the Burrishoole catchment area will be excluded. The mouth of Lough Furnace will be also excluded from all harvest activity.
  - 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. Harvest activities will take place in the *A. nodosum* intertidal zone and will not lead to any destruction of terrestrial habitat. It is highly improbable that otter food supply will be depleted due to harvest activities in Clew Bay. In particular, Kelly L. *et al.*, (2001) indicate that hand harvest is not associated with reductions in fish numbers within the *A. nodosum* biotope. Human presence at sites will be temporary and will not give rise to significant disturbance of otter. Harvester activity will take place in the intertidal zone and will not affect otter holts.
- Control measures (if applicable): Otters occupy both freshwater aquatic, marine aquatic and associated terrestrial habitats. An important requirement of otters is an adequate food supply and unrestricted access to sites and islands throughout Clew Bay. Harvest of *A. nodosum* beds will not exceed 20% of the available *A. nodosum* biomass per site per annum, thus ensuring the maintenance of the *A. nodosum* habitat. BioAtlantis will manage activities in a sustainable manner to prevent excessive removal of *A. nodosum* and in turn, circumvent any potentially negative effects on species further along the food chain, e.g fish & otters. In addition, no activities will take place in important areas of the Burrishoole catchment such as Lough Feeagh & Lough Furnace, thus preventing any impact on otter activity or important life-cycle stages of trout or salmon. A code of practise for protection of the otter is included in Appendix 4. For details on action limits, analytical procedures monitoring and corrective actions, see table 10(18) and Appendix 5 (a18).

Birds:

- Risk of affecting site/species: Low risk of potential biological hazard in the form of negative impacts on habitats relevant to species of bird or alteration to behaviour due to presence of humans (risk rating=5). No physical or chemical hazards have been identified (see table 10(19) and Appendix 6 for details).
- Explanation: Clew Bay supports a number of breeding and wintering bird populations of national importance. These species have important breeding, nesting, feeding and wintering requirements and activities during hand harvest of *A. nodosum* should be carried out in a manner which does not impact on their key biological imperatives. Species vary in their dietary requirements, habitats and sensitivity to human disturbance. As *A. nodosum*

provides a habitat for marine life such as fish, some bird species may be attracted to *A. nodosum* beds when hunting for food. In the absence of appropriate systems of management, monitoring and verification, there is increased likelihood of excess removal of *A. nodosum* and in turn, increased chance of affecting birds who may use these zones for feeding purposes. For example, Brent Geese potentially use areas such as grassland or algae as a secondary food source in the absence of its primary food resource, eelgrass (ref: NPWS, 2013). In addition, human presence may negatively impact on bird behaviour, particularly during breeding season, which could lead to nest desertation. Unexpected human activity is also a risk factor as it can lead to flight events for some wintering species (e.g. Brent Geese; Phalan B & Nairn RGW 2007). However, it is highly improbable that species of bird will be affected by harvest activities in Clew Bay given the following:

(a) **Harvest of *A. nodosum***: this will be undertaken sustainably and will not exceed 20% of the available biomass per site per annum, thus ensuring maintenance of the *A. nodosum* habitat. Therefore, the probability of affecting fish and in turn bird species in Clew Bay, is considerably reduced.

(b) **Foraging behaviour and nesting requirements**: harvest will not take place during sensitive times at sites indicated by the NPWS (*pers. comm. 03/12/2013*) as being important during breeding season for the following species: Common Tern *(Sterna hirundo),* Sandwich Tern *(Sterna sandvicensis),* Arctic Tern, *(Sterna paradisaea),* Black-headed Gull *(Larus ridibundus),* Cormorant *(Phalacrocorax carbo),* Common gull *(Larus canus),* Greater Black-backed Gull *(Larus marinus).* Likewise, sites indicated by NPWS as being of importance to wintering Brent Geese *(Branta bernicla hrota)* and Barnacle Geese *(Branta leucopsis)* will not be subjected to harvest activities during wintering the period (Oct –Mar). For species which utilize sandy beaches, sand dune and/or salt marsh habitats (Oystercatcher, *Haematopus ostralegus*; Ringed Plover, *Charadrius hiaticula*), these areas contain substrate which does not support dense growth of *A. nodosum* and therefore, these areas will be avoided (see Appendix 6 for details).

(c) While several species of birds use the *A. nodosum* zone as a habitat for feeding, reproduction or sheltering purposes, none are exclusively dependent on the *A. nodosum* biotope (reviewed by Kelly L. *et al.*, 2001).

- Control measures (if applicable): Harvest of *A. nodosum* beds will not exceed 20% of the available biomass per site per annum, thus ensuring the maintenance of the *A. nodosum* habitat. BioAtlantis will manage activities in a sustainable manner to prevent excessive removal of *A. nodosum* and in turn, circumvent any potentially negative effects on species further along the food chain, e.g fish & birds. In addition, no activities will take place in important areas of the Burrishoole catchment such as Lough Feeagh & Lough Furnace, thus preventing any impact during important life-cycle stages of trout or salmon. Control measures are in place to ensure that harvest activities do not occur during sensitive times of year at sites indicated by NPWS as being important during breeding and wintering periods (*pers. comm. 03/12/2013*). See "Code of Practise" for protection of bird species in Appendix 4 for details. For details on action limits, analytical procedures monitoring and corrective actions, see table 10(19). For details on the distribution, biological requirements and control measures for avian species of interest in Clew Bay, see Appendix 6.

3.3.4 Impact on species & habitats of general interest.

In addition to protecting the sensitive communities and habitats specified as part of Clew Bay's SAC status, it is also important to consider the Clew Bay environment as a whole and the overall position of *A. nodosum* within the rocky shore ecosystem. During high tide, fronds of *A. nodosum* rise and form a forest which forms part of a habitat for species of fish and invertebrates. This can in turn, represent a hunting ground for some marine and terrestrial animals during periods of high tide. The potential risk of harvesting activities negatively impacting on the *A. nodosum* ecosystem is outlined as follows, paying close attention to important species identified by Merc Consultants in their detailed survey of Clew Bay in 2006.

Fish species:

- Risk of affecting site/species: Low risk of potential biological hazards in the form of removal of zones important for feeding, reproduction and/or sheltering of fish species such as trout and salmon (risk rating=2). No physical or chemical hazards have been identified (see table 11(1) and Appendix 5(b1)).
- Explanation: In the absence of appropriate systems of management, monitoring and verification, there is increased likelihood of excess removal of *A. nodosum* which in turn, may impact upon species of fish who use these zones for feeding, reproduction and/or sheltering. However, it is highly improbable that fish numbers will be affected by harvest activities in Clew Bay given that:
  a) Harvest of *A. nodosum* will be undertaken sustainably and will not exceed 20% of the available biomass per site per annum, thus ensuring maintenance of the *A. nodosum* habitat.
  b) Important catchment areas of Burrishoole will be excluded from all harvest-related activities.
  c) Studies indicate that hand harvest of *A. nodosum* does not significantly effect fish and large mobile epifauna (Kelly L. *et al.*, 2001)
- Control measures (if applicable): no requirements. Nonetheless, BioAtlantis will manage activities in a sustainable manner to prevent excessive removal of *A. nodosum* and in turn, circumvent any potentially negative effects on species further along the food chain, e.g fish, birds, otters. For details on action limits, analytical procedures monitoring and corrective actions, see table 11(1) and Appendix 5(b1).

Lough Furnace:

- Risk of affecting site/species: Low risk of potential biological hazards in the form of damage to a rare example of a permanently stratified lake environment (risk rating=4). No physical or chemical hazards have been identified (see table 11(2) and Appendix 5(b2)).
- Explanation: It is highly improbable that this environment and it's associated species will be affected by activities due to hand harvesting, as these areas are excluded from the current application.
- Control measures (if applicable): Not applicable, as this area and it's associated lakes such as Lough Napransky and Lough Navroony will be completely excluded from all harvest activities. For details on action limits, analytical procedures monitoring and corrective actions, see table 11(2) and Appendix 5(b2).

The Rosmurrevagh area:

- Risk of affecting site/species: Low risk of potential biological or physical hazards in the form of removal of habitat of rare & endangered species or disruption and damage to diverse environs (risk rating=5). No chemical hazards have been identified (see table 11(3) and Appendix 5(b3)).
- Explanation: It is highly improbable that the Rossmurrevagh area and it's associated species will be affected by activities due to hand harvesting given that:
  (a) *Ascophyllum nodosum* does not grow in these locations, and therefore will not be subject to harvest activities,
  (b) Contamination with material from this area may damage production equipment and end product,
  (c) Harvested weed will not be stored in this area. This ensures no inadvertent co-removal of protected species in the Rosmurrevagh area. Harvesters will be trained to ensure that all transport activities will take place using established piers and roadways. Under no circumstances will transport be permitted to occur in these areas.
- Control measures (if applicable): Harvest and storage activities will be forbidden in these locations. For details on action limits, analytical procedures monitoring and corrective actions, see table 11(3) and Appendix 5(b3).

3.3.5 Impact on the *Ascophyllum nodosum* biotope and species therein

In addition to assessing the potential impact of hand harvesting of *A. nodosum* on the conservation requirements of Clew Bay SAC, this application has also assessed the impact of these activities on the *A. nodosum* biotope itself. This analysis is of relevance considering (a) the potential for impact on species further down the chain (i.e. fish, otters, birds, etc) and (b) *A. nodosum* grows within the intertidal zone on reef substrate and will be harvested.

***A. nodosum* species**

- Risk of affecting site/species: Moderate risk of potential biological hazards in the form of excess removal of *A. nodosum* habitat (risk rating=10). No physical or chemical hazards have been identified (see table 12(1a) and Appendix 5(c1a))
- Explanation: The impact of hand harvest of *A. nodosum* is influenced by a number of factors: the amount harvested, size of harvested area, homogeneity of the harvest and equipment used (Kelly L. *et al.*, 2001). Factors influencing the rate of regeneration of *A. nodosum* include: year of regeneration (higher the first year than successive years), harvesting regimes, age structure of the population, extent and pattern of branching and determined by the shore type/exposure, presence or absence of grazers (Baardseth E, 1955). Immediate effects of cutting of *A. nodosum* between 10-15cm (4-6 inches) above the holdfast are likely to include: removal of seaweed from the area, destruction of epifauna & flora, increase in desiccation, erosion and predation, potential settlement of other species and stimulation of bushy-type *Ascophyllum* growth (Boaden and Dring, 1980). Impacts of harvesting are considered to be similar to those occurring due to natural disturbances, i.e. removal of all or portions of populations and providing space for other species to initiate succession (Kelly L. *et al.*, 2001, and references therein). The structure of the *A. nodosum* population can change from a complex to a more uniform structure following harvest, which may cause alterations to community structure long term (Kelly L. *et al.*, 2001,and references therein). In the west of Ireland, harvest has been found to be associated with alterations in *Fucus vesiculosis*, ephemeral algae and periwinkle *Littorina obtusata*, with *Fucus* found to be increased post-harvest in Clew Bay.

  Environmental impact assessments in modern times at Clew Bay and Connemara indicate almost complete recovery of *A. nodosum* cover following 11 and 17 months post-hand harvest respectively (Kelly L. *et al.*, 2001). Provision of a 4-5 year window for recovery of *A. nodosum* post-harvest remains the current consensus amongst decision makers. Recovery periods such as these are essential, as in the absence of strict oversight, there is increased probability that excessive removal of *A. nodosum* habitat may occur. This was particularly evident in a recent survey of Clew Bay during which areas previously characterised as having high density levels of *A. nodosum*, was found to have less coverage than expected (see Appendix 1). Some sites were characterised by an abundance of *A. nodosum* 'stumps', and evidence of two different types of recent harvest activities in the area. Moreover, *Fucus* sp. levels were notably dense within the *A. nodosum* zone, which may be consistent with studies by Kelly L. *et al.*, (2001) and others which show that *Fucus sp*. coverage can increase as a result of hand harvesting of *A. nodosum*.

  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 R, 2011B). 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.

Significant levels of *A. nodosum* mortality may not be acceptable in an SAC such as Clew Bay. Harvest which contains holdfast material will be considered as representing a severe non-conformance by BioAtlantis Management and could lead to disciplinary procedures. 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. partial or 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. Inspections will also take place at production facilities to ensure no holdfast or other contaminants are present (recorded on production logsheets). As holdfast removal will be avoided, the potential for exposure of understory species to predators such as birds, will also be prevented.

