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.
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BioAtlantis Ltd,
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Executive Summary

Contents:

(a) Overview:

BioAtlantis applied for a license to sustainably hand harvest *A. nodosum* in Clew Bay in 2014 (ref: FS006269). The application was updated to reflect issues raised by various stakeholders during public consultation. The revised application ensures the following:

- Traditional seaweed harvesting rights are fully respected, in line with clarification provided by the Attorney General in 2018 – this includes both appurtenant and Profit-à-Prendre rights to harvest seaweed. It is envisaged that a clause may be inserted into the license issued to reflect this.
- Provision of a sustainable income along the western seaboard for local hand harvesters and associated parties, consistent with other sectors of the economy and prices paid by competing companies. This can be in the form of a contractor relationship or direct employee of BioAtlantis.
- Provision of careers in the seaweed harvesting and processing industry that are attractive to young people, offering reliable and attractive primary or stand-alone incomes, rather than secondary incomes only.
- Genuine competition between plant biostimulant companies on the market, ensuring maximum return for harvesters.
- Hand harvesting will be undertaken in a sustainable, regenerative and traceable manner, and in line with traditional hand harvesting methods currently employed in the area.
- Employment of science-based seaweed resource management practices.
- Inclusion of a sustainability Code of Practice and mitigation measures to prevent impacts on Annex I and II marine and coastal habitats and species in the SAC, in line with national and European environmental legislation. This includes measures to protect harbour seals, otters, birds, and sensitive community types and habitats such as shingle, reef, seagrass, large shallow inlets and bays, mudflat, sandflats and Atlantic salt meadows.

- Prevention of in combination and cumulative effects with other businesses and marine and coastal activities, including seaweed harvesting, aquaculture, fisheries, angling, periwinkle collection, tourism, recreation and sport.
- BioAtlantis will cooperate with indigenous Irish companies in Co. Mayo and the west who are engaged in seaweed harvesting, drying or processing, with the view to building partnerships which benefit the local economy and increase job creation in these areas.
- Full alignment with EU and Irish Government plans and policies, in relation to environmental sustainability and development of the Irish marine Blue Bioeconomy and Circular Bioeconomy.
- Value will be added to the resource in Ireland, maximizing economic returns to the State.
- The harvested seaweed will be utilized to develop and manufacture organically certified products and technologies, with significant environmental and societal benefits, as follows:
  - Mitigating the effects of climate change: BioAtlantis has pioneered the development of a 'Molecular Priming' technology, which mitigates the effects of climate change in agriculture. For example, applying a key product from BioAtlantis' portfolio, SuperFifty® Prime, to a crop 3 to 5 days in advance of an adverse weather event, ensures that the crop will be protected for up to 15 days post-application.
  - Reducing agrichemical inputs in crop production: BioAtlantis has developed products that strengthen crops making them more resilient to disease, thus the requirement for agrichemicals on farms can be minimized. The company is also working on the development of a biopesticide to help crop growers transition from some agrichemicals.
  - Nutraceuticals: BioAtlantis is developing food supplements to improve human health.

(b) Reasons why BioAtlantis requires a license:

BioAtlantis commissioned a new production facility in 2019 at its base in Tralee, Co. Kerry, costing €19M. This is the largest SME-owned, fully automated seaweed extraction facility in Britain or Ireland, including technologies for seaweed intake, extraction, separation, purification and spray drying. To ensure continued growth and job creation, the company must take steps to secure a sustainable source of its essential raw material, the seaweed *Ascophyllum nodosum*. From the commencement of operations in 2006, BioAtlantis depended on supply of seaweed from an external supplier, Arramara Teoranta, Kilkieran, Co. Galway. The necessity of having our own raw material supply became a key issue in 2023 when Arramara (owned by Acadian SeaPlants) terminated our supply, creating immense challenges for the company. Anticipating this issue, the company took steps to secure an alternative source of raw material and applied for a license to harvest *A. nodosum* in 2014 (FS006269). Applying for a license in Kerry was not a viable option, as the majority of *A. nodosum*

in Ireland (>90%) grows in Natura 2000 sites (SACs, SPAs), located in three counties: Galway, Mayo and Donegal (37,470, 16,600 and 16,430 sustainable annual tonnes respectively; Hession *et al.*, 1998, https://oar.marine.ie/handle/10793/202). BioAtlantis chose Clew Bay, Co. Mayo, as it has sufficient, sustainable quantities of *A. nodosum* necessary to secure the continued growth of the company. Clew Bay also has a well-established history of commercial seaweed harvesting since at least the 1970s, with hand harvesting of *A. nodosum* representing an established human activity in this SAC.

(c) Respecting legal rights of traditional hand harvesters:

BioAtlantis wish to work in partnership with local hand harvesters to create a vibrant and sustainable industry, whilst also ensuring that existing seaweed harvesting rights are respected. On the 28th of June 2018, Minister Damien English clarified the legal position around seaweed harvesting and applications received under the Foreshore Act, as advised by the Attorney General. In line with this, this application ensures that traditional seaweed harvesting rights are fully respected and measures are included to ensure the license has no impacts on existing harvesting rights in Clew Bay. BioAtlantis will not harvest in any area where existing appurtenant rights exist, without first obtaining permission from the owner of such rights. Where Profit-à-Prendre rights are successfully registered with the Property Registration Authority of Ireland, the harvesting plan will be adjusted to ensure that those individuals can continue to harvest. It is envisaged that a clause may be included in the licence issued to allow the harvesting of *A. nodosum*, stating that if a Profit-à-Prendre rights holder provides sufficient proof to their right, the licensee would be prohibited from harvesting in that area, without first obtaining permission from the owner of such rights. As confirmed by the Government, existing seaweed rights holders can continue to exercise their right to harvest seaweed and do not require consent under the Foreshore Act. However, requirements for operating in SACs and relevant national and European environmental legislation must be respected.

BioAtlantis will explore the potential of purchasing a boat for the area to collect/tow the harvested *A. nodosum* to pick up points, whilst also providing the option for local hand harvesters (including those with existing harvesting rights) to tow their harvested seaweed directly to pick-up points, as is currently the common practice employed by harvesters in the bay. The price paid for the harvested seaweed will be consistent with other sectors of the economy and prices paid by competing companies.

(d) Compliance with EU and Irish laws in relation to Special Areas of Conservation (SACs):

At any time, the current commercial harvesting of seaweeds underway in SACs along Ireland's coast may be stopped, as it is likely to be considered illegal under EU and Irish laws. To comply with EU laws in relation to commercial harvesting activities in SACs the activity must be regulated and licensed. This license application will bring

increased traceability to harvesting, helping to ensure compliance with Irish and EU regulations for human activities operating in SACs. Central to this is a sustainable hand harvesting methodology which ensures rapid recovery and re-growth post-harvest, monitored by a Resource Management team and a Marine Ecologist. In line with the EU Birds and Habitats Directives, this application includes measures to prevent impacts on Large Shallow Inlets and Bays [1160] and Annex I and II marine and coastal habitats and species in the SAC. The application is supported by the development of a sustainable hand harvesting Code of Practice, which includes a range of measures to prevent impacts from occurring. This application is also supported by the following environmental reports:

- Supporting Information for Screening for Appropriate Assessment (SISAA).
- Natura Impact Statement (NIS).
- Risk Assessment for Annex IV Species.

Granting a license to BioAtlantis will allow for improved management of sustainable harvesting, as it:

- Improves traceability.
- Ensures sustainable harvesting and post-harvest recovery.
- Ensure that activities are in line with conservation objectives for the SAC.
- Prevents in combination or cumulative effects with other marine and coastal activities.
- Complies with European and Irish laws in relation to commercial activities in SACs.

(e) Preventing interactions with other operators, plans and activities:

Measures are in place to prevent in combination or cumulative effects with existing business and marine and coastal activities, including other seaweed harvesting activities, aquaculture, fisheries activities, angling, periwinkle collection, tourism, recreation and sport. This includes both existing and planned developments and activities. Measures are also in place to prevent interactions with other activities during the transfer and pick-up of harvested seaweed. Site-specific measures are in place to prevent interactions with specific sites and locations during certain times of the year, and a code of practice for environmentally safe navigation and other health and safety measures are also included.

(f) Alignment of this application with Government plans and policies:

This application aligns with several Government plans and policies listed below. In order for these plans and policies to be realised, it is imperative that the Government prioritise the marine biotech sector and in particular, the regulation and licensing of seaweed harvesting:

- National Marine Planning Framework (NMPF) and Marine Spatial Planning policies: This proposal is consistent with the NMPF's aims to support sustainable harvesting of seaweed given its important economic and social contribution. Harvesting will be undertaken on a renewable and sustainable basis, without any negative interactions with other marine-based activities.

- Climate Action plan, 2024: As hand harvesting of *A. nodosum* is a sustainable and renewable activity, the proposal aligns with the Government's climate action plan in relation to the Marine Environment. BioAtlantis' products also provide a means of enhancing crop yields (10% increase) without increased use of fertilizer and agrichemicals, thus aligning closely with the action plan.
- National Adaptation Framework Planning for a Climate Resilient Ireland, 2024: Drought is listed as a sectoral impact associated with climate change, due to impacts on crop growth and soil. BioAtlantis has developed a 'Molecular Priming technology' (based on bioactive compounds from *A. nodosum)* that enhances crop tolerance to drought stress. This technology has been validated by the Max Plank Institute and the University of Potsdam in Germany and by the Center of Plant Systems Biology and Biotechnology (CPSBB), Bulgaria, as part of a number of EU Horizon research projects (ref: Rasul *et al.*, 2021. *International journal of molecular sciences*, *22*(3), p.1469).
- Ireland's National Biodiversity Action Plan 2023–2030: The application aligns with targets specifying requirements for a licence to harvest seaweed. The application is compatible with biodiversity policies, as harvesting will be undertaken sustainably and with ecological monitoring. Studies also show that hand-harvesting of *A. nodosum* has no impact on overall biodiversity.
- Bioeconomy Action Plan 2023-25: This proposal aligns with Government actions to support the development of the bioeconomy and steps needed to deliver on these actions, including facilitating opportunities for new high added-value biobased products and ensuring that enterprise, industrial and research policy support the goal of moving from research to industrial production with accelerated speed.
- The European Green Deal, EU Farm to Fork strategy (EC, 2020), EU biodiversity strategy for 2030 and EU soil strategy for 2030: The products developed by BioAtlantis are organically certified, listed by the Organic Materials Review Institute (OMRI), attested by EcoCert and are EU REACH compliant. These products provide a means of increasing yields (10%) with normal fertilizer and agrochemical use. The next step is to achieve the same yields with less agrichemical inputs. The products are safe to the environment, pollinators and humans alike. BioAtlantis has also developed a technology to restore soil health and function (MicroGrow®), thus aligning with relevant EU policies in this area.

(g) Blue Bioeconomy development along the western seaboard:

Coastal and marine areas along the west of Ireland face many challenges including:

- Rural population declines,
- Lack of economic opportunities,
- Lack of job creation,
- Challenges facing the Agri-sector,
- Increasing pressures associated with climate change and other environmental challenges.

These pressures are felt by communities and stakeholders throughout the western seaboard, and are experienced by people in a range of counties throughout the northwest, west and south west. However, the development of a thriving Blue Bioeconomy along the western seaboard has the potential to address some of these issues. Development of a Blue Bioeconomy, based on innovation, science and export of high value-added products, will require stakeholders from various counties along the western seaboard to work together to overcome these shared challenges. The indigenous Irish seaweed and marine biotechnology sectors are well established along the west of Ireland and have a proven track record in job creation and in stimulating economic growth in rural and coastal areas. BioAtlantis has been a key driver of this success and wishes to contribute further to sustainable growth in the Blue Bioeconomy in the west of Ireland, by expanding further and building strong relationships with local hand harvesters and other stakeholders in County Mayo.

BioAtlantis, a founding member the European Biostimulants Industry Council (EBIC), strives to position Ireland's seaweed industry as a global leader at the cutting edge of research and innovation, benefiting coastal communities and society by delivering highly innovative and sustainable applications. A stable supply of this essential raw material is required in order to maximise the potential of the industry and to create new jobs in the Blue Bioeconomy in rural, coastal and marine areas. A license granted to BioAtlantis will provide greater structure and opportunities to grow the harvesting industry and the Blue Bioeconomy, as it will:

- Provide sustainable quantities of renewable raw materials required to bring new environmentally friendly technologies to market, in the areas of crop, animal and human health.
- Facilitate investment in Ireland's indigenous harvesting sector, providing a sustainable income along the western seaboard, creating opportunities in coastal and rural communities in the process.
- Ensure responsible management of the sustainability of the resource, fostering collaboration between private and government interests to prevent impacts.
- Allow harvesters to be contracted or directly employed by BioAtlantis if they wish.

(h) About BioAtlantis:

BioAtlantis, an Irish-owned SME, was established with the vision of utilizing bioactive compounds sustainably derived from nature to solve significant environmental, societal and health problems. To realise this vision, the company had to invest in developing a cutting-edge R&D and engineering base, a highly automated be-spoke manufacturing facility and a technical sales and agronomy team to compete on the world market. BioAtlantis has become a leading innovator in the Irish bioeconomy, delivering environmentally friendly and sustainable solutions to its customers in over 30 countries worldwide. The company employs over 50 people in Ireland in a range of areas, including: science, engineering, skilled trades, sales, marketing and finance, and is committed to continuing its development as a major

employer in the west of Ireland. A further 14 people are employed overseas in agronomy and technical sales, with subsidiary offices located in Brazil, China, India, Mexico and USA.

BioAtlantis has grown rapidly since 2004 and has developed an extremely strong scientific base. In line with its strong reputation as an innovator in the European biotechnology sector, BioAtlantis is a partner in a range of EU Horizon research projects and collaborates with over 20 universities worldwide. The company also collaborates with a range of universities in Ireland, co-funding scholarships in education, internships and graduate programs, and co-funding MSc and PhD students and Post Doctoral Researchers. BioAtlantis is part of the following organizations and groups: European Biostimulants Industry Council (EBIC), Circular Bioeconomy Cluster in south-west Ireland, Marine Ireland Industry Network, Marine Spatial Planning, Climate KIC – DAFM programme, Tech Industry Alliance and Kerry Sci-Tech.

BioAtlantis has invested heavily in its business and the foundations are in place to build a world-leading Irish biotechnology company based in the west of Ireland. BioAtlantis is well known in the Plant Biostimulant industry and has built a strong reputation as a company which prioritizes honesty and integrity. BioAtlantis has also taken the necessary steps to secure the protection of its intellectual property, with several international patents granted in the areas of crop, animal and human health. In recognition of the company's success, BioAtlantis' CEO, John T. O'Sullivan, was nominated for the EY Entrepreneur of the Year Awards, 2022, in the international entrepreneur category.