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. BioAtlantis will take a strict approach which forbids cutting less than 200mm (8 inches), which would 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). These standards will also be assessed by means of quarterly and annual audits (Appendix 4 & 8).

- Control measures (if applicable):
  BioAtlantis will ensure that harvest activities are monitored, recorded, controlled and limited to 20% harvest of the available biomass per site per annum. Moreover, the system will require that *A. nodosum* plants will not be cut below 200mm from the holdfast (see Appendix 4). Cutting will be applied throughout the area rather than within specific patches, thus ensuring no extensive loss in *A. nodosum* coverage. This will ensure that *A. nodosum* in harvested in a manner which minimizes any impact to the canopy and associated species, whilst maximizing rates of recovery. This level of regulation is in keeping with the GMP+ Certification status of BioAtlantis, Ltd. and thus will ensure that the probability of over-harvesting of *A. nodosum* resources in Clew Bay is lowered. Important components of the management system include:

  - 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.

▪ Training: Compulsory training of harvesters to ensure competence in skills required to harvest *A. nodosum* in an environmentally friendly and sustainable manner.

▪ Protocols and schedules:
Activities carried out according to clearly defined protocols to ensure that (a) no damage to the environment or underlying growth substrate, and (b) re-growth and re-generation of the vegetation post-harvest is sufficiently facilitated. Standard protocols and methods will include:

- Site determination: identification of areas suitable for harvest, e.g. areas predominated by short A. nodosum fronds will not be harvested.
- Harvest Methods: Use of sickle/knife to cut between 200-300mm (8-12 inches) above frond base, without damaging holdfast or underlying substrate.
- Method for bagging of cut weed in nets.
- Methods of removal from islands and shores.
- Method for communicating with BioAtlantis.
- Method for reporting incidents to BioAtlantis.

Responsibility**:** Oversight, planning and teaching provided by Scientific, Engineering & Quality personnel along with regularly auditing to assess for compliance with procedures and for potential areas of improvement. The Resource Manager will also have responsibilities for several aspects of hand harvesting in Clew Bay. For details on action limits, analytical procedures monitoring and corrective actions, see table 12(1a) and Appendix 5 (c1a). For further details, see *A. nodosum* hand harvest Code of Practice (Appendix 4).

Fucus (*Fucus vesiculosis Linnaeus* and *Fucus serratus Linneaus*)

- Risk of affecting site/species: Low risk of potential biological hazards in the form of alterations to density of *Fucus* (risk rating=6). No physical or chemical hazards have been identified (see table 12(1b) and Appendix 5(c1b)).
- Explanation: The probability of inadvertent harvest of these fucoid species is low given that harvest will be limited to larger vegetative growth of *A. nodosum* fronds, approx. 200-300mm above the base. Otherwise, increases in the density of *Fucus* species may occur in the event of excessive hand harvesting of *A. nodosum* (Kelly L. *et al.*, 2001). Indeed, a recent survey of Clew Bay found evidence for high *Fucus* densities in areas found to have been subjected to recent harvest activities (See Appendix 1). In addition, *Fucus* sp. will be considered a contaminant during intake of harvested *A. nodosum*, and will be recorded as such on the GRN.
- Control measu*res (if app*licable): as described for *A. nodosum* above.

Red algae, *Polysiphonia lanosa (Linnaeus) Tandy*

- Risk of affecting site/species: Low risk of potential b*iological h*azards in *the fo*rm of alterations to density of habitat important to epiphytes of *A. nodosum*, e.g. red algae, *Polysiphonia lanosa (Linnaeus) Tandy* (risk rating=4). No physical or chemical hazards ha*ve be*en identified (see table 12(2a) and Appendix 5(C2a)).

- Explanation*: This spe*cies is hemiparasitic which predominantly uses *Ascophyllum nodosum* as a host (Guiry, M.D. & Guiry, G.M., 2013). This species is present throughout the north Atlantic in areas occupied by *A. nodosum* including Clew Bay SAC (Kelly L. *et al.*, 2001) It resides more rarely within other fucoid biotopes such as *Fucus vesiculosis*. Of note, a recent survey of Clew Bay found this species to be relatively well represented in the *A. nodosum* biotope, occurring in 5 out of 8 quadrants (1m2) were assessed (See Appendix 1). The risk of hand harvest activities affecting this species is considered low. This is due to the fact that 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.
- Control measures (if applicable): as described for *A. nodosum* above. For details on action limits, analytical procedures monitoring and corrective actions, see Table 12(2a) and Appendix 5(C2a)).

Red algae *Mastocarpus stellatus (Stackhouse) Guiry, Chondrus crispus Stackhouse* and *Corallinaceae*

- Risk of affecting site/species: Low risk of potential biological hazards in the form of alterations to density of these species (risk rating=2). No physical or chemical hazards have been identified (see table 12(2b) and Appendix 5(C2b)).
- Explanation: Kelly L. *et al.*, (2001) demonstrate that *Mastocarpus stellatus (Stackhouse) Guiry, Chondrus crispus Stackhouse* are found to be present at low level beneath the *A. nodosum* canopy in Clew Bay, while *Corallinaceae* was not identified in this region (Kelly L. *et al.*, 2001). It is highly improbable that the density of these species will be altered due to harvesting of *A. nodosum* given that harvest of *A. nodosum* will be limited to larger vegetative growth of *A. nodosum* fronds, approx. 200-300mm above the base, generally above the contact level with these species.
  In addition, other species of seaweed will be considered as contaminants during intake of harvested *A. nodosum*, and this will be recorded as such on the GRN.
- Control measures (if applicable): as described for *A. nodosum* above. For details on action limits, analytical procedures monitoring and corrective actions, see table 12(2b) and Appendix 5(C2b).

Ephemeral green algae (e.g. *Cladophora rupestris (Linnaeus) Kützing, Ulva sp. Linnaeus* and *Enteromorpha* sp. Link)

- Risk of affecting site/species: Low risk of potential biological hazards in the form of alterations to density of ephemeral green algae (risk rating=3). No physical or chemical hazards have been identified (see table 12(2c) and Appendix 5(C2c)).
- Explanation: It is highly improbable that ephemeral green algae will be altered due harvesting of *A. nodosum* given the findings of Kelly L. *et al.*, 2001, in which hand harvesting has no significant impact on ephemeral green algae over time. In addition, other species of seaweed will be considered as contaminants during intake of harveste*d A. nodosum*, and this will be recorded as such on the *GR*N.
- Control measures (if applicable): as described for *A. nodosum* above. For details on action limits, analytical procedures monitoring and corrective actions, see table 12(2c) and App*endix 5(C2c).*

Other* seaweed species (e.g. *Lomentaria articulata* (Hudson) *Lyngbye* & *Membranoptera alata (Hudson) Stackhouse)

- Risk of affecting site/species: Low risk of potential biological hazards in the form of alterations to density of other species of algae (risk rating=2). No physical or chemical hazards have been identified (see table 12(2d) and Appendix 5, (C2d)).
- Explanation: Kelly L. *et al.*, 2001, demonstrates an absence of *Lomentaria articulata* (Hudson) *Lyngbye* and *Lyngbye* and *Membranoptera alata (Hudson) Stackhouse* in Clew Bay despite being present at low numbers on Connemara. It is highly improbable that these species of seaweed will be altered due to harvesting of *A. nodosum* given that the frond length of these species generally does not exceed 200 mm and harvest will be limited to larger vegetative growth of *A. nodosum* fronds, approx. 200-300mm above the base. In addition, other species of seaweed will be considered as contaminants during intake of harvested *A. nodosum*, and this will be recorded as such on the GRN.
- Control measures (if applicable): as described for *A. nodosum* above. For details on action limits, analytical procedures monitoring and corrective actions, see table 12(2d) and Appendix 5(C2d).

Periwinkles

- Risk of affecting site/species: Moderate risk of potential biological hazards in the form of alterations to density of periwinkles or removal of habitat important to Winkles (risk rating=9). No physical or chemical hazards have been identified (see table 12(3a) and Appendix 5(C3a)).
- Explanation: *Littorina obtusata Linnaeus* and *Littorina littorea Linnaeus* are species of winkles which are widespread in the northwest Atlantic. They graze on other seaweeds besides *A. nodosum*, e.g. *Fucus*. These herbivorous species provide an important function in this ecosystem as they also graze certain epiphytes from the surface of *A. nodosum*. Studies also indicate that the polyphenols in *A. nodosum* serve as chemical defences to inhibit direct feeding by *Littorina littorea* (Geiselman, JA., and McConnell OJ, 1981), thus suggesting a complex relationship and co-evolution between these species. While Kelly L. *et al.*, (2001) demonstrates no evidence of change of *Littorina obtusata* agg. numbers after harvesting of *A. nodosum* in Clew Bay, a recent survey of Clew Bay found evidence for a positive correlation between *A. nodosum* density and periwinkle numbers (see Appendix 1). While the reasons are unclear, this may suggest a tendency towards increased periwinkle numbers in areas containing greater food resources. Alternatively, it may suggest that the reduction in numbers in areas of lower *A. nodosum* density may have arisen due to harvest activities. For a more detailed description of habitat requirements and potential impacts of inadvertent, non-targetted removal of species such as periwinkles, please see Section 3.5.3. Overall, however, there is a reduced risk of harvest activities negatively impacting upon winkles in Clew Bay given that:
  a) The harvest methodology employed by BioAtlantis will ensure that *A. nodosum* is cut 200-300mm (8-12 inches) above the *A. nodosum* holdfast, thus maintaining the canopy and allowing for sufficient re-growth.
  b) As periwinkles reside within other fucoid biotopes such as *Fucus* vesiculosis, the potential hazard of overharvesting of *A. nodosum* would not represent a detrimental threat to these populations.
  c) Control measures are in place to ensure that canopy coverage is maintained, by-catch is limited and reproductive aspects are not affect (see Appendix 4 and below).
- Control measures (if applicable): as described for *A. nodosum* above. Additionally:

- Reproduction: Harvesters will be trained to identify and avoid *A. nodosum* plants or fronds which contain visible *L. obtusata* eggs masses.
- Canopy damage:
  Harvesters will learn to avoid periwinkle disturbance by:
  (a) cutting at low tide, when species are more likely to be dormant/inactive.
  (b) aiming to leave between 200-300mm (8-12 inches) of material behind
  (c) under no circumstances cutting less than 200 mm above the holdfast.
  (d) avoiding holdfast removal
  (e) limiting harvest to 20% of the biomass per site per annum.
- Other habitats: harvesters will be trained to avoid *Fucus vesiculosis* and *F. serratus*, which are additional habitats for periwinkles.
- By-catch: any *Animalia* by-catch observed on the boat must be returned to the water.

For details on action limits, analytical procedures monitoring and corrective actions, see table 12(3a) and Appendix 5(C3a).

Limpets

- Risk of affecting site/species: Moderate risk of potential biological hazards in the form of alteration to density of limpets and/or habitat important to limpets (risk rating=9). No physical or chemical hazards have been identified (see table 12(3b) and Appendix 5(C3b)).
- Explanation: Limpets are resident in fucoid canopies as grazers, playing important roles in the *A. nodosum* biotope. Kelly L. *et al.*, (2001) demonstrate that hand harvesting of *A. nodosum* can be associated with increases and decreases in limpet density and size. A trend towards increased limpet numbers in areas of increased *A. nodosum* biomass was also identified in a recent survey in Clew Bay (See Appendix 1). However, as these species also reside within other fucoid biotopes such as *Fucus vesiculosis*, the potential hazard of overharvesting of *A. nodosum* would not represent a detrimental threat to these species. The risk of lowering the density of these populations is further reduced as hand harvesting will be carefully managed and controlled to ensure no excess removal of the *A. nodosum* canopy, i.e. *A. nodosum* will not be cut less than 200mm above the holdfast
- Control measures (if applicable): as described for *A. nodosum* above. For details on action limits, analytical procedures monitoring and corrective actions, see table 12(3b) and Appendix 5(C3b). Additionally,
  - Canopy damage:
    Harvesters will learn to avoid limpet disturbance by:
    (a) cutting at low tide, when species are more likely to be dormant/inactive.
    (b) aiming to leave between 200-300mm (8-12 inches) of material behind
    (c) under no circumstances cutting less than 200mm above the holdfast.
    (d) avoiding holdfast removal
  - Other habitats: harvesters will be trained to avoid *Fucus vesiculosis* and *F. serratus*.
  - By-catch: any *Animalia* by-catch observed on the boat must be returned to the water.

Barnacles

- Risk of affecting site/species: Moderate risk of potential biological hazards in the form of alteration to density of barnacles or habitat important to barnacles (risk rating=6). No physical or chemical hazards have been identified (see table 12(3c) and Appendix 5(C3c)).
- Explanation: Barnacles are resident in fucoid canopies as filter feeders. Some studies indicate that harvesting of *A. nodosum* can be associated reduced cover of barnacles.

These effects were not reported by Kelly L. *et al.*, 2001. As hand harvesting will be sustainable, there is a low risk of excess removal of *A. nodosum.* In turn, there is a low risk of potential negative effects on barnacle numbers.

- Control measures (if applicable): as described for *A. nodosum* above. For details on action limits, analytical procedures monitoring and corrective actions, see table 12(3c) and Appendix 5(C3c).

Hydroids (e.g. *Dynamena pumila Linnaeus*)

- Risk of affecting site/species: Low risk of potential biological hazards in the form of alterations to density of Hydroid (*Dynamena pumila Linnaeus*) or habitat important to these species (risk rating=6). No physical or chemical hazards have been identified (see table 12(3d) and Appendix 5(C3d)).
- Explanation: The presence of hydroids on the tips of *A. nodosum* may increase the probability of altering their density during harvest. However, there is no evidence from the study by Kelly L. *et al.*, (2001) that hand harvesting of *A. nodosum* in Clew bay is associated with alterations to density of hydroid species. In addition, hydroid numbers in the *A. nodosum* canopy of Clew Bay were found at low levels. *Dynamena pumila Linnaeus* also grow on other fucoid biotopes such as *Fucus*. Therefore, overharvesting of *A. nodosum* should it occur, would not represent a detrimental threat to these populations. The risk of altering hydroid density is further reduced as hand harvesting will be carefully managed and controlled to ensure no excess removal of the *A. nodosum* canopy.
- Control measures (if applicable): as described for *A. nodosum* above. For details on action limits, analytical procedures monitoring and corrective actions, see table 12(3d) and Appendix 5(C3d)).

Sponges (e.g. *Leucosolenia* sp. *Bowerbank, Halichondria panicea Pallas* & *Hymeniacidon perleve Montagu*)

- Risk of affecting site/species: Low risk of potential biological hazards in the form of alteration to density of Sponges (e.g., *Leucosolenia* sp. *Bowerbank, Halichondria panicea Pallas* and *Hymeniacidon perleve Montagu*) (risk rating=4). No physical or chemical hazards have been identified (see table 12(3e) and Appendix 5(C3e)).
- Explanation: *Halichondria panicea Pallas* and *Hymeniacidon perleve Montagu* are more widespread and occur in more deeper waters, occurring at low numbers in the *A. nodosum* canopy of Clew Bay (Kelly L. *et al.*, 2001). *Leucosolenia* sp. and Halichondria panicea are rarely found in upper or middle shores of Clew Bay where *A. nodosum* is found, while observed at low numbers increase in the lower zone (Kelly L. *et al.*, 2001). Likewise, *Hymeniacidon perleve* were found to be absent in the upper zone, at low levels in the middle zone while increasing into the lowers zone. While Boaden and Dring, (1980) identified changes in density of *Hymeniacidon* and *Halichondria* species due to harvest of *A. nodosum*, the harvest methodology involved was quite invasive and involved cutting between 10-15cm (4-6 inches). The predominance of these species in deeper waters will reduce the likelihood of impacts associated with potential overharvesting of *A. nodosum.*
- Control measures (if applicable): as described for *A. nodosum* above. For details on action limits, analytical procedures monitoring and corrective actions, see table 12(3e) and Appendix 5(C3e).

Sea squirts (e.g. *Ascidiella*)

- Risk of affecting site/species: Low risk of potential biological hazards in the form of alteration to density of Sea squirts (e.g. *Dendrodoa grossularia van Beneden* and *Ascidiella scabra O.F. Müller*; risk rating=2). No physical or chemical hazards have been identified (see table 12(3f) and Appendix 5(C3f)).
- Explanation: Kelly L. *et al.*, 2001, demonstrate that *Ascidiella* occur at low levels in the *A. nodosum* zone of Clew Bay. The probability of negatively impacting on these species is likely to be low, as hand harvesting will be sustainable.
- Control measures (if applicable): as described for *A. nodosum* above. For details on action limits, analytical procedures monitoring and corrective actions, see table 12(3f) and Appendix 5(C3f).

Other mobile species: (Phylum Arthropoda (Amphipods, isopods crabs, *Chironomida, Halacaridae, Ostracoda*), Phylum Platyhelminthes (e.g. *Turbellaria*), Phylum Annelida, Phylum Foraminifera, Phylum Nematoda)

- Risk of affecting site/species: Low risk of potential biological hazards in the form of alterations to the density of habitat important for mobile species (risk rating=4). No physical or chemical hazards have been identified (see table 12(3g) and Appendix 5(C3g)).
- Explanation: Kelly L. *et al.*, 2001 found no evidence that the mobile species listed above were affected by hand harvest activities. Low numbers of these species were found in the *A. nodosum* canopy of Clew Bay. This is in agreement with a recent survey in Clew Bay in which no mobile fauna were identified within test quadrants which were assessed (n=8, Appendix 1). As hand harvesting will be sustainable, there is a low risk of excess removal of *A. nodosum.* In turn, there is a low risk of potential negative effects on mobile species.
- Control measures (if applicable): as described for *A. nodosum* above. Also, measures are in place which ensure that any *Animalia* by-catch observed on the boat must be returned to the water. Nets used will also be appropriate with sufficient space to allow *Animalia* to leave. For details on action limits, analytical procedures monitoring and corrective actions, see table 12(3g) and Appendix 5(C3g).

3.3.6 Results of screening assessment & associated control measures, monitoring and corrective actions.

No	RISK ASSESSMENT SUMMARY (see Appendix 5 for further details)								CONTROL MEASURES (if applicable)	MONITORING				CORRECTIVE ACTIONS	
	Species/ Habitats	Distribution, extent & location	Compliance requirements: (in accordance with EU Dir. 92/43/EEC & NPWS)	Decision matrix						Action Limit / non-conformance	Analytical Procedure	By	Monitoring Schedule (Frequency)	Corrective Action	Verification
				Hazard (Bio,Chem,Phy)	Probability	Severity	Risk	Hazard level (L=Low, M=Med, H=High)							
1	**Permanent habitat area**	Encompasses all Annex I habitats in Clew Bay Complex SAC	Areas must be maintained at favourable conservation conditions to ensure stability of the permanent habitat area (Ref: Target 1 of Objective 1, NPWS, 2011A, page 12)	B	2	5	10	M	Training to ensure: • No removal of permanent habitat area (i.e. sand, shingle, stone). • No removal of *A. nodosum* holdfasts which may carry sand, shingle, stone.	• Non-conformance at in-take of raw material (i.e. presence of unacceptable levels of, shingle, stones, debris, or holdfasts).	• Visual inspection of harvested weed via Goods Received Notes (GRNs) and production logsheets • Inspection of GRNs and production logsheets	Resource Manager, production operators QC	Each batch of harvested seaweed. Quarterly audit	• Depending on the nature, source & extent of non-conformance, take the following steps: • Presence of sand, shingle/debris: -Removal by sand filter and decanter and clarifier. • Presence of rocks/stones: -reductions in weed price • A Non-Conformance Report will be filed and sent to management where deemed necessary (see Appendix 3 for Non-conformance Report Form (NCR). • Harvester undergoes re-training as required	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements
				C	1	3	3	L	• Routine maintenance of boat engines	Non-conformance during audit.	Regular Inspection of engine of harvest vessel Audit	Resource Manager	Ongoing basis		
				P	1	3	3	L	• Training to ensure good general waste disposal practices.	Non-conformance during audit.	Hygiene audit	Resource Manager	Ongoing basis		
2	**Seagrass, *Zostera* marina (and associated communities).**	**Large patches:** From southern section to the south of Inishlyre, N and E of Crovinish and SE of Inishgort. **Small patches:** Westport harbour between Green islands and Carricknamore **Dept:** 3-8m	Maintain natural extent and high quality of *Zostera* dominated communities (Ref: Targets 2-4 of Objective 1, NPWS, 2011A, pages 12, 13)	B	1	5	5	L	Harvest will not occur in these areas.	Unauthorized harvest in protected areas.	• Record harvest location and pick-up points on GRNs • Inspection of GRNs.	Resource Manager QC	Routinely during harvest periods. Quarterly audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Ensure that management instructions are adhered to. (b) Review communication system. (c)Harvester undergoes re-training as required	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.
3	**Maerl Dominated**	**Large patches:**	Maintain natural extent	B	1	5	5	L	As above for seagrass *(Table 10(2)).*						

	communities	From main navigation channel leading into Westport harbour. **Other areas:** E of Inishlyre and S of Inishraher. Channel E of Inishleague chanel leading to E of Inishgort lighthouse. Ilaanmore Harbour where current flow is strong e.g. between islands.	and high quality of Maerl dominated communities (Ref: Targets 2-4 of Objective 1, NPWS, 2011A, pages 12, 13)													
4	**Polychaetes & bivalves community complex** Distinguishing species: *Prionospio* sp., M. palmate, T.flexuosa, M. bidentata, A. alba	Widespread where soft sediment is present. Occurs Intertidally and subtidally (i.e. sandy mud areas) Differential distribution of species in the NW, Westport and Newport bay.	Maintain polychaete & bivalve community complex in Sandy mud areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14).	B	2	5	10	M	As below for *Table 10 (6) below* (i.e. *Tubificoides benedii* and *Pygospio elegans* community complex (Intertidal sandy mud areas).							
5	***Nephtys cirrosa* community** Associated communities: *Moerella donacina* & the amphipod *Bathyporeia guilliamsoniana*	Occurs on clean fine sand. SW boundary of the site. Out-reaches of Westport Bay to Inisheany	Maintain *Nephtys cirrosa* community in fine sand areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14).	B	2	5	10	M	A code of practice will be in place to ensure that harvesters do not attempt to navigate at low tide to rocky shorelines located beyond clean, fine sand areas in the south-west of the complex (see Appendix 4).	Unauthorized navigation at low tide to reach harvest sites located beyond clean, fine sand areas of the south-west.	• Record harvest location and pick-up points on GRNs • Inspection of GRNs. • Check Incident reports	Resource Manager QC	Routinely during harvest periods. Quarterly audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (b) Review communication system. (c) Harvester undergoes re-training as required	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.
6	***Tubificoides benedii* and *Pygospio elegans* community complex (Intertidal sandy mud areas)** Associated communities: T. benedii, P. elegans, Capitella sp., *Nematoda* sp., H. ulvae, C.volutator	All shores from Trawoughter strand (northwest) to White strand (south), Newport Bay Westport Bay Islands: Inishcottle, Inishbee and Clynish.	Maintain *Tubificoides benedii* and *Pygospio elegans* community complex in intertidal sandy mud areas (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13 and Target 2 of Objective 2: NPWS, 2011A, page 14).	B	2	5	10	M	A code of practice will be in place to ensure that harvesters do not attempt to navigate at low tide to rocky shorelines located beyond mudflat/sandflat areas, within which *Tubificoides benedii* and *Pygospio elegans* reside (see Appendix 4).	Unauthorized navigation at low tide to reach harvest sites located beyond mudflats or sandflats.	• Record harvest location and pick-up points on GRNs • Inspection of GRNs. • Check Incident reports	Resource Manager QC	Routinely during harvest periods. Quarterly audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (b) Review communication system. (c) Harvester undergoes re-training as required	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.
7	**Shingle (pebbles and gravel)** Associated communities: Talitrid amphipods	Throughout the region. Common on islands in particular and on the upper shore. Often occur behind fucoid dominated reef.	Maintenance of shingle habitats and species therein (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13).	B P	2 2	5 5	10 10	M M	Hand harvest techniques employed in shingle areas will ensure that *A. nodosum* is severed between 200-300mm (8-12 inches) above point of contact with underlying substrate (see Appendix 4).	Non-conformance during in-take of raw material (i.e. contamination with sand, shingle, stones, pebbles or holdfasts).	• Visual inspection of harvested weed via Goods Received Notes (GRNs) and production logsheets.	Resource Manager, production operators	Each batch of harvested seaweed.	Depending on the nature, source & extent of non-conformance, take the following steps: • Presence of rocks/stones: -reductions in weed price • A Non-conformance Report will be	Operations meeting/ Harvest Meeting.