Bioactive compounds from seaweeds such as *A. nodosum* and *Laminaria* Spp., are essential components of BioAtlantis' products and technologies, which provide substantial societal and environmental benefits, as follows:

- **Crops:** The AgriPrime product portfolio is a range of biostimulant technologies developed to aid growers in both organic and non-organic agriculture. These proven tools nourish crops from soil to harvest and help them cope with a variety of stresses and growth limiting factors, allowing crops achieve their genetic potential. Key technologies include:
  - **Oxidative stress reduction:** BioAtlantis has pioneered the development of a 'Molecular Priming' technology which mitigates the effects of climate change. The company's main product, SuperFifty® Prime, is a novel 'oxidative stress inhibitor' that works by modulating gene expression and inducing stress tolerance mechanisms in treated crops. SuperFifty Prime, works by 'priming' and preparing crops to tolerate and respond more efficiently to future 'abiotic' stresses, including adverse weather events associated with climate change, such as cold, drought, heat and water logging. Trials in Ireland and UK show that SuperFifty® Prime provides an extra 10% yield to potato growers, without the

requirement for additional agrichemical inputs. SuperFifty Prime has been validated by the Max Plank Institute and University of Potsdam in Germany and by CPSBB, Bulgaria, as part of a number of EU Horizon projects, culminating in the publication of several research papers in high-impact international scientific journals. The technology was launched and featured in Irish Times on October 26th, 2023: ***"Science and seaweed combine to protect crops from climate change"*** (https://www.irishtimes.com/business/innovation/2023/10/26/science-and-seaweed-combine-to-protect-crops-from-climate-change/).

- **Soil Health:** MicroGrow® improves the soil microbiome and microbial activity, fostering growth of beneficial microorganisms. The product targets early crop establishment, improving rooting and shoot formation and increasing yield.
- **Fruit finishing and shelf-life:** AtlantiCal® improve fruit-finish and post-harvest shelf-life, with application at the fruit-sizing stage.

- **Animals**: BioAtlantis has developed a technology that modulates the immune system and gastrointestinal microbiome in animals. This pioneering product (LactoShield®) improves maternal immunity transfer to piglets, reducing the requirement for antibiotics and zinc oxide in the first six weeks of the piglet's life. Administered in the form of a feed supplement, this product provides a sustainable, effective and economical means of preventing infectious diseases and enhancing gastrointestinal health and performance, aligning with the Irish Government's *'One Health National Action Plan on Antimicrobial Resistance 2021-2025'.* Lactoshield's efficacy has been validated by world-leading scientific experts in the School of Agriculture and Food Science, University College Dublin, Ireland. A case study can be read as follows: https://www.ucd.ie/t4cms/CASE_STUDY11_John%20ODoherty.pdf
- **Humans**: BioAtlantis is developing nutraceuticals targeting immunological, metabolic and stress-related conditions in humans. This technology is based on natural compounds that modulate biological processes, with efficacy proven in a range of cohorts. Our flagship nutraceutical is based on a unique composition that addresses immunological and metabolic problems.

(i) Conclusions:

To continue to bring societal and environmental solutions to market, BioAtlantis must grow and expand. The company's main barrier to growth is a lack of security over raw material supply. Issues with licensing and a lack of security over raw material supply have also been identified in the *"Ireland's Ocean Economy"* report, 2022, as major barriers to the growth of the seaweed, marine biotechnology and bio-products industry. BioAtlantis requires the Government to take the necessary steps to regulate seaweed harvesting to ensure that it benefits all relevant stakeholders, including seaweed harvesters and indigenous Irish companies. Regulation and licensing is also necessary in order for the Government to meet its targets and goals in relation to

environmental sustainability, climate mitigation and development of the blue bioeconomy. Granting a license to BioAtlantis will allow for improved management of sustainable harvesting, in line with EU and Irish environmental laws, whilst also helping to drive the development of the blue bioeconomy along the western seaboard of Ireland. A partnership approach with local hand harvesters in Clew Bay will be central to this, and as the technologies the company brings to the market are novel, BioAtlantis will be able to pay harvesters a competitive price for harvested seaweed.

The vision of BioAtlantis in 2004 was to research, produce and market products that enhance crop, animal and human health. The technologies are proven and can be produced at scale to fulfil market requirements for natural and safe products, equally as effective as synthetic chemicals. The only significant barrier to market entry is a sustainable supply of seaweed harvested in Ireland. This can be resolved by following the regulatory process and issuing a license for the sustainable harvesting of seaweed, as outlined in this application. BioAtlantis welcomes all comments regarding this proposal, and invites interested members of the public to contact the company directly if they wish to discuss any aspects of the proposal further.

Summary of Revisions (2020 - 2024)

This document has been updated following a public consultation period which took place between December 2014 and January, 2015 and to reflect further changes made between 2020 and 2024. The document was revised to account for:

- Appurtenant seaweed harvesting rights.
- Profit-à-Prendre seaweed harvesting rights.
- Additional planned and existing activities.
- Additional measures to prevent impacts on Annex I and II marine and coastal habitats and species.
- Additional measures to prevent in combination and cumulative effects.
- An assessment of *A. nodosum* and *Fucus vesiculosis* biomass levels by UCD.
- Other general and editorial changes.

A summary of the above changes and others are outlined as follows:

No	Document	Change/modification
1	**NIS**	• This Natura Impact Statement has been revised to account for changes to the application documents.
2	**Main text document**	• **Appurtenant rights to harvest or gather seaweed:** BioAtlantis has assessed the extent of appurtenant rights in relation to seaweed harvesting/gathering and have examined folios that have seaweed rights registered as a burden. These sites were identified and BioAtlantis will not engage in any harvesting activities in these areas, without first obtaining permission from the person to which those rights belong. This ensures that there is no overlap with any existing harvesting rights in Clew Bay. • **Profit-à-Prendre rights:** Where Profit-à-Prendre rights to harvest seaweed are successfully registered with the PRAI, the harvesting plan will be adjusted to ensure that those individuals can continue to harvest *A. nodosum.* It is envisaged that a clause may be inserted into the licence issued to allow the harvesting of *A. nodosum*, stating that if a Profit-à-Prendre right holder provides sufficient proof to their right, the licensee would be prohibited from harvesting in that area, without first obtaining permission from the owner of such rights. • **Maximum annual harvest of *A. nodosum*:** The maximum annual harvest was adjusted following an assessment of *A. nodosum* resources in Clew Bay by University College Dublin (UCD). Further adjustments were also made following the exclusion of areas with existing appurtenant rights to gather or remove seaweed and folios with burdens that relate to seaweed. The revised estimated annual harvest of *A. nodosum* in Clew Bay is 11,018 T. • **Other changes:** The main text document was updated where appropriate to reflect the changes outlined in the other appendix documents listed below.
3	**Appendix 1: Assessment of Resources**	This document is unchanged from the initial application. An additional survey was undertaken by UCD to verify the levels of *A. nodosum* in Clew Bay. This is provided as a separate report.
4	**Appendix 2: Maps**	The maps have been reviewed and updated. While sites containing appurtenant rights to harvest *A. nodosum* are not marked on these particular maps, such sites with appurtenant rights were identified and submitted in a separate report to the Department. BioAtlantis will not engage in any harvesting activities in these areas without first obtaining permission from the person to whom those rights belong.
5	**Appendix 3: Compliance & record forms**	This document was updated to include the limit of <5% for Fucus by-catch, amendment of the Goods Received Note (GRN) and creation of the Site Inspection Form (SIF), along with a number of other changes.
6	**Appendix 4: Code of practice**	This document was updated to include additional mitigation measures, particularly in relation to:

No	Document	Change/modification
		• Section 1.3: ➢ Existing appurtenant rights or burdens in relation to the harvesting. ➢ Avoiding congestion at pick up points. • Section 2.3: Otter *(Lutra lutra).* • Section 4: Working in the vicinity of tourism and recreation facilities. • Section 5: Working in the vicinity of aquaculture sites. • Section 6: Working in the vicinity of anglers and fisheries activities. • Section 7: Other harvesting activities. • Section 8: Preventing the spread of invasive species.
7	**Appendix 5: Risk Assessment**	This document was updated to include additional potential risks & in-combination effects.
8	**Appendix 6: Assessment of bird species**	This document was updated to include a wider range of bird species.
9	**Appendix 7: In-combination effects:**	This document was updated to account for activities and developments where in-combination effects may have the potential to impact on annex I and II species and habitats: • **Exiting activities:** ➢ Areas where there are existing rights to harvest, gather or remove seaweed, including areas where existing burdens or appurtenant rights exist. ➢ Existing aquaculture sites. • **New planned activities and developments in Clew Bay since 2014.** ➢ Planned floating pontoon just north of Roman Island and other developments. ➢ New aquaculture applications and fisheries activities. • **Other activities:** Information in relation to other activities was updated and expanded (e.g. planning, tourism, sport, recreation, fisheries, harvesting of edible seaweeds and invertebrates). A range of mitigations measures were put in place where necessary to prevent in combination effects between *A. nodosum* harvesting and the above activities and developments. The Code of Practice in Appendix 4 has been updated accordingly.
10	**Appendix 8**	This document was updated to include the limit of <5% for Fucus by-catch, amendment of the Goods Received Note (GRN) and creation of the Site Inspection Form (SIF), along with a number of other changes.
11	**New Document: Appendix 9: Assessment of fisheries species.**	An assessment was undertaken to examine the life-cycle requirements of commercial fisheries species, including fish, crustaceans and shellfish.
12	**New Document: Appendix 10: NMPF**	An assessment was undertaken to examine how the application secures and is consistent with the objectives of the National Marine Planning Framework (NMPF).
11	**New document: Biomass survey of Clew Bay**	A survey was undertaken by UCD to assess the levels of *A. nodosum* biomass in Clew Bay.
12	**New document: Assessment of appurtenant rights**	An assessment was undertaken to identify the nature and extent of existing seaweed harvesting rights in Clew Bay. Harvesting will not take place in areas where appurtenant rights to harvest seaweed exist.
15	**New Document:** Annex IV species	Supporting documentation for Risk Assessment for Annex IV Species (Article 12 Risk Assessment)
16	**New Document:** SISAA Report	Supporting Information for Screening on Appropriate Assessment (SISAA Report). This contains information required to carry out a Screening for an Appropriate Assessment.

Summary of changes (2014).

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. has assessed the issues raised by NPWS in relation to cited deficiencies in the submitted Natural Impact Statement (NIS) and the additional information requested. The application was 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)

Contents

Appendices

Other:

The following environmental reports are included with this application, as separate attachments:

- Supporting Information for Screening for Appropriate Assessment (SISAA).
- Natura Impact Statement (NIS).
- Risk Assessment for Annex IV Species.

Abbreviations:

AA	Appropriate Assessment
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
SIF	Site Inspection Form
SISAA	Supporting Information for Screening for Appropriate Assessment
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 exporting sector. Factors influencing the success of this industry include innovation, R&D and collaboration between academia and business. However, the growth of the industry is largely 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 with the second largest reserves of *A. nodosum* in Ireland. The harvesting system is based on good environmental practices and management principals and is designed to prevent any significant effects on marine biodiversity in Clew Bay SAC. BioAtlantis has a long-term commitment to these goals.

A. nodosum is a large, intertidal brown seaweed which grows in abundance on sheltered and rocky shores. While sexual reproduction maintains *A. nodosum* genetic diversity, vegetative reproduction maintains population size by generating shoot growth and biomass. Frond growth continues for years while the holdfast can reproduce vegetatively for decades. To maintain population size it is essential to incorporate data on vegetative growth and regeneration rates into harvesting strategies. This proposal draws on studies such as Kelly *et al.,* (2001) which assessed the impact of hand harvesting on *A. nodosum* regeneration and biodiversity. BioAtlantis will implement a sustainable method requiring that no less than 200mm (8 inches) of material is left behind post-harvest. The method has minimal effects on *A. nodosum* and species within the biotope, allowing for shorter recovery periods post-harvest. Harvest will not exceed 20% of the available harvestable *A. nodosum* per site per annum, thus ensuring sustainability of harvesting year-on-year, and minimizing any potential impacts on this important SAC.

Ireland has the potential to sustainably yield >74,000 tonnes (T) of *A. nodosum* per annum, the majority found in Galway, Mayo and Donegal (Hession, *et al.*, 1998). It is estimated that 37,470, 16,600 and 16,430 potential wet tonnes/annum may be sustainably harvested from each respective county. However, the annualized potential yield has been under-harvested and the true potential of *A. nodosum* as a renewable resource in Ireland has not been realized. Provided that harvesting programmes allow for sufficient regeneration periods, 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 is well established. Baardseth (1949, 1955) determined that sustainable harvesting was possible once adequate levels of material is left behind (reviewed by Guiry & Morrison, 2013). Kelly et al., (2001) determined that sites at Clew Bay and Connemara demonstrated almost complete recovery of *A. nodosum* cover, 11 and 17 months post-hand harvest respectively. Provision of a 4-5 year window for recovery post-harvest remains the current consensus. In light of such studies, the cautious 3-5 year fallowing time-frame preferred by decision makers would appear quite sufficient to ensure recovery of *A. nodosum* in areas harvested. A scientific review of sustainability aspects to harvesting *A. nodosum* and its use as a renewable raw material resource has recently been published by Sujeeth *et al.* (2022). BioAtlantis will incorporate known rates of *A. nodosum* recovery in 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 applying for a licence in Clew Bay

The reasons for applying for a license in Clew Bay are outlined in Section B of the Executive summary (see pages 3 and 4 of this document).

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 provide contracting opportunities for up to 20 local full-time harvesters 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 or contracted to manage activities in the area. Three people with responsibility for transporting harvested seaweed will also be contracted. A Marine Ecologist will be directly employed or contracted for the purposes of measuring *A. nodosum* recovery and conducting ecological surveys. The employment of over 50 people currently working at BioAtlantis will also be secured. The licence will also allow for the expansion of the operation in the BioAtlantis factory and increased employment. 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. of full-time hand harvesters
	Wet tonnes	
2024	7,000*	6
2025	9,000*	16
2026	11,018	16

Table 1: Projected harvesting of *A. nodosum* in the Clew Bay area.

* Over the first few years of harvesting in Clew Bay, the total harvest available may be lower as some areas that have been harvested in the recent past may require a recovery period.