											• Inspection of GRNs and production logsheets	QC	Quarterly audit	filed and sent to management where deemed necessary (see Appendix 3 for Non-conformance Report Form (NCR). Harvester undergoes re-training as required	
8	**Reef** *Associated communities* *A.nodosum, Fucus* sp., L.hyperborea, L. digitata, A. digitatum, M. senile, E. fucorum, M. fimbriata, P. canaliculata, F. spiralis, L. saccharina, S. polyschides, C. celata, H. panicea, A. lefevrei, P. saxicola **NOTE:** *A. nodosum and associated communities were assessed separately in, see Table 12 below.*,	Intertidal: Occurs as mixed substrata of pebbles and cobbles All coasts of the bay. Most islands. Sub tidal: Boulders and cobbles. Extensive in Western margin. Smaller patches: Newport Bay. Hard substrate at: 2m and 14m. Faunal dominated reef at 11 and 26m.	Maintenance of reef habitats and species therein (Ref: Target 5 of Objective 1, NPWS, 2011A, page 13).	B P	2 2	5 5	10 10	M M	Hand harvest techniques employed along rocky shores will ensure that *A. nodosum* is severed between 200-300mm (8-12 inches) above point of contact with underlying substrate (see Appendix 4).	Non-conformance during in-take of raw material (i.e. contamination with stones,, pebbles or holdfasts).	• Visual inspection of harvested weed via Goods Received Notes (GRNs) and production logsheets. • Inspection of GRNs and production logsheets	Resource Manager, production operators QC	Each batch of harvested seaweed. Quarterly audit	Depending on the nature, source & extent of non-conformance, take the following steps: • Presence of rocks/stones: -reductions in weed price • A Non-conformance Report will be filed and sent to management where deemed necessary (see Appendix 3 for Non-conformance Report Form (NCR). Harvester undergoes re-training as required	Operations meeting/ Harvest Meeting.
				P	2	5	10	M	Harvest collection boat will be fitted with a depth finding device to ensure that there is always sufficient water. Harvesters boats will be small. Training will be provided to advise the harvesters of the risks involved.	Non-compliance with boating code of practice.	• Inspection of boat practices by audit.	QC	Annual	Harvester undergoes re-training as required	
9	**Mudflats & sandflats not covered by seawater at low tide.** Associated communities: Not specified	Intertidally: Between mean low water mark and mean high water mark. Large expanses of sandflat on N shore from Trawoughter Strand to Roskeen pt. Shore of Westport Small areas: Newport Bay, Embayments on eastern shore. Small patches: Around islands	The permanent habitat area is stable or increasing, subject to natural processes (Ref: Target 1 of Objective 2, NPWS, 2011A, page 14).	P	2	5	10	M	As above for *Table 10 (6) above* (i.e. *Tubificoides benedii* and *Pygospio elegans* community complex (Intertidal sandy mud areas).						
10	**Harbour seals: General**	Occupy aquatic and terrestrial habitats in Clew Bay, including intertidal shorelines.	Human activities should occur at levels that do not adversely affect the harbour seal population at the site (Ref: Target 5 of Objective 3, NPWS, 2011A, page 16)	B	2	5	10	M	• There will be no activities which cause of Ariel disturbance, nor any deterioration of water quality or food source. • No activities at haul out sites during sensitive times of year. • Boats will be operated using methods which have least affects on harbour seal (See Appendix 4 for Code of Practise).	Unauthorized harvest at haul out sites at sensitive times of year (e.g. breeding, moulting and resting periods).	• Record harvest location and pick-up points on GRNs • Inspection of GRNs.	Resource Manager QC	Routinely during harvest periods. Quarterly audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b) Ensure that management instructions are being adhered to. (b) Review communication system. (c) Harvester undergoes re-training as required	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.

11	**Harbour seal: Affects on Species range due restriction by artificial barriers to site use**	Occupy aquatic and terrestrial habitats in Clew Bay, including intertidal shorelines.]Present during all aspects of life cycle incl. breeding (approx. May-July), moulting (approx. August-September) and phases of non-breeding foraging and rest].	Species range should not be restricted by artificial barriers to site use (Ref: Target 1 of Objective 3, NPWS, 2011A, page 15).	P	n/a	5	n/a	n/a	Hand harvesting activities will not include artificial barriers to site use.	n/a	n/a	n/a	n/a	n/a	n/a
12	**Harbour seal: Breeding sites.**	Vulnerable to disturbances between during May-July (annual breeding season).. Est. sites:: • North/north central: 15 • Central: 1 • South/South central: 5 • Total= 21	Breeding sites should be maintained in a natural condition (Ref: Target 2 of Objective 3, NPWS, 2011A, page 15)	B	2	5	10	M	• No harvest at sites between May-July. • Boats operated using methods which have least affects on harbour seals. • See BioAtlantis code of practise for protection of the harbour seal for details (Appendix 4)	Unauthorized harvest at breeding sites between May-July.	As above in Table 10 (10), i.e. harbour seals (general)..				
13	**Harbour seal: Moulting sites.**	Est. sites: • North/north central: 3 • Central: 2 • South/South central: 13 Total= 18	Moult-out sites should be maintained in a natural condition (Ref: Target 3 of Objective 3, NPWS, 2011A, page 15)	B	2	5	10	M	• No harvest at sites between Aug-Sept. • Boats operated using methods which have least affects on harbour seals. • See BioAtlantis code of practise for protection of the harbour seal for details (Appendix 4).	Unauthorized harvest at breeding sites between Aug-Sept.	As above in Table 10 (10), i.e. harbour seals (general).				
14	**Harbour seal: Resting sites.**	Est. sites: • North/north central: 4 • Central: 0 • South/South central: 6 Total= 10	Haul-out sites should be maintained in a natural condition (Ref: Target 4 of Objective 3, NPWS, 2011A, page 15)	B	2	5	10	M	• No harvest at sites between Oct-April. • Boats operated using methods which have least affects on harbour seals. • See BioAtlantis code of practise for protection of the harbour seal for details (Appendix 4).	Unauthorized harvest at breeding sites between Oct-April.	As above in Table 10 (10), i.e. harbour seals (general).				
15	**Perennial vegetation of stony banks**	Found at or above the mean high water spring tide mark on shingle beaches. Widespread in distribution both along the mainland and the islands of Clew Bay	To maintain the favourable conservation condition (ref: Objective 1, NPWS, 2011B, pg. 6).	B P	1 1	5 5	5 5	L L	Harvest will not occur in these areas. Loading and transport will be by means of existing piers and road networks.	Unauthorized transport in these areas.	As above for seagrass *(Table 10(2))*.				
16	**Atlantic salt meadows**	Occur along sheltered coasts. Flooded periodically by the sea, restricted to an area between mid neap tide level and high water spring tide level. Widespread distribution in Clew Bay, approx. 38.86ha.	To restore the favourable conservation condition (ref: Objective 2, NPWS, 2011B pg. 9)	B P	1 1	5 5	5 5	L L	Harvest will not occur in these areas. Loading and transport will be by means of existing piers and road networks	Unauthorized harvest in these areas.	As above for seagrass *(Table 10(2))*.				
17	**Sand dune habitats**	• Annual vegetation of drift lines: Distributed along	To restore the favourable	B P	1 1	5 5	10 10	L L	Harvest will not occur in these areas. Loading and transport will be by	Unauthorized transport in these areas.	As above for seagrass *(Table 10(2))*.				

		the high tidal mark of Clew Bay. • Embryonic shifting dunes: Distributed above the strandline. • Shifting dunes along the shoreline with *Ammophila arenaria*: Occurs in areas in which sand accumulates at a rapid rate.	conservation condition (ref: Objective 3, NPWS, 2011B, pg. 15).						means of existing piers and road networks		
18	**Otter**	Four out of five sites assessed from a total of 119.9km^2 area of river basin district in Clew Bay. Otters have access to most marine and freshwater areas within Clew Bay.	Species listed on Annex II of the EU Habitats Directive.	B	1	5	5	L	• There will be no activities which adversely affect the *A. nodosum* biotope and in turn, potential food supply of the otter. • All freshwater habitats are excluded from harvest activities • No activities in important areas of the Burrishoole catchment such as Lough Feeagh & Lough Furnace. No activity at the mouth of Lough Furnace. • See "BioAtlantis Code of Practise" for details (Appendix 4).	As below for Table12 (1a; *A. nodosum)*	
19	**Birds:** **Protected species:** Common Tern, Arctic Tern, Little Tern, Barnacle Goose, Great Northern Diver and Bartailed Godwit. **Unprotected species:** Red-breasted Merganser, Ringed Plover, Barnacle Geese (present on islands in winter), Great Northern Diver, Brent Goose, Shelduck, Wigeon, Teal, Mallard, Oystercatcher, Cormorant, Dunlin, Bar-tailed Godwit, Curlew, Redshank, Greenshank and Turnstone.	Wide-spread throughout Clew Bay	**Several Species listed on Annex I of E.U. Birds Directive.** **Clew Bay is not an SPA.** **No specifications published.** **Specifications provided by NPWS at Scoping Meeting (13/11/2013).** **See Appendix 6 for details.**	B	1	5	5	L	• There will be no activities which cause deterioration to the *A. nodosum* biotope and in turn, to food supply of relevant bird species. • Harvest at sites established by NPWS as important to important wintering and breeding species, will not be harvested at sensitive times of year. • See "BioAtlantis Code of Practise" for details (Appendix 4). See Appendix 6 for distribution, requirements and control measures for avian species of interest in Clew Bay.	Unauthorized harvest at breeding and wintering sites at sensitive times of year. See Appendix 6 for site-specific details along with the associated Appendix 4. See Appendix 5a(19) for summary of hazard scoring	As above in Table 10 (10), i.e. harbour seals (general).

Table 10 : Impact on protected marine habitats and species and coastal habitats in Clew Bay

No	RISK ASSESSMENT SUMMARY (see Appendix 5 for further details)								CONTROL MEASURES (if applicable)	MONITORING				CORRECTIVE ACTIONS	
	Species/ Habitats	Distribution, extent & location	Compliance requirements: (in accordance with EU Dir. 92/43/EEC & NPWS)	Decision matrix: Hazard (Bio,Chem,Phy)	Probability	Severity	Risk	Hazard level (L=Low, M=Med, H=High)		Action Limit / non-conformance	Analytical Procedure	By	Monitoring Schedule (Frequency)	Corrective Action	Verification
1	**Fish**	Burrishoole Catchment area of Clew Bay.	none	B	1	2	2	L	No harvest activities will take place in important areas of the catchment such as Lough Feeagh & Lough Furnace. There will be no activities which cause deterioration to quality of the environment of trout or salmon.	As below for *Table 12 (1a; A. nodosum)*					
2	**Lough Furnace habitat:** **Associated communities:** • Species on its exterior include: Common Reed (*Phragmites australis*), Common Club-rush (*Scirpuslacustris*), Small patches of Great Fen-sedge (*Cladium mariscus*) and Bottle Sedge (*Carex rostrata*). • **Other important flora & fauna:** two rare amphipods (*Lembos longipes* and *Leptocheirus pilosus*), *Neomysis integer*, *Jaera albifrons*, J.ischiosetosa and *J. nordmanni*, Irish species of tasselweed (*Ruppia maritima* and *R. cirrhosa*), eel, flounder, mullet, mallard nest and black-headed Gull.	Saline lake lagoon located at the north-eastern corner of Clew Bay.	None	B	1	4	4	L	No harvest activities will take place in Lough Furnace.	n/a	n/a	n/a	n/a	n/a	n/a
3	**Rosmurrevagh habitat:** Diverse range of species: • **Bog/fen type vegetation:** Bog Asphodel and Cuckooflower (*Cardamine pratensis*), Bog Mosses, sedges, Bog-myrtle (*Myrica gale*), Irish Heath, Soft Rush (*Juncus effusus*), Water Mint (*Mentha aquatica*) andYellow Iris (Iris pseudacorus). • **Coastal grassland species:** Common Ragwort (Senecio jacobaea), Daisy (Bellis perennis), Dandelion (Taraxacum officinale), Heath Wood-rush (Luzula multiflora), Ribwort Plantain (Plantago lanceolata) and Yarrow (Achillea millefolium). • **Saltmarsh vegetation** (5 m wide): Common Saltmarsh-grass (Puccinellia maritima), Common Scurvygrass, Thrift and 'turf fucoids' (diminutive forms of brown algae).	Habitats including the seashore, dunes, coastal grassland, saltmarsh, bog and fen.	None	B P	1 1	5 5	5 5	L L	No harvest activities will take place in the Rosmurrevagh area.	n/a	n/a	n/a	n/a	n/a	n/a

Table 11 : Impact on general species & habitats of Clew Bay

No	RISK ASSESSMENT SUMMARY (see Appendix 5 for further details)								CONTROL MEASURES (if applicable)	MONITORING				CORRECTIVE ACTIONS	
	Species within the *A. nodosum* biotope.	**Distribution, extent & location**	**Compliance requirements:** (in accordance with EU Dir. 92/43/EEC & NPWS)	**Decision matrix** Hazard (Bio,Chem,Phy)	Probability	Severity	Risk	Hazard level (L=Low, M=Med, H=High)		**Action Limit / non-conformance**	**Analytical Procedure**	**By**	**Monitoring Schedule (Frequency)**	**Corrective Action**	**Verification**
1a	***A. nodosum***	*A. nodosum* grows in abundance intertidally on sheltered, rocky shores along the coast at islands.	None	B	2	5	10	L	*A. nodosum* will be harvested in a sustainable manner (see Appendix 4 for Code of Practice). This prevents: • Severe reductions in canopy coverage, thus ensuring sufficient habitat for active feeding stages and reproductive purposes of *Animalia*. It also prevents *Fucus* sp. harvest, an additional copy habitat for understory species	Non-conformance at any stage of harvest or management.	1)Harvest activities will be assessed for compliance at all levels including: • Planning & Scheduling of harvest activities. • Hand-Harvesting training records. • Goods received notes (GRNs) 2)Monitoring the mass of *A. nodosum* resource harvested. 3)Monitoring levels of holdfast material	Resource Manager QC	Routinely during harvest periods & via: Quarterly audit Annual audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (c) Review communication system. (d) Harvester undergoes re-training as required.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.
1b	***Fucus vesiculosis Linnaeus* and *Fucus serratus Linneaus***	Occurs alongside *A. nodosum*.	None	B	2	3	6	L	As above for *A. nodosum.*						
2a	**Red algae:** *Polysiphonia lanosa (Linnaeus) Tandy*	An epiphyte of *A. nodosum*.	None	B	2	2	4	L	As above for *A. nodosum.*						
2b	**Red algae *Mastocarpus stellatus (Stackhouse) Guiry*, *Chondrus crispus Stackhouse* and *Corallinaceae***	Located beneath the *A. nodosum* canopy.	None	B	1	2	2	L	As above for *A. nodosum.*						
2c	**Ephemeral green algae** (e.g. *Cladophora rupestris (Linnaeus) Kützing*, *Ulva sp. Linnaeus* and *Enteromorpha* sp. Link)	Can occur at low densitites in *A. nodosum* biotope.	None	B	1	3	3	L	As above for *A. nodosum.*						
2d	**Other seaweed species:** *Lomentaria articulata* (Hudson) *Lyngbye* and *Membranoptera alata (Hudson) Stackhouse*)	Occur under tidal swept conditions.	None	B	1	2	2	L	As above for *A. nodosum.*						
3a	**Periwinkles** : (e.g. *Littorina obtusata Linnaeus* and *Littorina littorea Linnaeus*).;	Snails which graze some epiphytes from *A. nodosum* surface.	None	B	3	3	9	M	*A. nodosum* will be harvested in a sustainable manner (see Appendix 4 for Code of Practice). A	Non-conformance at any stage of harvest or	1)Harvest activities will be assessed for compliance at all levels including: • Hand-Harvesting training records.	Resource Manager QC	Routinely during harvest periods & via	Depending on the nature, source & extent of non-conformance, take the following steps:	Operations meeting/ Harvest Meeting.

									system is in place which ensures that: •Severe reductions in canopy coverage will not occur, thus ensuring sufficient habitat for active feeding stages and reproductive purposes of *Animalia* such as periwinkles. •*A. nodosum* mortality will not occur at levels which otherwise could lead to reductions in habitat for *Animalia*. •By-catch: all *Animalia* observed on boat post harvest will be returned to water. Teaching harvesters to avoid fronds with visible periwinkle egg masses.	management.	• Goods received notes (GRNs). 2)Monitoring: • Levels of holdfast. • Harvest technique at sites • Types of nets used		Quarterly audit Annual audit	(a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (c) Review communication system. (d) Harvester undergoes re-training as required.	Annual Review of compliance requirements.
3b	**Limpets**	Throughout the biotope.	None	B	3	3	9	M	*A. nodosum* will be harvested in a sustainable manner (see Appendix 4 for Code of Practice). A system is in place which ensures that: •Severe reductions in canopy coverage will not occur, thus ensuring sufficient habitat for *Animalia* such as limpets. •*A. nodosum* mortality will not occur at levels which otherwise could lead to reductions in habitat for *Animalia*. •By-catch: all *Animalia* observed on boat post harvest will be returned to water.	Non-conformance at any stage of harvest or management.	1)Harvest activities will be assessed for compliance at all levels including: • Hand-Harvesting training records. • Goods received notes (GRNs). 2)Monitoring: • Levels of holdfast. • Harvest technique at sites • Types of nets used	Resource Manager QC	Routinely during harvest periods & via Quarterly audit Annual audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (c) Review communication system. (d) Harvester undergoes re-training as required.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.
3c	**Barnacles**	Throughout the biotope.		B	3	2	6	L	As above for *A. nodosum*.						
3d	**Hydroid** (*Dynamena pumila Linnaeus*)	May be found on tips of *A. nodosum*.	None	B	3	2	6	L	As above for *A. nodosum*.						
3e	**Sponges** (e.g., *Leucosolenia* sp. *Bowerbank*, H*alichondria panicea Pallas* and *Hymeniacidon perleve Montagu*)	Can occur on steep surfaces and under boulders in areas of strong tidal currents.	None	B	2	2	4	L	As above for *A. nodosum*.						
3f	**Sea squirts** (e.g. *Ascidiella*)	Can occur at the	None	B	1	2	2	L	As above for *A. nodosum*.						

		lower shore												
3g	**Other mobile species:** (Phylum Arthropoda (Amphipods, isopods crabs, *Chironomida*, *Halacaridae*, *Ostracoda*), Phylum Platyhelminthes (e.g. *Turbellaria*), Phylum Annelida, Phylum Foraminifera, Phylum *Nematoda*)	Can occur amongt the seaweed.	None	B	2	2	4	L	•Net: sufficient space to allow mobile species leave. •By-catch: all *Animalia* observed on boat post harvest will be returned to water.	Non-conformance at any stage of harvest or management.	3)Harvest activities will be assessed for compliance at all levels including: • Hand-Harvesting training records. 4)Monitoring: • Harvest technique at sites • Types of nets used	Resource Manager QC	Routinely during harvest periods & via Quarterly audit Annual audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (c) Review communication system. (d) Harvester undergoes re-training as required.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.

Table 12 : Impact on the *Ascophyllum nodosum* Biotope and species therein

3.4 Ensuring continuous disturbance levels do not exceed an area of 15%.

Consultations between NPWS and BioAtlantis took place in September 2014. This provided clarity on obligations for ensuring that 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 damage 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 & Function. NPWS recommend that continuous disturbance of each community type should not exceed an approximate area of 15%. To measure the potential impact on structure and function in Clew Bay, BioAtlantis requested marine community type datasets for Clew Bay. The shapefile was provided by courtesy of NPWS in ESRI format (18/08/2014). Using AutoCAD software, engineering personnel at BioAtlantis calculated (a) the total area (m^2) in Clew Bay SAC of each marine community type and, (b) the area affected by harvest activities/annum (m^2 and percentage). A draft of Table 13 below was provided to NPWS (09/09/14) which contains a list of each marine community type 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. The BioAtlantis 'Code of Practice' for *A. nodosum* harvest activities in Clew Bay SAC has been updated to ensure that management work within these 15% limits (see Appendix 4). For details on action limits, analytical procedures, monitoring and corrective actions, see Table 16(1) and Appendix 5(d).

To adhere with the EU Commission, NPWS also require that the operations by BioAtlantis do not interact with other existing and planned activities, to levels which would increase interactions beyond the stated 15% limit. These activities include aquaculture, recreational use, other harvesting of seaweed or invertebrates, etc. BioAtlantis have assessed these potential interactions in detail in Section 3.6 of this document. A number of potential interactions were identified and mitigation measures have been developed to ensure that cumulative and in-combination effects do not occur. This ensures that BioAtlantis work within the 15% limit set by NPWS and in turn, comply with the EU Commission. A summary of the extent to which in combination effects potentially interact with marine community types, Annex I and II habitats and species, and their mitigation, is provided in Tables 14 & 15. For a full, in depth assessment of in-combination effects, please consult Appendix 7.

Marine habitat type (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%

Table 13: List of marine habitat types and the area affected by hand harvest activities

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.

3.5 Broad, holistic examination of the nature, extent and impact of hand harvesting.

3.5.1 Introduction

This section builds on findings from Section 3.3 (direct and indirect impacts), by providing holistic examination of the nature, extent and impact of hand harvesting in Clew Bay. This is required to examine the potential effects of hand harvesting in a broader context and if necessary, provide further mitigation where significant risks are identified. The scope of this examination includes:

- The spatial extent of harvesting techniques and activities:
  - Managing expansive and prolonged operations.
  - Managing personnel and exploitation levels.

- The potential interaction effects of seaweed harvesting:
  - Targeted removal of species
  - Non-targeted removal of species
  - Disturbance and displacement of species and habitats
  - Changes in community structure
  - Changes in hydrodynamics and water quality
  - Disturbance of marine fauna.
  - Coastal habitats

For details on action limits, analytical procedures, monitoring and corrective actions for each risk identified, please see Table 16 and Appendix 5(e).

3.5.2 The spatial extent of harvesting techniques and activities

(a) Management of expansive and prolonged operations

BioAtlantis will employ a site-specific management approach to managing harvest activitites in 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 seal and bird species, are not visited (see 'Code of Practice', Appendix 4). 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. For details on action limits, analytical procedures monitoring and corrective actions for risk associated with management or expansive and prolonged operations, please see Table 16(2) and Appendix 5(e1). All control measures have been included in the 'Code of Practice' (Appendix 4).

(b) Numbers of personnel and exploitation levels

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. 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 biomass will represent a relatively constant figure and will not be exacerbated due to significant levels of *A. nodosum* mortality due to partial or complete holdfast removal (see below for more details). For details on action limits, analytical procedures, monitoring and corrective actions for risk associated with numbers of personnel and exploitation levels, please see Table 16(3) and Appendix 5(e1). All control measures have been included in the 'Code of Practice' (Appendix 4).

3.5.3 The potential interaction effects of seaweed harvesting

(a) Targeted removal of species

See Section 3.3.5, "Impact on the *Ascophyllum nodosum* biotope and species therein", for assessment of potential impact of targeted removal of *A.* species. For details on action limits, analytical procedures, monitoring and corrective actions, please see Table 16(4) and Appendix 5(e2). All control measures have been included in the 'Code of Practice' (Appendix 4).