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' staff 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 / Raigh Pier

1.2.2 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 in 2014. The NIS was revised further in between 2020 and 2024 and 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 (m^2) in Clew Bay SAC of each Annex I Habitat and (b) the area affected by harvest activities/annum

(m^2 and percentage). The results are presented in Section 3.4 and demonstrate adherence to these limits. The percentage of the reef and shingle which are Marine Community Types of the Annex I habitat, Large shallow Inlets and Bays [1160], that will be impacted each year was also calculated.

d) Visits to the site:

A study 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 study was primarily qualitative in design and a preliminary test of the methods and procedures employed in order to evaluate important aspects such as feasibility, time, costs, and the underlying statistical variability involved. The pilot study was also deemed necessary to establish appropriate sample sizes and to determine ways in which to improve the experimental design, prior to up-scaling analysis during the operational phase. The report can be found in Appendix 1. A key finding from this study 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 is provided below with the document provided in full in Appendix 1.

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

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, 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.

f) Survey undertaken by University College Dublin.

An additional survey was undertaken by University College Dublin to assess the levels of *A. nodosum* and *Fucus vesiculosis* in Clew Bay in 2016. The corresponding report is provided along with this current document.

2. Development of Management & Implementation systems.

Management:

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

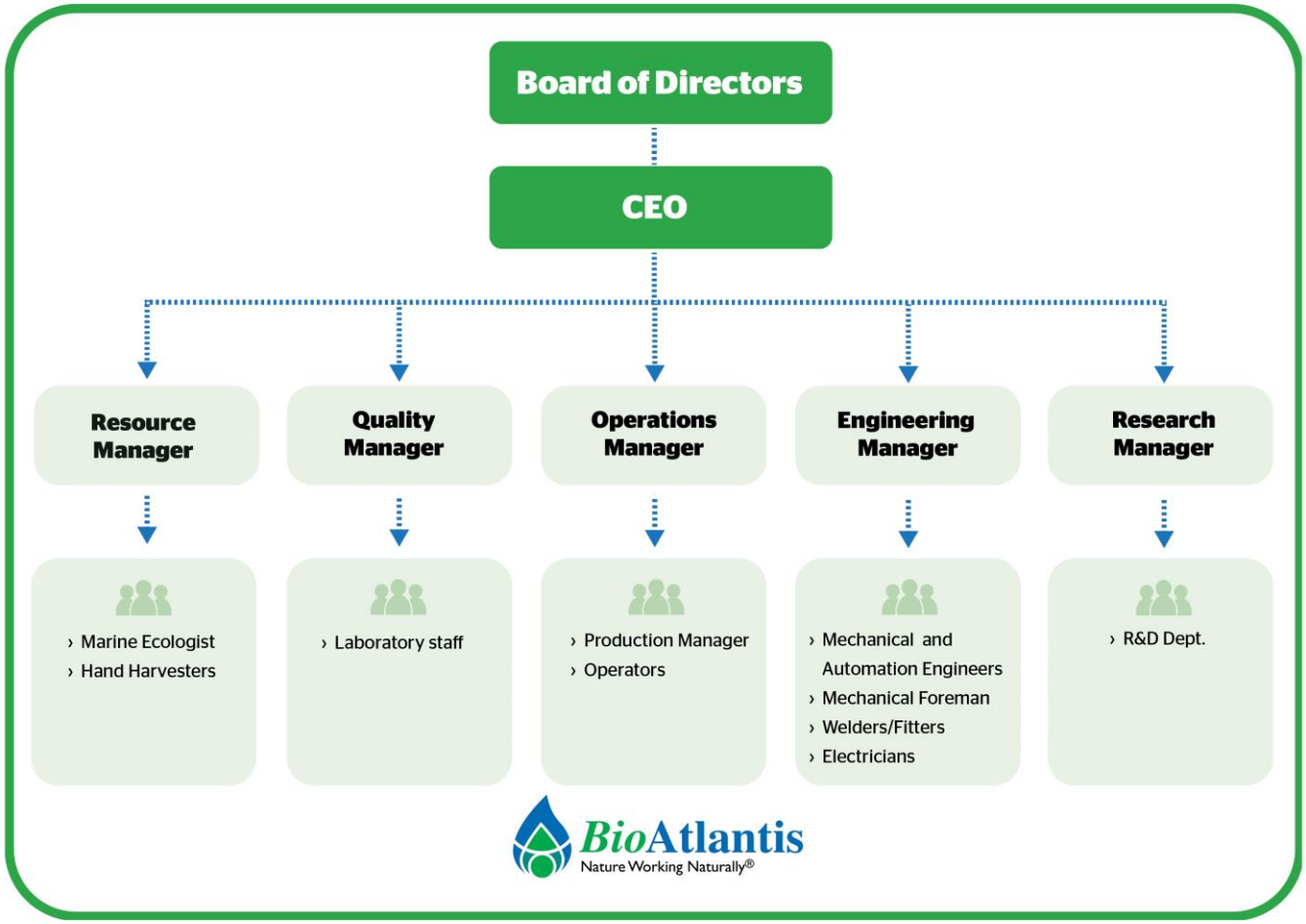

Figure 1 : Resource Management Team

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.
  - Site Inspection Form (SIF).
  - Non-Conformance Report (NCR) form (G012).
  - Incident Report (IRF), form (G008).
  - Information in the above may alternatively be provided in other suitable formats by electronic or other means on site and/or at production facilities.
- Code of Practice: Mitigation measures were developed by BioAtlantis (Appendix 4) to ensure that significant direct, indirect, in combination and cumulative effects on qualifying interests of Clew Bay SAC do not occur. These measures are considered 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. Where necessary, these procedures will be implemented along with regular training, assessment and supervision by members of the Resource Management Team at BioAtlantis Ltd.

3. Development of monitoring systems.

- Quantifying *A. nodosum*: Methods of quantifying the resource are required to ensure that 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 (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. The BioAtlantis plan will work to integrate in accordance with the needs and wishes of the Clew Bay region and provide important opportunities 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 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, Mr. 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 & Mr. 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, Mr. Brian Fanning, Engineering Manager & Mr. 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, Mr. Brian Fanning, Engineering Manager and Mr. 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 was updated and enclosed as a separate stand-alone document with the application in 2014. The NIS was revised further between 2020 and 2024.

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. Updates have been made to include additional work undertaken between 2014 to 2021:

No.	Operation/activity	Details			
1.	**Biomass Determination & Risk Assessment**	**Date**	**Location**	**Status**	**Ref.**
(a)	Literature review & data gathering.	May –Aug. 2013 Updates between 2019 and 2024.	BioAtlantis Ltd.	Complete	n/a
(b)	Electronic Mapping:	May –Aug. 2013 Updates between 2019 and 2024.	BioAtlantis Ltd.	Complete	Appendix 2
(c)	Visits to the site	26/09/2013. Further site visits by UCD in 2016.	Clew Bay	Complete	Appendix 1
(d)	Risk assessment, control measures, monitoring & corrective actions	May-Dec. 2013. Updates between 2019 and 2024.	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
(f)	Assessment of *A. nodosum* biomass in Clew Bay by UCD	2016	Clew Bay	Complete	Stand-alone document
2.	**Development of Management & Implementation systems**	**Date**	**Location**	**Status**	**Ref.**
(a)	Defining the management team.	Oct 2013	BioAtlantis Ltd.	Ongoing	Figure 1
(b)	Compliance & Record Forms (GRN, NCR, SIF, IRF)	March, 2021. Updates between 2019 and 2024.	BioAtlantis Ltd.	Complete	Appendix 3
(c)	Code of Practice for protecting Clew Bay	May-Dec 2013. Updates between 2019 and 2024.	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. Updates between 2019 and 2024.	BioAtlantis Ltd.	Complete	Current document, NIS & associated appendices
3.	**Development of monitoring systems**	**Date**	**Location**	**Status**	**Ref.**
(a)	General Systems	May-Oct. Updates between 2019 and 2024.	BioAtlantis Ltd. & Clew Bay	Complete	Section 1 & 3 & Appendix 4
(b)	Quantifying *A. nodosum*	May-Oct. Further assessment by UCD in 2016.	BioAtlantis Ltd.	Complete	Appendix 1
(c)	Fallowing and harvesting requirements	May-Oct 2014	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: Quarterly 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 & analysed	Appendix 6
(e)	BirdWatch Ireland	15 – 27th Nov 2013; June, 2020	Correspondence via email	Datasets obtained & analysed	Appendix 6
(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. Updates between 2020 and 2024.	BioAtlantis & Clew Bay	NIS completed (09/01/2014). Revision in Oct 2014, 2020/21 and 2023/24	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 DHLGH	30/07/2014. Further correspondence during updating of application, up to 2023.	Via email	Additional information requested	Application and NIS updated accordingly (Oct 2014)
(k)	National Parks & Wildlife Service (NPWS)	26/08/2014 - 30/10/2014	Via email	Recommendations taken on board. Application and NIS revised accordingly	Current document & associated appendices (Oct 2014)
(l)	Landowners	Dec 2024/25*	Not completed		
(m)	Mayo County Council & other parties	Dec 2024/25*			
5	**Seaweed harvesting rights**	**Date**	**Location**	**Status**	**Ref.**
(a)	• Assessment of existing burdens and appurtenant rights to harvest and gather seaweed in Clew Bay. • Further review of legal aspects in relation to seaweed harvesting.	2014-2021 2021-2024	BioAtlantis Ltd	Complete	n/a

Table 2 : Summary of operations/activities undertaken during developmental phase (May 2013-2024).

*Subject to the issuing of a hand harvesting license.

1.3 Operational Phase

1.3.1 Area to be directly impacted: Overview

BioAtlantis' *A. nodosum* harvesting plan has been designed based on sustainability. Based on our own assessment and findings from Hession, *et al.*, (1998), we propose to harvest *A. nodosum* from a region that extends from Rosmurrevagh point on north Clew Bay to White Strand in the south, including the islands within the Bay. This is identified in Appendix 2, Maps.

The study by Hession C, *et al.*, (1998) concluded that Co. Mayo has 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. NOTE: The maximum annual harvest in this application was adjusted to account for the findings from a biomass survey undertaken by University College Dublin. The maximum annual harvest was also reduced to account for the identification of sites with existing appurtenant rights in relation to seaweed harvesting.

To manage the harvest activities, BioAtlantis will hire or contract an experienced person who has a captain's licence, preferably an environmental science degree, a marine ecology background 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 harvesting activities. The Resource Manager will report directly to the CEO and work as part of the Resource Management Team. The person tasked with assessing recovery post-harvesting will have a marine ecology background.

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 requires:

(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 (Tonnes)†		Area in use / Per Year‡	
						Available Seaweed	Maximum Annual Harvest	Reef (m^2)	Shingle (m^2)
	Bartraw - Westport	CZ 1.1	61074	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 (m²)	Typical Density (Kg / m²)	Coverage§	Harvest levels (Tonne)† Available Seaweed	Harvest levels (Tonne)† Maximum Annual Harvest	Area in use / Per Year‡ Island No.	Area in use / Per Year‡ 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 (m²)	Typical Density (Kg / m²)	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

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m²)	Typical Density (Kg / m²)	Coverage§	Harvest levels (Tonne)†		Area in use / Per Year‡	
						Available Seaweed	Maximum Annual Harvest	Island No.	Name / Area
35	Illanmaw		74045	0	66%	0.0 T	0.0 T	0	0
36	Freaghillan East		6422	18	100%	115.6 T	23.1 T	1284	0
37			1476	16	100%	23.6 T	4.7 T	295	0
38	Inishcuill West		82042	20.75	79%	1348.2 T	269.6 T	12995	3413
39	Mauherillan		14262	16.75	91%	217.5 T	43.5 T	2598	255
40	Inishfesh		54236	18	70%	685.8 T	137.2 T	7620	3228
41	Inishmolt		23618	18	100%	425.1 T	85.0 T	4724	0
42	Inishloy		36182	18.5	100%	669.4 T	133.9 T	7236	0
43	Inishdaff		70875	20.5	100%	1452.9 T	290.6 T	14175	0
44	Inishbollog		13201	20.75	100%	273.9 T	54.8 T	2640	0
45	Inishlaughil		55888	0	100%	0.0 T	0.0 T	0	0
46	Inishgowla		67983	16	22%	243.7 T	48.7 T	3046	10550
47	Inishoo		23072	0	13%	0.0 T	0.0 T	0	0
48	InishTurk	IS 48.1	56134	21	100%	1178.8 T	235.8 T	11227	0
48		IS 48.2	10755	21	100%	225.9 T	45.2 T	2151	0
49	Illannaconney		17437	15	77%	201.6 T	40.3 T	2688	800
50	Inishakillew	IS 50.1	69800	21.75	100%	1518.1 T	303.6 T	13960	0
50		IS 50.2	18583	21.75	100%	404.2 T	80.8 T	3717	0
51	Trawbaun		256815	19.5	89%	4468.7 T	893.7 T	45833	5530
51	Carrigeenglass North								
51	Moneybeg								
51	Inishcottle								
52	Calf Island		30778	19.75	81%	490.3 T	98.1 T	4965	1190
53	Inishbee, Derrinish & Dernish West		200836	17.5	58%	2021.6 T	404.3 T	23104	17063
54	Freaghillan	IS 54.1	27454	19.75	66%	357.1 T	71.4 T	3616	1875
54		IS 54.2	55101	20	90%	989.7 T	197.9 T	9897	1123
54		IS 54.3	5995	21	100%	125.9 T	25.2 T	1199	0
55	Clynish		102154	18.5	77%	1463.2 T	292.6 T	15818	4612
56	llaunnamona		25370	16	95%	384.3 T	76.9 T	4804	270
57	Rabbit Island, Island More &Quinnsheen Island	IS 57.1	14757	19.5	100%	287.8 T	57.6 T	2951	0
57		IS 57.2	92903	16	88%	1307.4 T	261.5 T	16342	2239
57		IS 57.3	7894	17.5	100%	138.1 T	27.6 T	1579	0
57		IS 57.4	9330	18	100%	167.9 T	33.6 T	1866	0
58	Collan More, Carrigeenglass South & Collan Beg	IS 58.1	501217	16.75	100%	8395.4 T	1679.1 T	100243	0
58		IS 58.2	55220	18.75	100%	1035.4 T	207.1 T	11044	0
58		IS 58.3	29858	19.5	100%	582.2 T	116.4 T	5972	0

Island No.	Name / Area	Harvesting Zone ID*	Total Harvestable Area (m²)	Typical Density (Kg / m²)	Coverage§	Harvest levels (Tonne)†		Area in use / Per Year‡	
						Available Seaweed	Maximum Annual Harvest	Island No.	Name / Area
59	Inishgort		64954	15.5	57%	571.7 T	114.3 T	7376	5614
60	Inishlyre		121285	5	57%	347.3 T	69.5 T	13891	10366
61	Illanataggart & Crovinish		442259	14	99%	6133.0 T	1226.6 T	87614	838
62	Ininhgowla South + Carrickwee		183389	15	100%	2750.8 T	550.2 T	36678	0
63	Forilan		30569	9.75	100%	298.0 T	59.6 T	6114	0
64	Carrickawart	IS 64.1	26696	16	100%	427.1 T	85.4 T	5339	0
64		IS 64.2	1276	14.25	100%	18.2 T	3.6 T	255	0
65	Inishlaghan		32314	14.5	83%	388.4 T	77.7 T	5358	1105
66	Dorinish More & Dornish Beag		27107	12.5	100%	338.8 T	67.8 T	2980	2441
67	Inishimmel		0	0	0%	0.0 T	0.0 T	0	0
68	Inishleauge		54366	8	77%	334.3 T	66.9 T	8358	2515
69	Inishdaugh		22949	6.5	72%	108.0 T	21.6 T	3322	1268
70	Inishraher		81224	14.7	85%	1014.1 T	202.8 T	13798	2447
71	Inisheeney		53625	16	85%	725.4 T	145.1 T	9068	1657
72	Finnaun Island		0	0	0%	0.0 T	0.0 T	0	0
73	Corillan	IS 73.1	6787	6.5	100%	44.1 T	8.8 T	1357	0
73		IS 73.2	1016	6.5	100%	6.6 T	1.3 T	203	0
73		IS 73.3	1737	6.5	100%	11.3 T	2.3 T	347	0
73		IS 73.4	3001	6.5	100%	19.5 T	3.9 T	600	0
74	Carricknamore	IS 74.1	2436	6.75	100%	16.4 T	3.3 T	487	0
74		IS 74.2	1393	6.75	100%	9.4 T	1.9 T	279	0
74		IS 74.3	2640	6.75	100%	17.8 T	3.6 T	528	0
75		IS 75.1	0	6.75	100%	43.8 T	0.0 T	0	0
75		IS 75.2	0	6.75	100%	7.5 T	0.0 T	0	0
75		IS 75.3	0	6.75	100%	36.9 T	0.0 T	0	0
75	Stony Island	IS 75.4	0	0	100%	0.0 T	0.0 T	0	0
75		IS 75.5	0	5	100%	29.1 T	0.0 T	0	0
75		IS 75.6	0	6.5	100%	69.2 T	0.0 T	0	0
75		IS 75.7	0	6.5	100%	10.7 T	0.0 T	0	0
75		IS 75.8	0	6.5	100%	61.7 T	0.0 T	0	0
76	Green Islands	IS 76.1	0	0	100%	0.0 T	0.0 T	0	0
76		IS 76.2	0	0	100%	0.0 T	0.0 T	0	0
76		IS 76.3	0	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
						Estimated total	**12,900 T**		
						Revised Estimated total#	**11,018 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.

[#] The maximum annual harvest was adjusted following an assessment of *A. nodosum* resources in Clew Bay by UCD. This figure was adjusted further following the exclusion of areas with existing appurtenant rights to gather or remove seaweed and folios with burdens that relate to seaweed.

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 dataset shapefiles obtained from NPWS, BioAtlantis has 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 total 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 requirements of 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). The percentage of the reef and shingle which are Marine Community Types of the Annex I habitat, Large shallow Inlets and Bays [1160], that will be impacted each year is also very low. The overall area of Large shallow inlets and bays [1160] in Clew Bay is 10,188.5 hectares (https://eunis.eea.europa.eu/sites/IE0001482). The percentage of shingle to be impacted annually is 0.23% of this area, while percentage of reef to be impacted annually is 1.31%. In addition, BioAtlantis has 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)		Area of Large Shallow Inlets and Bays [1160] affected/annum
	(m^2)	(m^2)	%	%
Reef	26,870,000	1,331,699	4.96%	1.31%
Shingle	1,855,000	235,549	12.7%	0.23%

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 boat 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), with sites also inspected post-harvest to ensure the sustainability of the methods employed (Site Inspection Form, SIF; Appendix 3). Harvesting at low tide and pick-up or towing of nets/bags at high tide 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 (2.69 Ha) 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 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 significant level of harvesting of *A. nodosum* within the SAC region of Clew Bay was observed (see Appendix 1 for associated report). To manage activities along 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. As *A. nodosum* biomass can potentially recover within 11 to 17 months (Kelly et al., 2002), it may be possible therefore to harvest year on year in certain locations; however this is subject to recovery being achieved. As outlined in this application, measures will be implemented to ensure that harvesting does not take place if a site has not recovered from the previous year.

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, 2020	34	17.45%	0.9	June, 2021
32	Innishcannon	138.5	27.7	September, 2020	27	19.49%	1.0	August, 2021
36	Freaghillan East	115.6	23.1	October, 2020	10	8.65%	0.4	March, 2021
37		23.6	4.7	November, 2020	0	0.00%	0.0	November, 2020
38	Inishcuill West	1348.2	269.6	December, 2020	200	14.83%	0.7	August, 2021
39	Mauherillan	217.5	43.5	January, 2021	42	19.31%	1.0	December, 2021
40	Inishfesh	685.8	137.2	February, 2021	137	19.98%	1.0	January, 2022
41	Inishmolt	425.1	85.0	March, 2021	20	4.70%	0.2	May, 2021
42	Inishloy	669.4	133.9	March, 2021	25	3.73%	0.2	May, 2021
43	Inishdaff	1452.9	290.6	March, 2021	100	6.88%	0.3	July, 2021
44	Inishbollog	273.9	54.8	April, 2021	25	9.13%	0.5	September, 2021

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.

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

Duty: BioAtlantis Resource Management Team

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.

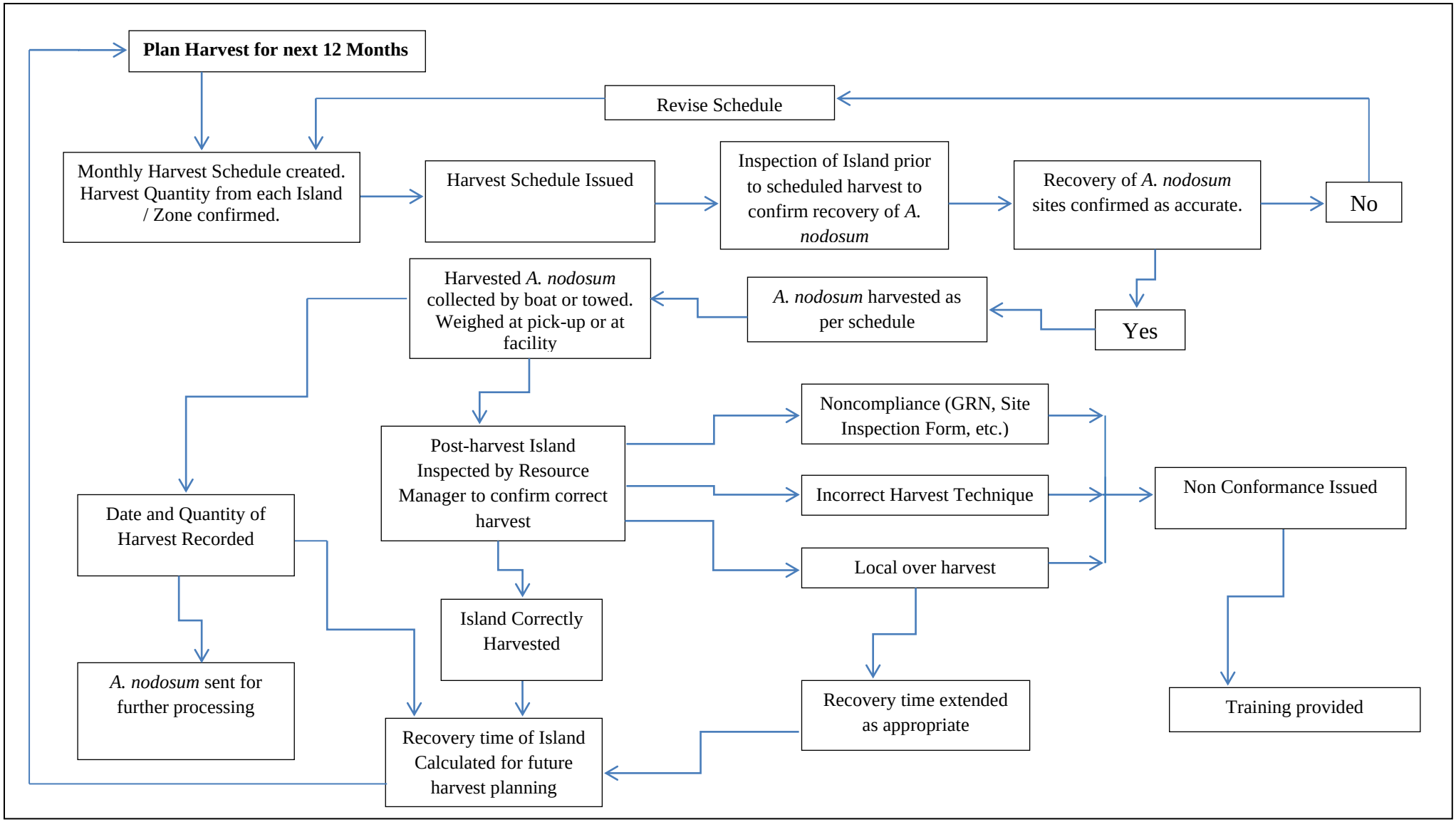

Figure 2: Harvesting Flow Chart

(iv). Data recording & analysis

BioAtlantis will explore the applicability of purchasing a boat for the area to be used for the collection of harvested *A. nodosum*. Alternatively, harvesters may tow the floating bags/nets from the harvest site directly to the pick-up point. In some cases, certain individuals with existing seaweed harvesting rights may prefer to land seaweed at pick up points. The seaweed collected from each point will be weighed and the details of the harvest recorded at each collection point. The harvested seaweed may alternatively be weighed on delivery to the processing facility. The person or transport company in receipt of the harvested seaweed 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:
    - Excessive levels of sand, shingle, gravel, pebbles stones or debris.
    - *A. nodosum* holdfasts.
    - Other species (e.g. *Fucus*).

The Resource Manager will inspect sites post-harvest using the "Site Inspection Form (SIF)" (Appendix 3) to confirm that harvesters have 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 (applicable if harvesters are present during inspection).

After receipt of the *A. nodosum* in the factory, these details will be uploaded into the main database and a second GRN will also be completed. Alternatively, where the quality cannot be checked on collection, quality will be assessed by production staff and/or the QSE team and any deviations from the specified requirements will be recorded. Checks may be undertaken by random or specific quality inspections on bags/nets. Regular auditing of the harvest records (e.g. Site Inspection Form, 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:

- Relevant personnel may be advised of the non-conformance and receive further training 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 BioAtlantis staff (e.g. Engineering, IT, Production, Quality personnel and Resource Manager).

(v). Navigation to and from harvest sites:

The harvesters shall use their own boats 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 explore the applicability of purchasing a boat for the area that would be approved by the Marine survey office (MSO) for use on the open waters of Clew Bay, and used to collect the harvested *A. nodosum* from the designated sites. Alternatively, harvesters may tow the floating bags/nets from the harvest site directly to the pick-up points. 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 or pick up points identified on the harvesting schedule or as required by management. In some cases, certain individuals with existing seaweed harvesting rights may prefer to land seaweed at pick up points. The seaweed will be weighed by BioAtlantis at pick up points and/or on delivery to the processing facility.

(vi). Communication

The number of harvesters contracted by 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 primarily 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 has 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 will receive training, where necessary, on methods 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 or when the tide has begun to recede.
- 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 bags/nets.
- Method for automatic weighing and transfer of weed to boat (subject to being applicable to the area).
- 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: Training provided by BioAtlantis staff.

(viii). Health and Safety measures

All harvesters will be provided with appropriate and certified Health & Safety Training. BioAtlantis will run regular training days for the harvesters, where necessary. The seaweed collection boat, if deemed applicable to the area, 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. To ensure that harvest activities do not lead to the spread of *Bonamia ostreae, Botrylloides violaceus, Caprella mutica, Crassostrea gigas, Crepidula fornicate, Didemnum vexillum, Perophora japonica, Sargassum muticum Spartina anglica or Styela clava*, BioAtlantis require that any collection or 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, cleaning measures on land will be implemented which will involve cleaning appropriate cleaning agents or using other suitable methods on delivery to production facilities and returned to harvesters in a clean condition. Harvesting will be limited to the *A. nodosum* zone and will not take place in subtidal areas, exposed or semi-exposed sites. Harvesters will keep distance from aquaculture units to prevent the spread of any species that may be associated with artificial structures. Harvesters will prevent disturbance to rocky substratum, will avoid co-harvesting non-*A. nodosum* material and will ensure that inadvertent by-catch of other Animalia, algae or dead, drifting material/algae will be prevented and minimized. 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 will 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: *A. nodosum* levels will be monitored 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 to sites where *A. nodosum* density has recovered.

  Duty: BioAtlantis staff (e.g. Resource Manager), etc. A Marine Ecologist will be directly employed or contracted for the purposes of measuring *A. nodosum* recovery and conducting ecological surveys.

(iii). Maintenance of Harvest Database.

Immediately following harvest, *A. nodosum* will be bagged. The harvested seaweed will be weighed automatically on the collection boat (if applicable to the area), at the pickup point or at the processing facility. 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 BioAtlantis staff. 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 will 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 Resource Management and QC team in BioAtlantis will play a key role in the management and monitoring of work relating to harvest of *A. nodosum* in Clew Bay. 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, Site Inspection Form, 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 personnel & contractors involved in hand harvesting activities in the Clew Bay area.
- Liaise with R&D Dept. 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 (NCR) will be issued. Harvesters will be provided with training if necessary. The Resource Manager will routinely inspect sites post-harvest to ensure compliance with sustainable hand harvest methods. An NCR will be filed and training provided if necessary.

(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 quarterly 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 (obtained through training above).
  Step 3: Records, forms & documents (general).
- Audit Part B: Quality Assessment (documentation):
  Step 1. GRNs and Site Inspection Forms (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 boat (if applicable to the area)

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 that 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.
- Quarterly review of hand harvesting records (i.e. GRNs and Site Inspection Forms).
- 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 regular 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 previously unknown sensitive sites. On review of quality checks on Goods Received Notes (GRNs), Site Inspection Forms (SIFs) 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 of the system in the short and long term.