(b) Non-targeted removal of species

Species with potential to be inadvertently co-removed during *A. nodosum* harvesting may include *Fucus* sp., periwinkles, limpets, Amphipods and isopods. The potential impact of hand harvesting on these species is outlined below. For details on action limits, analytical

procedures, monitoring and corrective actions, please see Table 16(5) and Appendix 5(e2). All control measures have been included in the 'Code of Practice' (Appendix 4).

- ***Impact on Fucus***
  BioAtlantis Ltd. produce pure extracts of *A. nodosum* and as such, consider *Fucus* as a contaminant material. In addition, by-catch of *Fucus* will not be accepted as this could also lead to unnecessarily increases in loss of fucoid canopy. 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. In some cases, *Fucus* can be observed to be closely interspersed alongside *A. nodosum* and in rare cases can even grow directly on *A. nodosum* plants. Harvesters working for BioAtlantis will be provided with sufficient training to ensure avoidance of *Fucus*. The traditional sickle/knife hand harvest method at low tide allows for necessary sufficient oversight over cutting. BioAtlantis consider a range of levels of *Fucus* exceeding 1% as being unacceptable (see 'Code of Practice', Appendix 4).

- ***Impact on Periwinkles and Limpets***
  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). To avoid alterations in numbers of species within the biotope in general, BioAtlantis will take a strict approach which forbids cutting below 8 inches and through continuous training, will require harvesters to leave 8-12 inches of the crop behind.

  Littorina 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, *Littorina 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). The technique employed by BioAtlantis will ensure that harvest takes place at low tide when periwinkles are more likely to be dormant or covered by *A. nodosum* fronds. Harvest will not take place during the feeding stage at high tide when periwinkles are out of their shells. Leaving 200-300mm (8-12 inches) of *A. nodosum* behind during harvest and strictly forbidding cutting below 200mm (8 inches), will ensure maintenance of the canopy (see Appendix 4, 'Code of Practice' and Appendix 3, GRN). Holdfast removal will not be accepted. Since most periwinkles will reside low down within the canopy at low tide, the chances of their inadvertent by-catch is also reduced.

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 vesiculosis* and *Fucus* serratus. BioAtlantis will not harvest either of these species, thus ensuring that this portion of the perwinkle and limpet habitat is unaffected. BioAtlantis do not consider *Fucus* by-catch to be acceptable and will limit by-catch at <1%. This will be achieved through inspections by the Resource Manager (See Appendix 4, 'Code of Practice' and Appendix 3, GRN).

In terms of reproductive requirements, *L. obtusata* lays white, oval eggs masses containing a large number of eggs, on *Ascophyllum*, *Fucus vesiculosis* and *F. serratus*. The eggs masses are clearly visible to the naked eye. Eggs may sometimes be laid on the surface of rocks. As part of the training requirements and to mitigate against risks of reducing *L. obtusata* numbers, harvesters will learn how to identify and avoid *A. nodosum* plants or fronds which contain substantial 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 vesiculosis* 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. As a mitigation measure, 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').

- ***Impact on Amphipods and isopods.***
  Most amphipods and isopods are relatively inactive at low tide. Harvest at low tide therefore, avoids potential by-catch of species which would otherwise be active in the intertidal zone during high tide. The likelihood of displacement will be low and harvesters will be trained and have full view and control of their activities. The nets in use will also provide sufficient space for Amphipods and Isopods to leave the nets, thus reducing the potential for trapping. As with other species, any by-catch observed on the boat will be collected and returned to the water (See Appendix 4, 'Code of Practise').

(c) Disturbance and displacement of species and habitats

Reef and understory *Animalia* and *Fucus* sp. have been identified as being potentially at risk of disturbance and displacement. This is outlined below. For details on action limits, analytical procedures, monitoring and corrective actions, please see Table 16(6&7) and Appendix 5(e3). All control measures have been included in the 'Code of Practice' (Appendix 4).

- ***Reef***

  A. nodosum can grow on almost any solid substrate provided that the coast is very sheltered. 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 their 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). This is particularly relevant for Clew Bay and must be mitigated against.

  The risk of disturbing or displacing substrate during hand harvest with a sickle or knife in Clew Bay will be minimal. The hand cutting method employed by BioAtlantis is more appropriate for the small, stony, friable, substrate of the drumlin islands of Clew Bay. In this process, harvesters operate at low tide and therefore, have full view of the cutting process, allowing them to take care not to disturb the substrate. 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. 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.

- ***Understory Animalia and Fucus sp.***

  As described in (b) above, the potential for disturbance and displacement of understory *Animalia* such as periwinkles and limpets is reduced, as hand harvest will take place at low tide, when species are less active. Mitigation measures are also in place to ensure that by-catch is returned to the water. Algae species such as *Fucus* are also unlikely to be disturbed or displaced, as harvesters will be trained to avoid non-*A. nodosum* canopies.

(d) 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 and/or density 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, preferable between 5-10 years. An initial pilot study has also already been performed as can be found in Appendix 1 to this application. For further details on the experimental design, see Section 1.3.3 (d).

This approach will allow scientists and engineers at BioAtlantis to continually validate and improve the methodology 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 timeframe assessed by Kelly *et al.,* 2001. This will be important in ensuring that conservation objectives are met continually into the future. For details on action limits, analytical procedures, monitoring and corrective actions associated with potential changes in community structure, please see Table 16(8) and Appendix 5(e4). All control measures have been included in the 'Code of Practice' (Appendix 4).

(e) Changes in 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. Given the negative effects that polluted water can have on *A. nodosum* performance, epiphyte infestation, colonisation and competition by green algae (Hurd, CL *et al.,* 2014), 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. As a mitigation measure, BioAtlantis will not harvest within 50m of sewage outfalls or other sources of pollution (see Appendix 4, 'Code of Practice'). This will ensure that stressed *A. nodosum* growth is not exacerbated further by harvest activities.

A. nodosum is adapted to growing in highly sheltered environs and as such, has difficulty remaining attached to hard substrate in less sheltered waters. Therefore, *A. nodosum* is unlikely to exert a substantial influence on hydrodynamics. Harvest activities will not

reduce height of *A. nodosum* below 200mm (8 inches) and will be trained to cut between 200-300mm (8-12 inches). Therefore, dramatic changes in biomass levels within the intertidal zone are unlikely to occur. For details on action limits, analytical procedures, monitoring and corrective actions associated with potential changes in hydrodynamics, please see Table 16(9) and Appendix 5(e5). All control measures have been included in the 'Code of Practice' (Appendix 4).

(f) Potential disturbance of marine fauna.

The technique employed during *A. nodosum* harvest, requires cutting at heights well above the holdfast, thus avoiding any fauna present at the base of the canopy. Harvest at low tide also prevents any immediate effects on marine fauna which are exclusively active around the area during high tide. By ensuring maintenance of sufficient canopy, marine fauna can still utilize the *A. nodosum* environment at high tide. 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 available biomass per site per annum will ensure that sufficient biotope coverage remains. For details on action limits, analytical procedures, monitoring and corrective actions associated with potential disturbance of marine fauna, please see Table 16(10) and Appendix 5(e6). All control measures have been included in the 'Code of Practice' (Appendix 4).

(g) Potential Interactions with coastal habitats:

- ***Introduction***

  As a 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 a closed system and organic matter will tend to transfer from the area into the wider marine environment. It should be noted that *A. nodosum* is very low in protein content and its contribution to nitrogen levels in the ecosystem are minimal. However, as a primary producer located close to the back shore, it is essential that the potential impact of any loss of *A. nodosum* on nearby costal habitats is examined. 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. This is described as below. For details on action limits, analytical procedures, monitoring and corrective actions associated with potential interactions with coastal habitats, please see Table 16(11) and Appendix 5(e7). All control measures have been included in the 'Code of Practice' (Appendix 4).

- ***Atlantic salt meadows (Glauco-Puccinellietalia maritimae)***
  Clew Bay is characterised by the presence of saltmarsh habitats extending 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* occur at the lower part of the intertidal belt (Valiela L, 1995). 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. *Ascophyllum 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 that determine this morphological expression may include: physical, abiotic factors such as temperature and light-intensity during winter and spring months and/or salinity (Brinkhuis BH, Jones RF, 1976 and references therein). Further research by O'Connor *et al.,* (2011) found no effects of macroalgal removal on 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).

  It should be noted that some species of cordgrass are considered as invasive species in Clew Bay and in other parts of Ireland. *S. anglica* species of cordgrass 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).

- ***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 the formation of coastal 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 *Ammophila* leaf length compared to other types of debris. This may be associated with the stimulation of growth due to a C:N ratio of 15:1 in algae (Maun, 2009). *A. nodosum* organic drift litter may therefore

contribute somewhat 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. Strict mitigation measures are in place to ensure that the potential for overharvesting which could have potential indirect impacts on sand dunes, is avoided (Appendix 4). 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.

3.6 Cumulative and in Combination Impacts

3.6.1 Introduction

Clew Bay is characterised by a wide range of marine activities including aquaculture, fishing, tourism and leisure interests, along with a number of other stakeholders. It is important therefore, to assess the potential for in combination effects to emerge as result of interactions between hand harvesting and other operations in the complex. This is particularly important in ensuring that continuous disturbance does not exceed an approximate area of 15% and that marine community types are not impacted. The current section provides an overview of potential interactions with existing and planned operations in Clew Bay. This is based on an in depth analysis in Appendix 7 of the extent of these operations in Clew Bay. Each significant risk has been mitigated against to ensure the limit of disturbance of 15% is not exceeded. Table 14 and 15 summarises the extent of such effects with respect to marine community types, Annex I and II species and habitats and the use of mitigation measures to ensure the limit of 15% is not exceeded. For details on action limits, analytical procedures, monitoring and corrective actions associated with potential in cumulative and in combination, please see Table 16 (sub-sections 12-16) and Appendix 5 (sections, f, g & h). All control measures have been included in the 'Code of Practice' (Appendix 4). Areas covered by the current assessment is summarised below.

- Existing Operations:
  - Planned, unlicensed, traditional and casual harvesting of seaweed.
  - Recreation & Tourism
  - Aquaculture.
  - Harvesting of invertebrates

- Planned Operations:
  - Recreation & Tourism
  - Other harvest activities:
  - Aquaculture:
  - Harvesting of Invertebrates

- Vector potential of harvest activities: the spread of invasive species, *Didemnum vexillum*.

- Conclusions of potential in-combination effects

3.6.2 Existing Operations: Potential in-combination effects and interactions

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. It is therefore essential to assess these factors to ensure that activities are within the 15% limit for the planned harvesting, as outlined in Section 1 of this document. To assess these effects, data was taken from online resources to measure the extent of existing activities (see Appendix 7). Tourism and recreation companies typically advertise their services online. Information relating to aquaculture activities is also available online. Information on other harvesting activities or harvesting of invertebrates was largely obtained through word-of-mouth or as 'common knowledge'. A detailed assessment of potential in combination effects is provided in Appendix 7 to this application. Risk and mitigation measures which were identified for each type of existing operation are described below:

(a) Unlicensed, traditional and casual harvesting of seaweed.

(i).Overview

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. Based on a 4 year regeneration cycle this is a maximum yield of 66,400 Tonnes per annum. Through use of data obtained from the on-site assessments (Appendix 1), 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.

As shown in Table 1 of this document, BioAtlantis aim to harvest ~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 available biomass from any one site per anum. In this context, the potential impact of other small-scale activities may be low. However, a recent survey has provided evidence that harvest activities are currently ongoing in Clew Bay (see Appendix 1). Moreover, the methods used are generally quite severe and not in line with best practice. 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 undertake hand harvest activities in the region. In such an event, BioAtlantis will commit to ensuring that all activities under its control are monitored and recorded with full traceability. This will include a non-conformance reporting system and strict corrective actions. Management systems such as these represent the only practical means of guaranteeing that there are no significant risks either direct, indirect, isolated, interactive, cumulative or short term or long-term on this SAC site. As described in this assessment, the implementation of the BioAtlantis plan to hand harvest *A. nodosum* in Clew Bay will ensure that there are no significant effects on the extent, biodiversity or species richness at this site.

(ii). Preventing in-combination effects with current hand harvesting activities:

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. However, once the license is issued to BioAtlantis, the activities of Arramara and others will cease. 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 have been included in the Code of Practice for *A. nodosum* harvest activities in Clew Bay SAC (see Appendix 4):

- **Management obligations:** 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 any incident of such activities. Depending on the severity, these issues will be reported to the Department of the Environment. This will be decided on a case by case basis. 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. In terms of traditional or casual harvesting, BioAtlantis will permit occasional 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.
- **"Seaweed harvesting discovery days":** BioAtlantis will not harvest beyond Rossmurvagh, thus avoiding much of the Mulranny area. This avoids in combination effects with excursions in the area.
- **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 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.

- **Traditional and casual harvesting:**
  In terms of traditional harvesting activities, BioAtlantis aim to utilize and improve the existing system and employ those with experience in the traditional hand cutting methodology. BioAtlantis will employ responsible, traditional hand harvesters who will work exclusively within the BioAtlantis system. This will ensure that traditional hand harvest activities are incorporated seamlessly into a fully licensed system, thus protecting traditional methods, the harvesters themselves and the environment, in tandem. BioAtlantis aim to get the best from the traditional approach but provide improvements which ensure better working conditions and compliance with the SAC objectives. As stated above, occasional low scale removal of <0.5 tonnes will be permitted for personal use. This will be reviewed in the case of abuse. Companies requiring >0.5 tonnes per annum, 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.

(b) Recreation & Tourism

There are >18 companies specializing in watersports-related activities in Clew Bay. Activities take place throughout the complex. There are also several important bases present. In most cases, the potential risks associated with such activities are deemed insignificant (See Appendix 7). However, potential risks have been identified which include potential impacts on Annex II species and potential for increased anthropogenic disturbances at certain sites along the intertidal zone. Risks identified are described below. Mitigation measures are also indicated and are included in the Code of Practice for hand harvest activities (see Appendix 4):

- **Risk 1 (Annex II species & 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. This must be mitigated against.
  - Mitigation measure: hand harvest activities will not take place at harbour seal and bird sites at sensitive times of the year, thus preventing any in combination effects from occurring.

- **Risk 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, localized reductions in seaweed cover (http://www.theadventureislands.com/images/thingsToDoInWestport/Dinghy%20Sailing/Sailing-Rosmoney-13.jpg). 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 (see Appendix 4, 'Code of Practice' and below).
  - Mitigation measures: 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.

- **Risk 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 (see Appendix 4, 'Code of Practice' and below).
  - Mitigation measures: Harvest will only occur on Collanmore between Sept-April. This will prevent in combination effects such as exacerbation of anthropogenic disturbance which may occur during peak tourist season. Also, hand harvesters will not work within 50m of bases where equipment or vessels are manually introduced in the water, thus preventing further anthropogenic disturbance.

(c) Aquaculture and fisheries activities.

There are several companies specializing in Aquaculture in Clew Bay. Activities are diverse and include shelfish 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. However, there is one potential exception with a licence to culture abalone which may have potential to impact on harbour seals (Marine Institute, 2014). Hand harvesting of *A. nodosum* would require mitigation to prevent in combination effects. 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 Practise (Appendix 4) which work to ensure such risks are mitigated against:

- Harbour seals: harvest will not take place at sites relevant to harbour seals during sensitive times of year (breeding, moulting, resting). This prevents in combination effects from occurring.
- Mudflats and Sandflats: 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* (See Appendix 4).
- Fishing and Angling: harvesters will respect angler's space and not impact on requirements of fisheries in the Complex.

(d) Harvesting of invertebrates

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: Crab Edible, Lobster European, Crab Velvet, Mussel Blue, Oyster Pacific, Shrimp Palaemonid nei, Periwinkle Common. 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):

- **Risk 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 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. These are described below and listed in Appendix 4:

- Mitigation measures:
  1. Harvest of *A. nodosum*: Harvesters will be taught to leave between 8-12 inches of the crop behind. Cutting below 8 inches will be forbidden and could lead to disciplinary procedures. This standard will be monitored by the Resource Manager. This approach:
     - Avoids extensive removal of *A. nodosum* canopy coverage and damage to the ecosystem and
     - Avoids interactions with or by-catch of dormant or resting periwinkles positioned at the base of the *A. nodosum* canopy and
     - Ensures that developing free-living forms of *L. Littorina* are able to settle and establish within intact canopies.
  2. *L. obtusata* eggs: Harvesters must work to avoid *A. nodosum* plants which contain visible *L. obtusata* egg masses. This is important to prevent harvest of viable eggs, thereby promoting maintenance of population size.
  3. Do not harvest *Fucus*: *Fucus* content of harvested *A. nodosum* will be limited to <1%, thus preventing removal of an additional canopy source which supports periwinkles, their egg masses and other species.
  4. By-catch checks: Inadvertent co-removal of periwinkles identified as by-catch on the collection vessel will be collected and returned to the water.

- **Risk 2: 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.

  - Mitigation measures: A code of practice is in place to ensure environmentally safe navigation when operating mudflats and sandflat areas. This will prevent any impact on intertidal sedimentary communities (See Appendix 4).

- **Risk 3: 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.

  - Mitigation measures (also listed in Appendix 4):
    1. By-catch: A code of practice is in place to ensure that 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.

2. Inadvertent co-removal of *Animalia* identified on the collection vessel must be collected and returned to the water.

3.6.3 Planned Operations: Potential in-combination effects and interactions

The potential in combination effects of planned operations in Clew Bay and hand harvesting of *A. nodosum* have been assessed (see Appendix 7). The planned operations have been identified are decribed below. For details on action limits, analytical procedures, monitoring and corrective actions associated with potential in cumulative and in combination, please see Table 16 (sub-sections 12-16) and Appendix 5(sections, f, g & h). All control measures have been included in the 'Code of Practice' (Appendix 4).

(a) Harvest activities:

No planned operations identified.

(b) Recreation & Tourism

- **Risk 1: increased anthropogenic disturbances**

  Westport Towns and Environs Development Plan 2010-2016 targets Roman Island for considerable development in terms of marine-based activities and tourism (ref: 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 (ref: Hynes P, 2014), thus raising the potential for interaction between hand harvesting and increased tourism-related activities at Westport Quay (e.g. increased anthropogenic disturbances).

  - Mitigation:
    1. 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 tourist season.
    2. 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 which could reduce seaweed cover.

(c) Aquaculture and fisheries activities:

Hand harvest activities may exacerbate existing effects attributed to licensed aquaculture activities, e.g. disturbance at sites relevant to harbour seals. Overall the risk of such interactions is considered low (Marine Institute, 2014). However, the Marine Institute cannot rule out potential effects of aquaculture on seal behaviour at Inishcorky and potentially neighbouring site: Inishdeashmore, Inishdeasbeag, unnamed neighbouring island of Inishdeasbeag and Inishnacross (pg. 78, Marine Institute, 2014). The licence application for Inishcorky island is for abalone culture.

- Mitigation: Seasonal avoidance of sensitive harbour seal sites must be adhered to for all haul out sites, including Inishcorky. This will ensure that harbour seals are unaffected (Code of Practice, appendix 4).

(d) Harvesting of Invertebrates

No planned operations identified.

3.6.4 Vector potential of harvest activities in the spread of invasive species.

To ensure that harvest activities to not lead to the spread of *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.

3.6.5 Conclusions of potential in-combination effects assessment

Table 14 and 15 below summarise the type and number of potential in-combination effects which could arise through hand harvesting *A. nodosum*. As indicated, each type of potential interaction has been mitigated against in order to ensure that such interactions will not occur. On this basis, we conclude that areas of reef and shingle affected by harvest activities, will remain unchanged and will not exceed 15% required by NPWS. Risks and mitigation measures are described in the sections above and were initially identified as outlined in Appendix 7. Mitigation measures have been incorporated in the BioAtlantis "Code of Practice" (see Appendix 4). For details on action limits, analytical procedures, monitoring and corrective actions associated with potential in cumulative and in combination, please see Table 16 (sub-sections 12-16) and Appendix 5(sections, f, g & h).

3.6.6 Holistic examination, cumulative & in-combination effects and continuous disturbance levels (<15%): control measures, monitoring & corrective actions.

Tables 14 and 15 summarise the potential in combination and cumulative effects of harvesting on marine community types, Annex I and II species & habitats in Clew Bay. The numbers of operations impacting on each area are indicated, as previously determined in the analysis in Appendix 7. The use of mitigation to ensure that areas continually affected by harvest does not exceed 15%, is indicated in the right-most column. "*No. of risks", refers to the number of different risks identified in Appendix 7. The figures of 0% are assigned for areas where *A. nodosum* does not grow or areas specifically avoided due to their sensitive nature.

Marine Community Type (Clew Bay SAC)	**Total Area in Clew Bay SAC (m^2)**	**Area affected by harvest activities/annum**		**Potential in-combination and cumulative effects identified**				**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		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	26,870,147	1,331,699	4.9%					
Maerl Dominated community	2,878,607	0	0.0%	0	0	0	0	n/a
Fine Sands Dominated by *Nephtys cirrosa* community	2,950,308	0	0.0%	0	0	0	0	n/a
Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex	7,817,100	0	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	0.0%	• Recreation & Tourism • Existing harvest activities • Existing aquaculture • Invertebrate harvesting	0 0 1 0	0	0	Yes. See Appendix 4, "Code of Practice".

Table 14: Potential in-combination & cumulative effects with marine community types

Species	Potential in-combination and cumulative 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.

Table 15: Potential in-combination and cumulative effects with Annex II Species & birds.

No	RISK ASSESSMENT SUMMARY (see Appendix 5 for further details)								CONTROL MEASURES (if applicable)	MONITORING				CORRECTIVE ACTIONS	
	Species/ Habitats/ parameter	Distribution, extent & location	Compliance requirements: (in accordance with EU Dir. 92/43/EEC & NPWS)	Decision matrix						Action Limit / non-conformance	Analytical Procedure	By	Monitoring Schedule (Frequency)	Corrective Action	Verification
				Hazard (Bio,Chem,Phy)	Probability	Severity	Risk	Hazard level (L=Low, M=Med, H=High)							
1	Continuous disturbance limit for marine community types (<15%)	• Shingle • Reef • *Zostera* Community • Maerl Dominated community • Fine Sands • Intertidal sandymud	Continuous disturbance of each community type should not exceed an approximate area of 15% (NPWS 2011A)	B/P B/P B/P B/P B/P B/P	2 2 1 1 1 1	5 5 5 5 5 5	10 10 5 5 5 5	M M L L L L	Hand harvesting can only take place within the licence area to ensure that the marine community type areas affected by harvest activities/ annum does not exceed 15%. 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	•Any activities taking place outside the licensed area.	• Record harvest location and pick-up points on GRNs • Inspection of GRNs.	Resource Manager QC	Quarterly audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management are aware of the non-conformance. (c) Review communication system.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements
2	Management of expansive and prolonged operations	Entire SAC	Protection of Clew Bay SAC	B	2	5	10	M	• Activities are planned in advance. • Site-specific management approach: Harvest locations, pick-up points, quantities, quality measures & personnel involved are recorded on a daily basis. See "Code of Practise" for details (Appendix 4).	•Any unplanned activities taking place without approval by BioAtlantis. •Any activity at inappropriate sites. •GRNs not been filled out correctly	• Record harvest location and pick-up points on GRNs • Inspection of GRNs, cross checking the appropriateness of locations.	Resource Manager QC	Quarterly audit Annual audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (c) Review communication system. (d) Harvester undergoes re-training as required	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements
3	Number of personnel and exploitation levels	Entire SAC	Protection of Clew Bay SAC	B	2	5	10	M	• Activities are planned in advance. • Site-specific management approach: Harvest locations, pick-up points, quantities, quality measures & personnel involved are recorded on a daily basis. See "Code of Practise" for details (Appendix 4).	•Any unplanned activities taking place without approval by BioAtlantis. •Any activity at inappropriate sites. •Too many people on-site. •Excessive harvest levels •GRNs not been filled out correctly	• Record harvest location and pick-up points on GRNs • Inspection of GRNs, cross checking the appropriateness of locations.	Resource Manager QC	Quarterly audit Annual audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements

														(c) Review communication system. (d) Harvester undergoes re-training as required	
4	Targeted removal of species (*A. nodosum*)	Intertidal zone	Protection of Clew Bay SAC	B	2	5	10	M	As per table 12 (1a) in Section3.3.6 above.						
5	Non-Targeted removal of species (e.g. *Fucus*, periwinkles, limpets, amphipods, isopods)	Intertidal zone	Protection of Clew Bay SAC	B P	3 3	3 3	9 9	M M	*A. nodosum* will be harvested in a sustainable manner (see Appendix 4 for Code of Practice). A system is in place which ensures that: •Harvest of *Fucus* sp. is not accepted. •Severe reductions in canopy coverage will not occur, thus ensuring sufficient habitat for active feeding stages and reproductive purposes of *Animalia* such as periwinkles. •*A. nodosum* mortality will not occur at levels which otherwise could lead to reductions in habitat for *Animalia*. •Net: sufficient space to allow mobile species leave. •By-catch: all *Animalia* observed on boat post harvest will be returned to water.	Non-conformance at any stage of harvest or management.	1) Harvest activities will be assessed for compliance at all levels including: • Hand-Harvesting training records. • Goods received notes (GRNs). 2) Monitoring: • Mass of harvest. • Presence of *Fucus* sp. • Presence of holdfast. • Harvest technique at sites • Types of nets used	Resource Manager QC	Routinely during harvest periods & via quarterly audit Annual audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (c) Review communication system. (d) Harvester undergoes re-training as required.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.
6	Disturbance and displacement of species and habitats: Reef	Intertidal zone	Protection of Clew Bay SAC	B P	2 2	5 5	10 10	M M	*As per Table 12 (1a, Ascophyllum nodosum)*						
7	Disturbance and displacement of species and habitats: Amphipods and isopods	Intertidal zone	Protection of Clew Bay SAC	B P	3 3	3 3	9 9	M M	*As per 5 above*						
8	Changes in community structure (long term impacts in *A. nodosum* community structure as a whole)	Intertidal zone	Protection of Clew Bay SAC	B	2	5	10	M	The Code of Practice (Appendix 4) requires that BioAtlantis assess the impact of *A. nodosum* harvesting over the life-time of the licence. Key features: • Measurement of rates of re-growth of A. nodosum and biodiversity.Experimental site: non-harvested Vs. harvested areas comparison. • Parameters measured: ➢ *A. nodosum* biomass, *Fucus* plants, *Animalia*. • Species assessed: periwinkles, limpets, barnacles, red algae, ephemeral green algae. • Assessments performed on an annually.	Annual assessment not being assessed according to plan.	• Assessment of annual scientific report, datasets and statistical analysis for quality and completeness. • Assessment of validity of any deviations from experimental design or measurements.	Scientific personnel	Annually	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that instructions by qualified scientific personnel, statisticians and other personnel are being adhered to.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.

9	Changes in hydrodynamics and water quality (exacerbation of impacts of pollution and reduction in water quality; alterations to hydrodynamics)	Entire SAC	Protection of Clew Bay SAC	B	1	5	5	L	• Hand harvest techniques employed along rocky shores will ensure that *A. nodosum* is severed between 200-300mm (8-12 inches) above point of contact with underlying substrate and that no more than 20% of the total available biomass from a site is harvested per annum. (see Appendix 4). • Harvest cannot occur within 50m of sewage outfalls.	• *A. nodosum* harvest levels exceed agreed levels. • Harvesting in areas within 50m of sewage outfalls.	• Record harvest location and pick-up points on GRNs • Inspection of GRNs.	Resource Manager QC	Quarterly audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (c) Review communication system. (d) Harvester undergoes re-training as required	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.
10	Potential disturbance of marine fauna	Intertidal zone	Protection of Clew Bay SAC	B	1	3	3	L	• The code or practice (Appendix 4) requires: ➢ Harvest at low tide ➢ Harvest sustainably ➢ Use of suitable nets ➢ Return by-catch	• Harvest is not being performed sustainably according to the code of practice.	• Assess GRNs • Assess training records • Assess practices on-site	QC	Quarterly audit Annual audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (c) Review communication system. (d) Harvester undergoes re-training as required.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements
11	Potential interactions with coastal habitats	• Atlantic salt meadows • Sane dunes	Protection of coastal habitats	B	1	5	5	L	According to the Code of Practise (Appendix 4): • Harvest cannot take place at the fringes of Atlantic Salt Meadows. • Overharvesting cannot occur at levels which would reduce organic drift to levels which could impact on sand dune formation and other habitats.	• Harvest is not being performed sustainably according to the code of practice.	• Record harvest location and pick-up points on GRNs • Inspection of GRNs. • Assess practices on-site	Resource Manager QC	Quarterly audit Annual audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (c) Review communication system. (d) Harvester undergoes re-training as required.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements
12	In combination effects with other harvesting activities (e.g. Arramara and others companies, traditional or casual harvesting, small-scale harvesting for personal use, seaweed excursions)	• Entire SAC	Protection of Clew Bay SAC	B	2	5	10	M	• Record any incident of large-scale unlicensed harvesting. • Approach any commercial user having small requirements of >0.5 tonnes per annum (e.g. hotels, health Spas), and assess potential for in-combination effects. • Do not harvest in Mulranny area where excursions take place	• Quantities being removed exceed 0.5 tonnes. • Other unlicensed companies continue their activities.	• Incidents are recorded on the Incident report Form (Appendix 3). This form is brought to the attention of BioAtlantis Management.	Resource Manager QC	Quarterly audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Inform Department of the Environment	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements
13	In combination effects with Recreation and Tourism activities (impacts on harbour seal and bird sites, anthropogenic disturbance)	• Sensitive harbour seal and birds sites • Intertidal zone	Protection of Clew Bay SAC, in particular harbour seals and protected bird species.	B P	2 2	5 5	10 10	M M	The Code of Practice (Appendix 4) requires: • Seasonal avoidance of sensitive harbour seal and bird sites • 50m avoidance of bases where equipment or vessels are manually introduced into the water • Seasonal avoidance of Collanmore island, Roman Island and Westport harbour at peak tourist season (May-Aug)	Unauthorized harvest at protected sites at sensitive times of year (e.g. breeding, moulting and resting periods). Unauthorized harvest at Collanmore, Roman island and	• Record harvest location and pick-up points on GRNs • Inspection of GRNs.	Resource Manager QC	Quarterly audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b) Ensure that management instructions are being adhered to. (b) Review communication system. (c) Harvester undergoes re-training as	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.

									Westport harbour				required.	
14	In combination effects with aquaculture activities (impacts on harbour seal and bird sites, mudflats and sandflats)	• Sensitive harbour seal and birds sites • Mudflats and sandflats	Protection of Clew Bay SAC, in particular harbour seals and protected bird species and mudflats and sandflats.	B	2	5	10	M	The Code of Practice (Appendix 4) requires: • Seasonal avoidance of sensitive harbour seal and bird sites • That harvesters do not attempt to navigate at low tide to rocky shorelines located beyond mudflat/sandflat areas, within which *Tubificoides benedii* and *Pygospio elegans* reside (see Appendix 4).	Unauthorized harvest at protected sites at sensitive times of year (e.g. breeding, moulting and resting periods). Unauthorized navigation at low tide to reach harvest sites located beyond mudflats and sandflats.	• Record harvest location and pick-up points on GRNs • Inspection of GRNs. • Incident report forms	Resource Manager QC	Quarterly audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b) Ensure that management instructions are being adhered to. (b) Review communication system. (c) Harvester undergoes re-training as required.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.
15	In combination effects with harvesting of invertebrates (periwinkles, cockles, other invertebrates)	Intertidal zone and mudflats and sandflats	Protection of Clew Bay SAC	B	2	5	10	M	The Code of Practice (Appendix 4) requires: • Sustainable harvesting to ensure maintenance of sufficient canopy coverage for periwinkles. • Avoidance of frond with visible periwinkle eggs masses • Avoidance of *Fucus*, another habitats for periwinkles. • Environmentally safe navigation when operating mudflats and sandflat areas. • Use of appropriately sized nets which allow for *Animalia* to escape. • Return of inadvertent by-catch	Harvest is not being performed sustainably according to the code of practice. Unauthorized navigation at low tide to reach harvest sites located beyond mudflats and sandflats. Use of inappropriate nets.	• Record harvest location and pick-up points on GRNs • Inspection of GRNs. • Inspection of training records. • Incident report forms • On-site inspections	Resource Manager QC	Quarterly audit Annual audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b) Ensure that management instructions are being adhered to. (b) Review communication system. (c) Harvester undergoes re-training as required.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.
16	Invasive species (spread of *Didemnum vexillum*)	• Entire SAC	Protection of Clew Bay SAC	B	1	5	5	L	The Code of Practice (Appendix 4) requires: • 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.	Collection vessel not being painted. Harvesters not adhering to cleaning procedures when leaving Clew Bay. Nets not being cleaned in production facilities	• Check records for annual treatment with anti-fouling paint. • Check cleaning records in production facilities	Resource Manager QC	Quarterly audit Annual audit	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance using Non-conformance Report Form (NCR, see Appendix 3). (b) Ensure that management instructions are being adhered to. (b) Review communication system. (c) Harvester undergoes re-training as required.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.

Table 16 : Broad examination of impacts of harvesting, potential in combination effects and continuous disturnance

3.7. Conclusions of Risk Assessment

The risk assessment described in Section 3 of this document was undertaken by staff at BioAtlantis in order to identify risks which would affect qualifying interests in the SAC. This assessment had a strong scientific basis and involved the undertaking of detailed hazard risk assessments and decision-making based on current best practice and knowledge, incorporating findings emerging from previous impact assessments in Clew Bay and the peer-reviewed literature. This allowed for the development of management system with appropriate control measures, monitoring and corrective actions for potential hazards, thus ensuring no impact on qualifying interests in the SAC.

Following the initial assessment by BioAtlantis staff, a screening assessment was subsequently undertaken by Ecofact Environmental Consultants Ltd, in accordance with Article 6(3) of the Habitats Directive, to determine whether a full appropriate assessment was required for activities relating to sustainable hand harvesting of *A. nodosum* in Clew Bay SAC by BioAtlantis Ltd. 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. On submission of the application to the Department of the Environment in January 2014, additional information was requested by NPWS on 30th July 2014. This was required in order to address deficiencies in the NIS and areas not covered in the application. The NIS and application were re-worked and further mitigation measures developed as required.

The revised Screening Statement prepared by Ecofact Environmental Consultants Ltd to inform the Appropriate Assessment 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 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 the NIS. The NIS was prepared by Ecofact Environmental Consultants Ltd. and is enclosed as a separate stand alone document with this application. The NIS concludes, 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 Clew Bay SAC.

Section 4: Concluding remarks.

In this current application, BioAtlantis Ltd. has provided details of (a) the importance of the Clew Bay region as a source of *A. nodosum* raw material to the burgeoning Irish seaweed sector, (b) our assessment of the potential impact of hand harvesting of this resource on the Clew Bay environs and control measures therein, (c) our plan for harvesting and its likely effects on the local economy of Clew Bay and (d) our system for securing and managing the 'Code of Practice' for protecting the SAC. The enclosed NIS prepared by Ecofact Environmental Consultants Ltd. demonstrates *"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".* On receipt of a License to harvest *A. nodosum* in Clew Bay, BioAtlantis Ltd. are committed to ensuring that harvest activities will have no impacts which would affect the integrity of this SAC.

This application provides substantial details to the nature and safety of hand harvesting activities in Clew Bay under BioAtlantis Ltd. On gaining the approval by the Dept. of the Environment Heritage and Local Government, BioAtlantis will immediately proceed to the public consultation phase and proceed in working towards implementing the harvesting system as early as possible in 2015. BioAtlantis has already benefited from consultations with the NPWS, IFI and Clew Bay hand harvesters and we wish to extend our consultations further to ensure the smooth progression of the plan. The system is ready to be implemented with substantial mitigation measures positioned at the heart of this plan in order to ensure no impacts(s) on marine community types, Annex I and Annex II species and habitats within Clew Bay.

BioAtlantis, as a knowledge economy-based company, consider this an excellent opportunity in which to implement a sustainable mode of hand harvest of *A. nodosum* in Ireland. Moreover, a licence to harvest in Clew Bay in a sustainable manner will form a solid foundation in which to continue production of value-added extracts of *A. nodosum* in Ireland, for subsequent export to global markets.

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