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

BioAtlantis has invested considerably in R&D throughout its history and is 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 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. Additionally, 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 was 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, personnel 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 and to enhance the accuracy of the assessment, the number, size and type of replicates may be altered 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. 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. Alternatively, replicates may be assigned randomly if required.

- 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.

The experimental design outlined above may be subject to change depending on the sites involved, the underlying analytical methodology and the parameters/statistical methods employed. 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. Scientists 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: BioAtlantis staff (R&D personnel), etc. A Marine Ecologist will be directly employed or contracted for the purposes of *measuring A. nodosum* recovery and conducting ecological surveys.

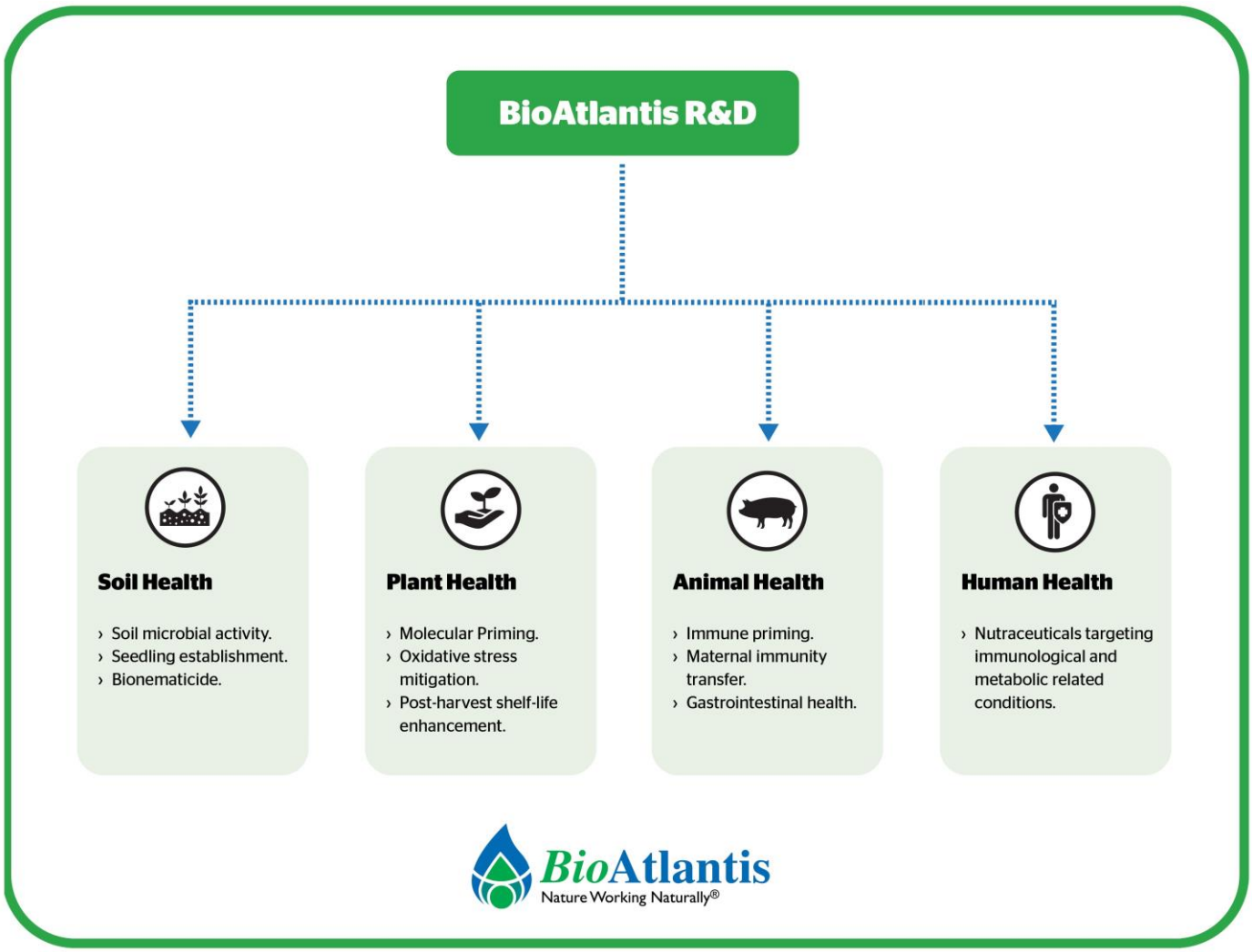

Figure 3: BioAtlantis - Research and Development

1.3.4 Locations in which operations/activities will take place.

1.3.4.1 Harvest zones

BioAtlantis will initially identify areas in Clew Bay which were subject 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). This figure was adjusted following on site assessments of *A. nodosum* resources in Clew Bay by UCD, and following the exclusion of areas with existing seaweed harvesting rights or burdens. The revised figure is an annual sustainable harvest of 11,018 Tonnes.

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	8,752,817	8,753	1,751
Northern Islands	13.46	15,738,415	12,846	2,569
Mid Islands	16.96	29,302,494	29,302	5,860
Southern Islands	7.96	13,857,656	13,858	2,720
Estimated total			**64,759 Total**	**12,900 Total**
Revised Estimated total #			**55,090 Total**	**11,018 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.

\# The maximum annual harvest was adjusted following an assessment of *A. nodosum* resources in Clew Bay by UCD. The figure was adjusted further following the exclusion of areas with existing appurtenant rights to gather or remove seaweed and folios with burdens that relate to seaweed.

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. Should a pick-up boat be deemed applicable to the area, launch to islands will be made from existing piers. Individual harvesters will access sites via existing methods. The harvested seaweed will be collected in nets or bags at the shoreline; these nets or bags will then be collected by the pick-up boat (if deemed applicable for the area) and delivered to a pier for onward transport. The size of the shore area covered by an individual net or bag will be approximately $2m^2$ to 8 m^2. Harvest will occur at islands and shorelines as described in the harvest management plan. Nets or bags will then be picked up at each location in which harvesting took place. Alternatively, harvesters may tow the floating nets or bags from the harvest site directly to the pick-up points. In some cases, certain individuals with existing seaweed harvesting rights may prefer to land seaweed at pick up points. The seaweed will be weighed by BioAtlantis at pick up points and/or on delivery to the processing facility. 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. Other established pick-up points not listed above may also be used.

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 facilities in Tralee, Co. Kerry where it will be used as raw material for extraction of bioactives for the plant, animal and human health sectors. BioAtlantis Ltd. production facilities are certified in the EU by GMP+ International B.V (www.gmpplus.org), granting the company permission to produce and trade seaweed extracts destined for use in highly regulated markets of Northern Europe. The production facilities are located in Tralee, Co. Kerry 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 Westport Harbour are being targeted by Mayo County Council for increased recreational tourism activity. 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, Westport 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													

Island No.	Name / Area	Harvesting Zone ID	Harvest Control Measures											
			Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
7	Inishtubrid		X	X	X	X						X	X	X
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		X	X	X	X						X	X	X

	West													
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													

Island No.	Name / Area	Harvesting Zone ID	Harvest Control Measures											
			Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
66	Dorinish More & Dornish Beag				X	X	X	X	X	X	X			
67	Inishimmel				X	X	X	X	X	X	X			
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 maerl, 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). This assessment in Appendix 6 was updated to include new data obtained from Birdwatch Ireland in 2020.

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 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 (updated in 2020 and 2021).

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 Burrishoole 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, between 2013-2020).
- **NPWS:** data describing specific breeding and wintering sites of relevance to important bird species within Clew Bay (data 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 and fisheries 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). Marine fish, shellfish, invertebrates and fisheries species utilize a broad range of habitats during early and adult life stages, including: deep water areas, estuarine mud areas, saltmarsh, seagrass, lagoons, maerl, subtidal gravel/coarse bottom, subtidal soft bottom areas, intertidal soft bottom areas and exposed shores.
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*) 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).

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*).
- Periwinkles (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 densities).
- 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 cumulative 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 staff 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 recommendations on 30th July 2014, as to areas in need of improvement in the NIS. The NIS and plan was updated accordingly. Following public consultation, the NIS was updated further between 2020 and 2024 and is provided along with this application.

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, existing 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 has 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. In addition, the life-cycle requirements and sensitivity of the otter to human disturbance was also considered closely. 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 and 2020).

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 *(e.g. 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).
- The conservation status of marine Annex I habitats.
- Potential pressures on the marine environment.

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 cumulative 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:** Effects 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	***Bonamia ostreae, Botrylloides violaceus, Caprella mutica, Crassostrea gigas, Crepidula fornicate, Didemnum vexillum, Perophora japonica, Sargassum muticum Spartina anglica or Styela clava.***	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 impacts 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 provided, where necessary, to ensure that correct cutting and loading techniques are used.
    (b) harvested *A. nodosum* will be collected in floating nets/bags. This system ensures settlement to the seabed of any rarely occurring sand or other shore material that may be attached to the bottom or sides of the bag or in the netting containing the harvested weed.
  - Chemical: It is highly improbable that a chemical hazard will occur given that no chemicals will be carried on board a 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): measures are in place to ensure adequate training is provided to harvesters, where necessary, to ensure no removal of permanent habitat area (e.g. measures are in place to prevent removal of excessive levels of sand, shingle, stones, pebbles, gravel, *A. nodosum* holdfast, etc). Harvested seaweed will be inspected on collection, on the boat, at the pick-up point and/or at the processing facility. Having the ability to trace the seaweed to a specific harvester will ensure that issues such as removal of excessive levels of sand, shingle or debris are identified and addressed effectively. Should excess material be observed in water, the separator or mill, additional training for harvesters will be provided where necessary. 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 biological 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 support 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 or when the tide has begun to recede, 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 or when the tide has begun to recede when attempting 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 or when the tide has begun to recede 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 will be provided, where necessary, 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 any harvest collection boat will be fitted with a depth finding device to ensure that there is always sufficient water.

- Control measures (if applicable): Training will be provided, where necessary, 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 or when the tide has begun to recede 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 or when the tide has begun to recede.
- 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 has 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, 2016). 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 boats according to practises which minimise impact on harbour seals.

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 them 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 or 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 cannot 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 cannot 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 cannot 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 for unload/pick-up. Use of banks for this purpose will not occur,
  (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 training will be provided to staff and harvesters to ensure that all transport activities will take place using established piers and roadways. Transport cannot 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 for unload/pick-up. Use of ASM regions will not occur,
  (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 staff and harvesters will be provided with training where necessary to ensure that all transport activities will take place using established piers and roadways. Transport cannot 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 or other areas where they may be encountered. 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. This includes a wider range of measures to prevent disturbance to or interactions with otters and their dietary requirements and food supply. These measures are also listed below:

    (a) Otters may be sensitive to human presence and alterations of food source and supply. To avoid or prevent disturbance or interactions with otters, ensure the following:

    - All activities are maintained within the intertidal *A. nodosum* zone. Avoid linear habitats located beyond the intertidal zone or marine riparian areas beyond the foreshore. Only use existing routes.

- Never interfere with couching sites, holts, access paths/routes, that may be present near coastal areas, agricultural fencing, roads, slipways, access points or other areas.
- Avoid large trees near coastal areas as they can represent important otter breeding and resting sites. Avoid undisturbed areas (e.g. impenetrable scrub/reeds) which are refuges for otters.
- Do not behave in an obtrusive or noisy manner around otters.
- Never interfere with, deliberately approach or disturb otters or their cubs that are resting, sleeping, hunting, feeding or foraging in water or on the shore during the daytime, dawn or dusk. Ensure caution during the periods of breeding, rearing and hibernation.
- If migrating/commuting otters are encountered in water, do not obstruct their movement. Slow down the boat and give sufficient space to pass without "boxing" them in, blocking narrow channels or acting as a barrier to commuting or connectivity.
- If encountered on the shore, allow otters free access and ample opportunity to escape to the water/land. Do not behave in manner causing them to move away or flee human disturbance.
- To prevent in combination effects, adhere to the above measures at all times, particularly when working in areas known to exhibit signs of otter activity.

(b) To prevent impacts on the dietary and other requirements of otter, the following measures apply:

- Follow pre-planned schedules and harvest in areas defined by BioAtlantis. Harvesting is limited to 20% of the total available *A. nodosum* biomass per site per annum, to allow for sufficient regrowth.
- Harvesting must not take place beyond the *A. nodosum* zone, as these habitats represent the broader habitat range of the otter's prey during adult and early life stages, including: flowing and static freshwater areas (rivers, streams, canals, lakes, reservoirs, ponds), deep water subtidal areas (>30m), shallow subtidal areas (<30m), exposed areas, estuarine mud areas, brackish waters, subtidal gravel/coarse bottom substratum, intertidal soft bottom (sand/mud), lagoons, maerl, rock pools, saltmarsh habitats, seagrass, subtidal soft bottom (sand/mud) and exposed waters in the vicinity of rocky cliffs.
- Avoid exposed and non-sheltered areas that represent the otter's broader habitat range, hunting ground and foraging area.
- Avoid co-harvesting non-*A. nodosum* material near coastal habitats, near the shoreline or on the shore. Ensure that inadvertent by-catch of other algae, dead/senescing algae, amphipods, isopods or other *Animalia* or material is prevented and minimized.
- Do not remove the *A. nodosum* holdfast and take care not to disturb rocky/crevice substratum.
- Avoid all freshwater aquatic linear habitat and riparian environments including lakes and rivers and other areas (e.g. east side of InishGowla South).
- Harvesting cannot occur in fresh water habitats, including at the mouth of Lough Furnace or the Burishoole Catchment. This prevents potential impacts on salmon, trout and European eel, in turn preventing any impacts on otter.

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 desertion. 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. Moreover, a range of other habitats of relevance too fish and fisheries species will not be subject to harvesting (see Appendix 9).

  (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).

  (d) A Before-After Control-Impact experiment to assess the bottom-up effects of commercial *A. nodosum* harvest on a high trophic-level consumer group (birds) showed no evidence for strong bottom-up forcing of *A. nodosum* harvest on birds' site visitation (Johnston *et al.,* 2024).

- 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, prevent 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 and fisheries 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 affect fish and large mobile epifauna (Kelly L. *et al.*, 2001).

  Sustainable harvesting is also unlikely to impact on commercial fisheries species (fish, crustaceans and shellfish), their distribution, spawning areas, nursery areas and food sources (See Appendix 9 & 10).
- 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. A wider range of mitigation measures are provided in the Code of Practice in Appendix 4. 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. Staff and harvesters will be provided with training where necessary to ensure that all transport activities will take place using established piers and roadways. Transport will not occur in these areas.
- Control measures (if applicable): Harvest and storage activities will not occur 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: Lauzon-Guay *et al.,* 2023, shows that harvest of *A. nodosum* (at sites with a 20 + year history of commercial harvesting) does not have long-term impact on the morphology of the algae or on the abundance of its main inhabitants. A scientific review of sustainability aspects to harvesting *A. nodosum* and its use as a renewable raw material resource has also recently been published by Sujeeth *et al.* (2022). A study by Kelly *et al.*, (2001) in particular has shown that the impact of hand harvesting 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, harvesting 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 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 allow for 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 GRNs at intake and/or 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). To ensure that harvesting is carried out in a safe and practical manner, harvesters will be provided with a high level of training, where necessary, 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 an approach which prevents cutting less than 200mm (8 inches), which would represent a serious non-conformance (see Appendix 4 'Code of Practice'). This standard will be monitored by the Resource Manager and recorded on the Site Inspection 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 harvesting 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: Training will be provided to harvesters, where necessary, 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/bags.
  - Methods of removal from islands and shores.
  - Method for communicating with BioAtlantis.
  - Method for reporting incidents to BioAtlantis.

  Responsibility**:** Oversight, planning and training provided by BioAtlantis staff along with regular 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 measures (if applicable): as described for *A. nodosum* above.

Red algae, *Polysiphonia lanosa (Linnaeus) Tandy*

- Risk of affecting site/species: Low risk of potential biological hazards in the form 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 have been identified (see table 12(2a) and Appendix 5(C2a)).
- Explanation*:* This species 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 to harvesting of *A. nodosum* given the findings of Kelly L. *et al.*, 2001, in which hand harvesting had no significant impact on ephemeral green algae over time. 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(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 periwinkles (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 periwinkles 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 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 harvesting activities. For a more detailed description of habitat requirements and potential impacts of inadvertent, non-targeted removal of species such as periwinkles, please see Section 3.5.3. Overall, however, there is a reduced risk of harvesting activities negatively impacting upon periwinkles 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 affected (see Appendix 4 and below).

- Control measures (if applicable): as described for *A. nodosum* above. Additionally:
  - Reproduction: Harvesters will be trained, where necessary, to identify and avoid *A. nodosum* plants or fronds which contain visible *L. obtusata* egg 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, where necessary, to avoid *Fucus vesiculosis* and *F. serratus*, which are additional habitats for periwinkles.
  - By-catch: any *Animalia* by-catch observed post harvest will be returned to the water, where possible.

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 where necessary, to avoid *Fucus vesiculosis* and *F. serratus*.
  - By-catch: any *Animalia* by-catch observed post harvest will be returned to the water, where possible.

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 with 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 harvesting. 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 post harvest will be returned to the water, where possible. Harvesters will be required to work to ensure that co-harvesting of other species does not occur. Additional measures are outlined in the Code of Practice (Appendix 4).
- 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: 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	**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 where necessary to ensure: • No removal of permanent habitat area (i.e. preventing the removal of excessive levels of sand, shingle, pebbles, gravel, stone, etc.). • No removal of *A. nodosum* holdfasts which may carry sand, shingle, stone, etc.	• 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 excessive levels of sand, shingle/debris, etc: -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 is provided with training if necessary.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements
				C	1	5	5	L	• Routine maintenance of boat engines	Non-conformance during audit.	Regular Inspection of boat engines. Audit	Resource Manager	Ongoing basis		
				P	1	3	3	L	• Training where necessary, 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 and Site Inspection Forms.	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 is provided with training if necessary.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.
3	**Maerl Dominated communities**	**Large patches:** From main navigation	Maintain natural extent and high quality of	B	1	5	5	L	As above for seagrass *(Table 10(2))*.						

		channel leading into Westport harbour. **Other areas:** E of Inishlyre and S of Inishraher. Channel E of Inishleague channel leading to E of Inishgort lighthouse. Ilaanmore Harbour where current flow is strong e.g. between islands.	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 and Site Inspection Forms. • 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. (c) Review communication system. (d) Harvester is provided with training if necessary.	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 and Site Inspection Forms. • 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. (c) Review communication system. (d) Harvester is provided with training if necessary.	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 excessive levels of sand, shingle, shingle, stones, pebbles or holdfasts, etc).	• 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, Site Inspection Forms and production logsheets.	QC	Quarterly audit	filed and sent to management where deemed necessary (see Appendix 3 for Non-conformance Report Form (NCR). Harvester is provided with training if necessary.	
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, Site Inspection Forms 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 is provided with training if necessary	Operations meeting/ Harvest Meeting.
				P	2	5	10	M	Harvest collection boat, if applicable to the area, will be fitted with a depth finding device to ensure that there is always sufficient water. Harvester boats will be small. Training will be provided where required to advise the harvesters of the risks involved.	Non-compliance with boating code of practice.	• Inspection of boat practices by audit.	QC	Annual	Harvester is provided with training if necessary	
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 effects 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 and Site Inspection Forms.	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. (c) Review communication system. (d) Harvester is provided with training if necessary.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.

11	**Harbour seal: Effects 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 effects 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 effects 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 effects 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**	• Annual vegetation of drift lines: Distributed along	To restore the	B	1	5	10	L	Harvest will not occur in these areas.	Unauthorized transport in	As above for seagrass *(Table 10(2)).*				

	habitats	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.	favourable conservation condition (ref: Objective 3, NPWS, 2011B, pg. 15).	P	1	5	10	L	Loading and transport will be by means of existing piers and road networks	these areas.	
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. • The Code of Practice must be followed to (a) avoid or prevent disturbance or interactions with otters and (b) prevent impacts on food supply or dietary requirements. • A wider range of measures are outlined in the "Code of Practise" (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:** Examples include 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 and fisheries species**	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. A wider range of measures are outlined in the Code of Practice (Appendix 4).	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) • Site Inspection Forms. 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 is provided with training if necessary	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 densities 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 system is in place which	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	Resource Manager QC	Routinely during harvest periods & via Quarterly	Depending on the nature, source & extent of non-conformance, take the following steps: (a) Report non-conformance	Operations meeting/ Harvest Meeting.

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
									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 post-harvest will be returned to water, where possible. Teaching harvesters to avoid fronds with visible periwinkle egg masses.		(GRNs). • Site Inspection forms. 2)Monitoring: • Levels of holdfast. • Harvest technique at sites		audit Annual audit	using Non-conformance Report Form (NCR, see Appendix 3). (b)Ensure that management instructions are being adhered to. (c) Review communication system. (d) Harvester is provided with training if necessary.	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*.	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). • Site Inspection Forms. 2)Monitoring: • Levels of holdfast. • Harvest technique at sites	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 is provided with training if necessary.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.

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
									•By-catch: all *Animalia* observed post harvest will be returned to water, where possible.						
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 lower shore	None	B	1	2	2	L	As above for *A. nodosum.*						
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 amongst the seaweed.	None	B	2	2	4	L	•Harvesters will work to ensure that co-harvesting of other species does not occur. •By-catch: all *Animalia* observed post harvest will be returned to water, where possible.	Non-conformance at any stage of harvest or management.	Harvest activities will be assessed for compliance at all levels. This will include assessment of hand-harvesting training records and harvesting technique at sites	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 is provided with training if necessary.	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 significant continuous or ongoing disturbance outlined in the conservation objectives document for this SAC and the associated limits for conservation of structure and function, thereby complying with the EU Commission. Adherence with these limits is ensured as harvesting site locations and activities will be planned and recorded. The percentage of the reef and shingle which are Marine Community Types of the Annex I habitat, Large shallow Inlets and Bays [1160], that will be impacted each year is also very low. The overall area of Large shallow inlets and bays [1160] in Clew Bay is 10,188.5 hectares (https://eunis.eea.europa.eu/sites/IE0001482). The percentage of shingle to be impacted annually is 0.23% of this area, while percentage of reef to be impacted annually is 1.31%. The status and quality of the *A. nodosum* habitat will be maintained by adhering to the sustainable harvesting methods and limits specified for the extent of these harvesting activities. 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 has 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**		**Area of Large Shallow Inlets and Bays [1160] affected/annum**
		(m^2)	**(%)**	**(%)**
Zostera Community	1,423,891	0	0.0%	0.0%
Shingle	1,855,000	235,549	12.7%	0.23%
Reef	26,870,000	1,331,699	4.9%	1.31%
Maerl Dominated community	2,878,607	0	0.0%	0.0%
Fine Sands Dominated by *Nephtys cirrosa* community	2,950,308	0	0.0%	0.0%
Intertidal sandymud with *Tubificoides benedii* and *Pygospio elegans* community complex	7,817,100	0	0.0%	0.0%
Mudflats & sandflats not covered by seawater at low tide	12,541,069	0	0.0%	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 has 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 activities 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 boat ensures ease of access 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. Alternatively, harvesters may tow the floating

bags/nets from the harvest site directly to the pick-up points. In some cases, certain individuals with existing seaweed harvesting rights may prefer to land seaweed at pick up points. The seaweed will be weighed by BioAtlantis at pick up points and/or on delivery to the processing facility. The site ID or GPS location of the harvest area will be recorded.

A second GRN will also be completed on receipt of the harvested seaweed at BioAtlantis' factory in Tralee. The Resource Manager will inspect sites post-harvest to confirm that harvesters are operating as required (recorded on the SIF). 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 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* is not acceptable 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 will be provided with sufficient training, where required, 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 1-5% 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, BioAtlantis will take an approach which prevents cutting below 8 inches and training will be provided to harvesters, where necessary, on measures to ensure that 8-12 inches of the crop is left behind post-harvest.

  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. Harvesting 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 preventing cutting below 200mm (8 inches), will ensure maintenance of the canopy (see Appendix 4, 'Code of Practice' and Appendix 3, Site Inspection Form). Holdfast removal is not acceptable. 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 periwinkle and limpet habitat is unaffected. BioAtlantis do not consider *Fucus* by-catch to be acceptable and will limit by-catch at 1-5%. 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 egg masses containing a large number of eggs, on *Ascophyllum*, *Fucus vesiculosis* and *F. serratus*. The egg masses are clearly visible to the naked eye. Eggs may sometimes be laid on the surface of rocks. As part of training on approaches to mitigate against risks of reducing *L. obtusata* numbers, harvesters will be provided with training, where necessary, to identify and avoid *A. nodosum* plants or fronds which contain substantial egg 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. Training will be provided to harvesters, where necessary, on approaches to avoiding 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* egg 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 post harvest, will be collected and returned to the water, where possible (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 as harvesters will have full view and control of their activities, and will receive training where necessary. Harvesters will work to ensure that co-harvesting of other species does not occur, thus reducing the potential for trapping. As with other species, any by-catch observed post-harvest will be collected and returned to the water, where possible (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 will have full view of the cutting process and have adequate training, where necessary, 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 prevented. In effect, this avoids potential for *A. nodosum* mortality. For these reasons, BioAtlantis has 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 observed post harvest is returned to the water, where possible. Algae species such as *Fucus* are also unlikely to be disturbed or displaced, as harvesters will receive training, where necessary, 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. Furthermore, a study by UCD was undertaken in 2016 to assess the *A. nodosum* resource in Clew Bay. In addition to estimating biomass levels for *A. nodosum*, the study assessed the levels of existing harvesting, estimated biomass of *F. vesiculosis* and characterised substrata at sampled sites.

For further details on the experimental design for future trials is provided in Section 1.3.3 (d). This approach will allow staff 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 that the relevant authorities 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 authorities 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 harvesters will receive training, where necessary, 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. 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. 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, e.g. *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 harvesting 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 has 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 ~11,018 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 annum. 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 can be 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 a 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 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 and supplied to commercial companies. Details as to the quantities harvested are unknown. There is a risk therefore, for in combination effects of the proposed hand harvesting by BioAtlantis Ltd. and existing harvest activities. Also, there are risks for in combination effects associated with local companies (e.g. hotels and health Spas), who use seaweed as part of 'seaweed baths' and other health and beauty services. Some companies and individuals also offer "Seaweed harvesting discovery days", particularly in the Mulranny area. The 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 will be responsible for commercial harvesting of *A. nodosum*. To ensure compliance with Clew Bay's conservation objectives and prevent in combination or cumulative effects, the following applies:

- **Burdens and appurtenant rights to harvest seaweed:** BioAtlantis will not harvest in areas where there are existing appurtenant rights or burdens in relation to the harvesting, gathering or removal of seaweed from the shore, without first obtaining permission from the owner of such rights.
- **Profit-à-Prendre rights:** Where Profit-à-Prendre rights to harvest seaweed are successfully registered with the PRAI, the harvesting plan will be adjusted to ensure that those individuals can continue to harvest *A. nodosum.* It is envisaged that a clause may be inserted into the licence issued to allow the harvesting of *A. nodosum*, stating that if a Profit-à-Prendre right holder provides sufficient proof to their right, the licensee would be prohibited from harvesting in that area, without first obtaining permission from the owner of such rights.
- **Small scale harvesting:** Harvesting activities will not impact on other people who harvest small volumes of seaweed, edible seaweeds or invertebrates for their own personal use, e.g. dillisk, carrageenan, limpets, mussels, clams, periwinkles and scallops.
- **Commercial harvesting:**
  - If unlicensed large-scale commercial harvesting is observed to occur, this will be recorded and advice will be sought from the relevant authorities on how to proceed. BioAtlantis will not harvest in such areas until *A. nodosum* has regenerated and will work to ensure that any harvesting is limited to 20% of the total available biomass per site per annum and continuous disturbance of each community type does not exceed the required limit.
  - Any commercial user having small requirements of approximately 1 Tonne per annum (e.g. hotels, health Spas) will be identified and BioAtlantis will work to prevent in combination effects.
- **"Seaweed harvesting discovery days":** BioAtlantis will not harvest beyond Rossmurrevagh, 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 area 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 will contract those with experience in the traditional hand cutting methodology. BioAtlantis will contract traditional hand harvesters who will work 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.

(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 which may be associated with small, localized reductions in seaweed cover. 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 shellfish species (oyster, mussels, clams), culture of Atlantic Salmon and a fish hatchery (Marine Institute, 2014). Many aquaculture sites have been identified as predominating in mudflat and sandflat areas along northern and southern portions of the complex. There are other sites located in north-central Clew Bay and along the eastern shoreline. In many cases, aquaculture sites are located in proximity to sites which are sensitive to Annex II species such as harbour seals and protected bird species. There are risks therefore, that such activities may interact with hand harvesting activities and such affects must be mitigated against. There are also risks that activities associated with hand harvesting could interact with existing impacts attributed to aquaculture in these areas. A recent study by the Marine Institute (2014) assessed potential impacts of licensed and planned aquaculture activities on species and habitats in Clew Bay. The study concluded that existing aquaculture activities are non-disturbing to harbour seals species or otter species. 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). Studies by the Marine Institute (2014 and 2019) 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 has 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.
- Caution is required when approaching or operating near areas where existing aquaculture sites are known to be in relatively close proximity to harbour seal breeding sites (e.g. Inishcarrick, Inishcorky, Inishdasky, Inishilra), harbour seal moulting sites (e.g. Inisheeny), harbour seal resting sites (e.g. Inishtubrid), bird breeding sites (e.g. MoynishBeg, Inishcorky, Mauherillan) and bird wintering sites (e.g. Inisheeny).
- 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.
- Adhere to all aspects of Section 10 of the Code of Practice and other relevant sections.

See Appendix 4 for a full range of measures to prevent interaction or in combination effects with aquaculture and fisheries activities.

(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 avoided. 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 will 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 no more than 5%, 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 post-harvest will be collected and returned to the water, where possible.

See Appendix 4 for a full range of measures.

- **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, 2019). 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 removed from Clew Bay, are mainly limited to deeper waters, 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/bags are used along the intertidal zone.

- Mitigation measures (also listed in Appendix 4):
  1. By-catch: A code of practice is in place requiring harvesters to ensure that co-harvesting of other species does not occur.
  2. Inadvertent co-removal of *Animalia* will be collected and returned to the water, where possible.

See Appendix 4 for a full range of measures.

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 described 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. Planning permission has also been granted for the construction of a new reinforced concrete slipway and installation of a floating pontoon just north of Roman Island. The development will supplement proposals to develop a coastguard station in this area, and a number of other recreational uses. 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.
    3. Adhere to all aspects of Section 8 of the Code of Practice.

(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, care must be taken at Inishcorky and potentially neighbouring sites: Inishdeashmore, Inishdeasbeag, unnamed neighbouring island of Inishdeasbeag and Inishnacross (Marine Institute, 2014, 2019). The licence application for Inishcorky island is for abalone culture.

- Mitigation: Seasonal avoidance of sensitive harbour seal sites will be adhered to for all haul out sites, including Inishcorky. This will ensure that harbour seals are unaffected (Code of Practice, appendix 4).
- Caution is required when approaching or operating near areas where planned aquaculture sites are known to be in relatively close proximity to harbour seal breeding sites and bird breeding sites.

(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 *Bonamia ostreae, Botrylloides violaceus, Caprella mutica, Crassostrea gigas, Crepidula fornicate, Didemnum vexillum, Perophora japonica, Sargassum muticum Spartina anglica and Styela clava,* BioAtlantis will ensure the follows:

- 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 appropriate cleaning agents or using other suitable methods.
- All nets/bags must be cleaned with appropriate cleaning agents or using other suitable methods on delivery to production facilities and returned to harvesters in a clean condition.
- Harvesting will be limited to the *A. nodosum* zone and will not take place in subtidal areas, exposed or semi-exposed sites.
- Harvesters will keep distance from aquaculture units to prevent the spread of any species that may be associated with artificial structures.
- Harvesters will prevent disturbance to rocky substratum, will avoid co-harvesting non-*A. nodosum* material and will ensure that inadvertent by-catch of other Animalia, algae or dead, drifting material/algae will be prevented and minimized.

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 and Site Inspection 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 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 or Site Inspection Forms not been filled out correctly	• Record harvest location and pick-up points on GRNs • Inspection of GRNs and Site Inspection Forms, 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 is provided with training if necessary.	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 or Site Inspection Forms not been	• Record harvest location and pick-up points on GRNs • Inspection of GRNs and Site Inspection Forms, 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 is provided with training if necessary.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements

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: 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
										filled out correctly					
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*. •Harvesters will work to ensure that co-harvesting of other species does not occur. •By-catch: all *Animalia* observed post harvest will be returned to water, where possible.	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). • Site Inspection Forms. 2) Monitoring: • Mass of harvest. • Presence of *Fucus* sp. • Presence of holdfast. • Harvest technique at sites	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 is provided with training if necessary.	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	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.	Annual assessment not being assessed according to plan.	• Assessment of annual scientific report, datasets and statistical analysis for quality and completeness.	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,	Operations meeting/ Harvest Meeting. Annual Review of compliance

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)							
	structure as a whole)								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.		• Assessment of validity of any deviations from experimental design or measurements.			see Appendix 3). (b)Ensure that instructions by qualified scientific personnel, statisticians and other personnel are being adhered to.	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 and Site Inspection 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. (c) Review communication system. (d) Harvester is provided with training if necessary.	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 ➢ Prevent co-harvesting of other species. ➢ Return by-catch where possible	• Harvest is not being performed sustainably according to the code of practice.	• Assess GRNs. • Assess training records • Assess practices on-site (Site Inspection Forms)	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 is provided with training if necessary.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements
11	Potential interactions with coastal habitats	• Atlantic salt meadows • Sand 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 (Site Inspection Forms)	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 is provided with training	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements

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)							
														if necessary.	
12	In combination effects with other harvesting activities	• Entire SAC	Protection of Clew Bay SAC	B	2	5	10	M	• If unlicensed large-scale commercial harvesting is observed to occur, this will be recorded and advice will be sought from the relevant authorities on how to proceed. BioAtlantis will not harvest in such areas until *A. nodosum* has regenerated and will work to ensure that any harvesting is limited to 20% of the total available biomass per site per annum and continuous disturbance of each community type does not exceed the required limit. • Approach any commercial user having small requirements of ~1 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. • Do not harvest in areas where there are existing appurtenant rights or burdens in relation to the harvesting, gathering or removal of seaweed from the shore, without first obtaining permission from the person to which those rights belong. • Where Profit-à-Prendre rights to harvest seaweed are successfully registered with the PRAI, the harvesting plan must be adjusted to ensure that those individuals can continue to harvest *A. nodosum.*	• Quantities being removed exceed 1 tonne. • Other unlicensed companies continue their activities. • Harvesters not following the harvesting plan.	• Incidents are recorded on the Incident report Form (Appendix 3). This form is brought to the attention of BioAtlantis Management. • Record harvest location and pick-up points on GRNs • Inspection of GRNs and Site Inspection 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. (c) Review communication system. (d) Harvester is provided with training if necessary.. (e) Seek advice will from the relevant authorities on how to proceed.	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,	• Record harvest location and pick-up points on GRNs • Inspection of GRNs and Site Inspection 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. (c) Review communication system.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.

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)							
									• A range of other measures are outlined in the Code of Practice.	Roman island and Westport harbour				(d) Harvester is provided with training if necessary.	
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). • Prevention of impacts on navigation routes or physical interaction with aquaculture units.	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. Harvesters do not maintain sufficient distance from aquaculture units.	• Record harvest location and pick-up points on GRNs • Inspection of GRNs and Site Inspection Forms. • 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 is provided with training if necessary.	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 egg masses • Avoidance of *Fucus*, another habitat for periwinkles. • Environmentally safe navigation when operating mudflats and sandflat areas. • Use of harvesting methods that prevent co-harvesting of other species. • Return of inadvertent by-catch where possible.	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.	• Record harvest location and pick-up points on GRNs • Inspection of GRNs and Site Inspection Forms. • 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 is provided with training if necessary.	Operations meeting/ Harvest Meeting. Annual Review of compliance requirements.
16	Invasive species (spread of	• Entire SAC	Protection of Clew Bay SAC	B	1	5	5	L	The Code of Practice (Appendix 4) requires:	Collection boat (if applicable to area)	• Check records for annual treatment	Resource Manager	Quarterly audit	Depending on the nature, source & extent of non-conformance, take the	Operations meeting/ Harvest

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)							
	Didemnum vexillum, *Styela clava,* etc).								• 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 appropriate cleaning agents or using other suitable methods. • All nets/bags must be cleaned with appropriate cleaning agents or using other suitable methods on delivery to production facilities and returned to harvesters in a clean condition. • Harvesting will be limited to the *A. nodosum* zone and will not take place in subtidal areas, exposed or semi-exposed sites. • Harvesters will keep distance from aquaculture units to prevent the spread of any species that may be associated with artificial structures. • Harvesters will prevent disturbance to rocky substratum, will avoid co-harvesting non-*A. nodosum* material and will ensure that inadvertent by-catch of other Animalia, algae or dead, drifting material/algae will be prevented and minimized.	not being painted. Harvesters not adhering to cleaning procedures when leaving Clew Bay. Nets/bags not being cleaned in production facilities. Unauthorized navigation.	with anti-fouling paint. • Check cleaning records in production facilities. • On-site inspections. • Incident report forms	QC	Annual audit	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 is provided with training if necessary.	Meeting. Annual Review of compliance requirements.

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

3.6.7 The conservation status of marine Annex I habitats in Clew Bay Complex SAC.

A national conservation assessment indicates that shallow inlets and bays [1160] in Ireland is classified as 'unfavourable-bad' (Scally et al., 2020). The 'area' conservation attribute is classified as 'favourable', while 'structure & functions' and 'future prospects' are considered as 'unfavourable-bad' and 'unfavourable-inadequate' respectively. Clew Bay is categorized as 'unfavourable-bad' for three attributes: 'structure & functions' and 'future prospects' and 'overall site assessment'. In their report, Scally et al., (2020) assessed the status of community distribution in Large shallow inlets and bays in Clew Bay. Their study included an assessment of three community/habitats: (a) Sandy mud with polychaetes and bivalves community, (b) Fine sand dominated by Nephtys cirrosa community and (c) Intertidal sandy mud with *Tubificoides benedii* and *Pygospio elegans* community. Sampling took place in subtidal and intertidal sediment areas and in mudflat/sandflat habitats. The unfavourable status of Clew Bay was attributed to the loss of eelgrass beds, a significant decrease in the abundance of eelgrass shoots within a bed and an increase in negative indicators, e.g. epiphytic algal cover on eelgrass leaves, the presence of opportunistic species and invasive alien species. In terms of 'area', Clew Bay SAC is classified as favourable. At a national level, the conservation status of Reef in Ireland has been assessed as 'Favourable' in terms of Area, Structure and function, future prospects. This includes both inshore and offshore reef areas (Scally et al., 2020).

As outlined in Appendix 5 (i), measures are in place to ensure that the conservation status of Annex I habitats in Clew Bay SAC are maintained, encompassing the following major categories where relevant:
(1) Sandbanks which are slightly covered by sea water all the time [1110]
(2) Estuaries [1130]
(3) Mudflats and sandflats not covered by seawater at low tide [1140]
(4) Reefs [1170]
(5) Submerged or partially submerged sea caves [8330].
(6) Large shallow inlets and bays [1160]

Harvesting will not take place in areas categorized as unfavourable, unless mitigation measures are in place to ensure they are unaffected. While Mudflats and sandflats not covered by seawater at low tide [1140] are in favourable condition in Clew Bay, they are considered as being in Unfavourable-Inadequate condition on a national level. Harvesting will not take place in this habitat and measures are in place to ensure mudflats and sandflats are unaffected when travelling to and from sites (see Appendix 4 and 5). While 'submerged or partially submerged sea caves' [8330] and 'Sandbanks which are slightly covered by sea water all the time [1110]' are in favourable condition, harvesting will not take place in these areas. Mitigation measures are in place to ensure that harvesting does not impact on Estuaries (1130) which are categorized as Unfavourable-Inadequate at national level.

Large shallow inlets and bays [1160] is a broad category with 5 attributes encompassing 7 habitats/community types: Sandy mud with polychaetes and bivalves community complex, Fine sand dominated by *Nephtys cirrosa* community, Intertidal sandy mud with Tubificoides benedii and *Pygospio elegans* community complex, Shingle, Reef. The overall conservation

status of Large shallow inlets and bays, both on a national level and in Clew Bay SAC, is considered as 'Unfavourable-Bad'. In the context of Clew Bay, the 'Unfavourable-Bad' conservation status has been attributed to impacts *Zostera* spp. (Scally et al., 2020). *A. nodosum* harvesting will not take place in areas where *Zostera* spp. grows. In addition, *A. nodosum* harvesting will not take place in soft substratum areas (intertidal and subtidal mud/sandy mud areas) and mitigation measures are in place to ensure they are unaffected during travel to and from harvesting sites.

Reef represents a subcategory of Large shallow inlets and bays [1160] whilst also forming a stand-alone Annex 1 habitat category (Reef [1170]). According to Scally et al. (2020), Reef [1170] in Ireland is categorized as being in a 'favourable conservation' condition. This includes intertidal and subtidal reef areas. *A. nodosum* harvesting will take place in intertidal reef areas, subject to close compliance with mitigation measures listed in Appendix 4 of this application. This will ensure that Reef [1170] is maintained in favourable conservation condition in terms of area, structure and function and future prospects.

The percentage of the reef and shingle which are Marine Community Types of the Annex I habitat, Large shallow Inlets and Bays [1160], that will be impacted each year is very low. The overall area of Large shallow inlets and bays [1160] in Clew Bay is 10,188.5 hectares (https://eunis.eea.europa.eu/sites/IE0001482). The percentage of shingle to be impacted annually is 0.23% of this area, while percentage of reef to be impacted annually is 1.31%. The evidence from the literature suggests that the potential for effects to arise as a result of sustainable hand harvesting of *Ascophyllum nodosum*, are limited. For example, Kelly et al., 2001, shows that *A. nodosum* regenerates 11 to 17 months post harvesting. Kelly et al., 2001, also demonstrates that there are no impacts of harvesting on overall biodiversity, mobile epifauna and fish 11 to 17 months post-harvesting. A study by Lauzon-Guay et al., 2023, shows that harvest of *A. nodosum* (at sites with a 20 + year history of commercial harvesting) does not have long-term impact on the morphology of the algae or on the abundance of its main inhabitants. Therefore, It is considered unlikely that sustainable hand harvesting of *Ascophyllum nodosum* would give rise to any no further effects on Large Shallow Inlets and Bays [1160] in Clew Bay. However, mitigation measures are in place to ensure that no further effects occur, particularly areas where harvesting will take place such as reef and shingle areas.

3.6.8 Potential pressures on the marine environment.

An independent expert group recently issued a report which identified a range of potential pressures in Ireland's marine environment resulting from human activity (See Marine Protected Area Advisory Group, 2020 and references therein). Based on the information provided in this report, an additional hazard analysis was undertaken (see Appendix 5(j)) to identify and mitigate against any potential effects of *A. nodosum* harvesting on the marine environment. The potential for interactions, in combination effects and cumulative effects (due to *A. nodosum* harvesting and other human activities), were also assessed and mitigation measures put in place where required (see Appendix 7).

3.6.9 Ensuring recovery of harvested areas.

The potential for cumulative and in combination impacts are outlined in this application. This includes impacts associated with planned and existing activities such as seaweed harvesting. The proposed harvest levels in this application are considered sustainable and measures are in place to ensure that sites have recovered before harvesting takes place again.

In terms of fallowing periods, data will be entered in the database as described in Table 5. The maximum harvest available from each island or coastal zone has been estimated and the nominal recovery time is will be 3-5 years from a complete harvest, or potentially within 11 to 17 months post-harvest given the post-harvest recovery rates reported by Kelly et al., 2001. BioAtlantis will harvest a maximum 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 biomass harvested per site per annum (the Maximum Annual Harvest). This is outlined in Section 1.3.3, of this document, under "Planning & scheduling of harvesting activities". If quota is exceeded, the Resource Manager will issue a Non-Conformance Report (NRC) to BioAtlantis management. Harvesters will be provided with training if necessary.

As *A. nodosum* biomass can potentially recover within 11 to 17 months (Kelly et al., 2002), it may be possible therefore to harvest year on year in certain locations; however this is subject to recovery being achieved. As outlined in this application, measures will be put in place to ensure that harvesting does not take place if a site has not recovered from the previous year, thus preventing cumulative effects from occurring. BioAtlantis will be required to verify that each site has fully recovered prior to re-harvesting. This will be done via on-site assessments and updating the plan as necessary with the results of this analysis. Cumulative effects will therefore be very limited.

As outlined in this application, harvesting will not take place in areas with existing appurtenant rights/burdens in relation to seaweed, without first obtaining permission from the person to whom those rights belong. Where Profit-à-Prendre harvesting rights are successfully registered with the Property Registration Authority of Ireland (PRAI), the harvesting plans must be adjusted to ensure that those individuals can continue to harvest *A. nodosum*. It is envisaged that a clause may be inserted into the licence issued to allow the harvesting of *A. nodosum*, stating that if a Profit-à-Prendre right holder provides sufficient proof to their right, the licensee would be prohibited from harvesting in that area, without first obtaining permission from the owner of such rights. If unlicensed large-scale commercial harvesting is observed to occur, this will be recorded and advice will be sought from the relevant authorities on how to proceed. The Resource Manager will routinely inspect sites post-harvest to ensure compliance of harvesters with sustainable hand harvest methods. Harvest will be recorded using BioAtlantis Compliance and Record Forms.

A pre-license survey study of Clew Bay was undertaken by UCD and submitted with this application. This study included an assessment of *A. nodosum* biomass and an assessment of the extent of existing harvesting activities. Key findings from the report included: (a) There was

evidence of harvesting at 26 out of the 40 sampled sites. The intensity of harvesting varied across these sites, (b) Six, eight and twelve sites exhibited evidence of low, moderate and increased levels of harvesting respectively, and (c) There was no evidence of harvesting at 18 out of 40 sites sampled. The measures outlined above ensure the recovery of harvest areas and prevention of cumulative impacts with unlicensed harvesting, particularly in relation to appurtenant rights/burdens and Profit-à-Prendre rights.

A pre-harvesting survey of an unharvested site will be undertaken to assess the recovery of *A. nodosum* harvesting over the life-time of the licence. This is outlined in Section 1.3.3 of BioAtlantis' application (under "Operation/Activity 4: Long term assessment biomass and community structure") and Section 3.5.3 (under "The potential interaction effects of seaweed harvesting"). Parameters by which recovery will be assessed include: rates of re-growth of *A. nodosum*, biomass (Kg/m2) and numbers and/or density of *A. nodosum* plants per area (as outlined in Section 1.3.3 and Section 3.5.3 of the BioAtlantis application). These measures ensure that recovery will be assessed over the lifetime of the license.

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 has 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. Following a period of public consultation, the application and NIS were revised further between 2020 and 2024.

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 updated NIS was prepared by Ecofact Environmental Consultants Ltd. between 2020 to 2024 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 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 potential benefits 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. concludes:

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

The Clew Bay Complex SAC, within the activities area of the proposed Foreshore Licence Application was assessed with particular regard to potential impacts affecting qualifying interests of the designation, including Annex I habitats (large shallow inlets and bays) and Annex II listed mammal species. It is evaluated that the proposal will not have a significant adverse effect on this Natura 2000 site; with the implementation of prescribed mitigation measures. These mitigation measures are incorporated into the updated Foreshore Licence Application (BioAtlantis, 2024) and in particular, the associated 'Code of Practice' in order to ensure the avoidance of significant impacts on these sensitive receptors. There will therefore, be no long-term impact on the integrity of the Clew Bay Complex SAC site.

From examination of the information available, it is considered that as long as all mitigation measures listed in this NIS are adhered to, there will be no impacts on the integrity of the Clew Bay Complex SAC as a result of the proposed hand harvesting of A. nodosum in Clew Bay by BioAtlantis Ltd. This conclusion and the supporting evidence is provided in order to allow the Competent Authority to complete the Appropriate Assessment process for the proposed project."

This document describes the nature and extent of BioAtlantis' application, including a range of effective measures to prevent impacts from occurring. On gaining the approval by the Department of Housing, Local Government and Heritage, BioAtlantis will work towards implementing the sustainable hand harvesting system and is committed to ensuring that activities will have no impacts which would affect the integrity of this SAC. BioAtlantis has already benefited from consultations with the NPWS, IFI and Clew Bay hand harvesters and wish to extend consultations further. 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. Overall, this represents an excellent opportunity in which to improve the management of sustainable harvesting, in line with EU and Irish environmental laws, whilst also helping to drive the development of the blue bioeconomy along the western seaboard of Ireland.

Section 5: Bibliography

Allen et al., 1984 89
Andersen et al., 2011 89
Anon 2013 88
Anon, 2002 77
Ashwell-Erickson et al., 1986 89
Baardseth E, 1949 19
Baardseth E, 1955 ..... 19, 100
Bailey and Rochford 2006 69
Bejder et al., 2009 89
BioMar, 1995 77
Boaden and Dring, 1980 ..... 100, 106
Brinkhuis BH, Jones RF, 1976 126
Callaway, R. M. 2007 126
Davies et al., 2007 121
DoEHLG (2009) 149
Dúchas, 1999 77
Geiselman, JA., and McConnell OJ, 1981 104
Gerard et al., 1999 126
Gollety et al., 2008 125
Guinan KJ et al., 2013 ..... 21, 26, 30, 129
Guiry, M. and L. Morrison, 2013 ..... 19, 52
Guiry, M.D. & Guiry, G.M., 2013 103
Henry and Hammil, 2001 90
Henry and Hammill 2001 89
Henry and Hammill, 2001 89
Hession C, et al., 1998 ..... passim
Hurd, CL et al., 2014 124
Hynes P, 2014 135
Johnson et al., 2007 ..... 89, 90
Jones and Jones, 2002 69
Karleskint et al. 2009 121
Kelly L. et al., 2001 ..... passim
Kirk McClure Morton, and MarEnCo 2013 124
Marine Institute 2014 ..... 132, 136
Marnell et al., 2011 69
Maun, 2009 127
Mayo County Council 2010 135
McCorry & Ryle, 2009 77
McCorry, 2007 77

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

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

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

Anon (2016). Code of Conduct. Hampshire & Isle of Wight Wildlife Trust in partnership with Chichester Harbour Conservancy.

Ashwell-Erickson, S., Fay, F. H., Elsner, R. & Wartzok, D. (1986) Metabolic and hormonal correlates of moulting and regeneration of pelage in Alaskan harbour and spotted seals (Phoca vitulina and Phoca largha). Can. J. Zool. 64, 1086–1094.

Baardseth E (1949) Regrowth of *Ascophyllum nodosum* after harvesting. Report to Institute for Industrial Research and Standards, Dublin. Typewritten manuscript at NUI Galway

Baardseth E (1955) Regrowth of *Ascophyllum nodosum* after harvesting. Institute for Industrial Research and Standards, Dublin

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

Bejder, L., Samuels, A., Whitehead, H., Finn, H., Allen, S., 2009. Impact assessment research: use and misuse of habituation, sensitisation and tolerance in describing wildlife responses to anthropogenic stimuli. Marine Ecology Progress Series 395, 177e185.

BioMar (1995). Survey of the Achill Island and Clew Bay area, Co. Mayo.

Boaden, P.J.S. & Dring, M.T., (1980). A quantitative evaluation of the effects of Ascophyllum harvesting on the littoral ecosystem. Helgolander Meeresuntersuchungen, 33: 700-710.

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

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

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

Dúchas (1999). A Survey of Selected Littoral and Sublittoral Sites in Clew Bay, Co.Mayo. A report prepared by Aqua-Fact International Ltd for Dúchas, Department of Arts Heritage and the Gaeltacht, Ireland.

Geiselman, J. A., and O. J. McConnell. 1981. Polyphenols in brown algae *Fucus vesiculosis* and Ascophyl/um nodosum: chemical defenses against the marine herbivorous snail, *Littorina littorea*. Journal of Chemical Ecology 7: ll15-ll33.

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

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

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

Guiry, M.D. & Guiry, G.M. 2013. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org; searched on 28 August 2013.

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

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

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

Hynes P,. (2014). Adopted Annual Budget for Mayo County Council. Accessed: 16/09/2014.

Ireland's Ocean Economy (2010). Socio-Economic Marine Research Unit (SEMRU), National University of Ireland, Galway. Authors: Morrissey K, Hynes S, Cuddy M, O'Donoghue C.

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

Johnston EM, Klemmer AJ, Braun LA, Mittelstaedt HN, Muhlin JF, Webber HM, Olsen BJ (2024). Evaluating bottom-up forcing of a rocky intertidal resource harvest on a high trophic-level consumer group. Estuarine, Coastal and Shelf Science. Jan 6:108627.

Jones, T. & Jones, D. 2004. Otter Survey of Wales 2002. Environment Agency, Bristol.

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

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

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

Lauzon-Guay, Jean-Sébastien, Alison I. Feibel, Bryan L. Morse, and Raúl A. Ugarte."Morphology of Ascophyllum nodosum in relation to commercial harvesting in New Brunswick, Canada." Journal of Applied Phycology (2023): 1-11. https://link.springer.com/article/10.1007/s10811-023-03028-6

Marine Institute (2014). Report supporting Appropriate Assessment of Aquaculture and Risk Assessment of Fisheries in Clew Bay Complex SAC (Site Code: 1482). Accessed: 15/09/2014

Marine Institute (2019). Report supporting Appropriate Assessment of Aquaculture and Risk Assessment of Fisheries in Clew Bay Complex SAC (Site Code: 1482).

Marine Protected Area Advisory Group (2020). Expanding Ireland's Marine Protected Area Network: A report by the Marine Protected Area Advisory Group. Report for the Department of Housing, Local Government and Heritage, Ireland. web: https://www.gov.ie/en/publication/135a8-expanding-irelands-marine-protected-area-network/

Marnell, F., O'Neill, L. and Lynn, D. (2011) How To Calculate Range And Population Size For The Otter? The Irish Approach As A Case Study. Proceedings of XIth International Otter Colloquium, IUCN Otter Spec. Group Bull. 28B: 15 – 22.

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

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

McCorry M (2007). Saltmarsh Monitoring Project 2006. Unpublished report to the National Parks and Wildlife Service, Dublin.

McCorry M, & Ryle T (2009). Saltmarsh Monitoring Project 2007-2008. Unpublished report to the National Parks and Wildlife Service, Dublin.

Merc Consultants (2006). Report. Surveys of sensitive subtidal benthic communities in Slyne Head Peninsula SAC, Clew Bay Complex SAC, Galway Bay Complex SAC.

Minch Project (1995) Littoral seaweed resource assessment & management in the Western Isles, Report prepared by Environment & Resource Technology Ltd. Accessed 09/05/2013)

Moore D & Wilson F (1999) National Shingle Beach Survey of Ireland 1999. Unpublished report to NPWS, Dublin.

Newport Sewerage Scheme EIS (2007). Chapter 3.9, pages 161-162. Accessed: 15/09/2014

NPWS (2007). The status of EU protected habitats and species in Ireland. National Parks & Wildlife Service, Dublin, Ireland.

NPWS, 2011AClew Bay SAC (site code: 1482). Conservation objectives supporting document –marine habitats and species.

NPWS, 2011B Clew Bay SAC (site code: 1482). Conservation objectives supporting document –coastal habitats.

NPWS, 2011C. Clew Bay SAC (site code: 1482). Conservation objectives. Version 1.0, 19th July, 2011

NPWS (2012). Marine Natura Impact Statements in Irish Special Areas Of Conservation (A working document). Prepared By The National Parks & Wildlife Service of Ireland.

NPWS (2013). Rogerstown Estuary Special Protection Area (Site Code 4015). Conservation Objectives Supporting Document VERSION 1. page 30.

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

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

Phalan, B. and Nairn, R. (2008). Disturbance to waterbirds in South Dublin Bay. Irish Birds 8: 223-230.

Ryle T, Murray A, Connolly K and Swann M (2009). Coastal Monitoring Project 2004-

2006. Unpublished report to the National Parks and Wildlife Service, Dublin.

Scally L, Pfeiffer N, Hewitt E (2020). The monitoring and assessment of six EU Habitats Directive Annex I Marine Habitats. Irish Wildlife Manuals, No. 118. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

Sea Change, A Marine Knowledge, Research and Innovation Strategy for Ireland, 2007-2013 (2006). Marine Institute.

Steen, H (2009). Chapter 2.11. Stortare. Kyst og havbruk 2009: 211-214. Institute of Marine Research.

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

Sujeeth, N., Petrov, V., Guinan, K.J., Rasul, F., O'Sullivan, J.T. and Gechev, T.S., 2022. Current insights into the molecular mode of action of seaweed-based biostimulants and the sustainability of seaweeds as raw material resources. *International Journal of Molecular Sciences*, *23*(14), p.7654. https://www.mdpi.com/1422-0067/23/14/7654

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

Ugarte,R.&G.J. Sharp (2011A). Management and production of the brown algae *Ascophyllum nodosum* in the Canadian maritimes. Journal of Applied Phycology.

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

Valsdóttir P *et al.*, (2011). Seaweed in Iceland. Presentation. Accessed 08/05/2013.)

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

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

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