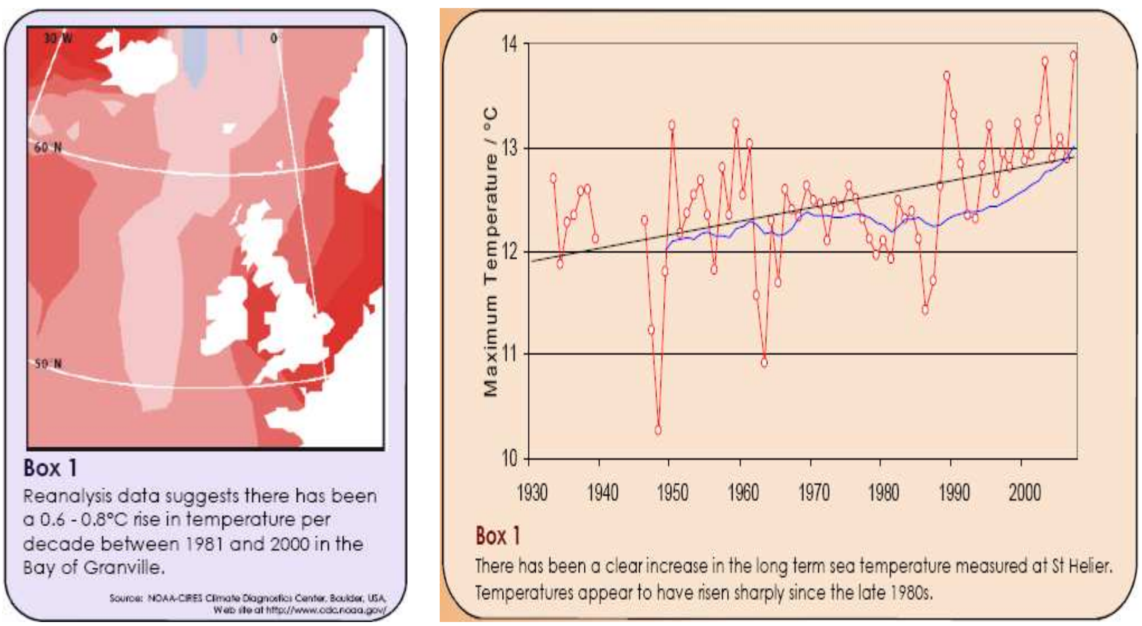
SECTION 9 – CLIMATE CHANGE

9.1 Introduction

Climate change is likely to have a significant impact upon Jersey fisheries and aquaculture through a variety of mechanisms some of which may be predicted, others of which are at this stage unknown. This Section considers potential impacts upon water quality, algal blooms, shellfish diseases, public health, productivity, non-native species proliferation and ocean acidification. Some of these issues have been raised in the ECO-ACTIVE 'Turning Point' report to assess the impact upon Jersey (Eco-Active 2009).

There are indications that climate change impact upon sea surface temperatures has already occurred as highlighted in Figure 21 below.

Figure 21. Sea surface temperature warming around Jersey (Source: ECO-ACTIVE 2009)



The United Kingdom Marine Climate Change Impacts Partnership (MCCIP) brings together scientists, government, its agencies and NGOs to provide co-ordinated advice on climate change impacts around our coast and in our seas. The primary aim of the MCCIP is to provide a co-ordinating framework within the UK for the transfer of high-quality marine climate change impacts evidence and advice to policy advisors and decision-makers. The work of the MCCIP is well summarised in a series of Annual Report Cards which give an overview of marine climate impacts.

It should be noted that whilst most climate change predictions for sea surface temperature indicate a warming of up to 0.4ºC/decade there are also suggestions that changes to the polar melting regime could cause the North Atlantic Conveyor (which drives the Gulf Stream) to weaken by 30% which could alternatively allow localised cooling to Britain and the western approaches. This highlights that whilst it is likely that climate change could have a significant impact upon the aquaculture industry there is a high degree of uncertainty as to what changes will occur and their actual likely severity.

9.2 Water Quality

The quality of coastal waters may be adversely affected due to increased storm water overflows which can impact upon shellfish harvesting water classifications. FitzGerald (2008) considers the influence of climate change upon intermittent discharges and their associated impact upon shellfish quality. For mainland UK, modelled rainfall predictions have been obtained and input into sewerage models to assess spill performance. This work has demonstrated that the current system design will be insufficient to maintain current shellfish waters' CSO spill frequency of <10 significant spills/annum. Financial estimates for mainland UK using traditional storm water storage technology indicate a national cost of £10-15 billion to meet existing bathing water and shellfish water spill frequencies. OFWAT has recognised that this level of resource requirement is unsustainable and that new approaches will be needed to manage future threats.

Catchment sources from some agricultural practices can also provide intermittent first flush pollution events as described in Section 6.2. These diffuse sources are also likely to have a high potential to impact on shellfish classification with increased storm intensity. However, the relative significance between agricultural faecal coliform loads and human waste water loads may be skewed with the advent of future regulation based upon a norovirus standard.

In the case of Jersey with its much higher aspirations for storm water storage to retain CSO spills the challenge will be considerably greater. There is already an indication that the Cavern, designed to contain 1:10 year storms, is being utilised on numerous occasions every year. In consequence, Transport and Technical Services are attempting to maintain the 'no deterioration' requirement against an increasingly difficult backdrop where most of the easy to achieve low cost options have already been addressed. It is probable that unless there is a political will and resources to undertake massive flow separation between crude waste water and surface water, then spill frequency and magnitude from Jersey's combined sewerage system will increase. Increased waste water contamination of marine waters is likely to compromise both Classification status and to increase viral loading with consequent human health implications.

A new sewerage hydrometric model is currently being constructed for the St. Helier sewerage network – this is an ideal opportunity to link up to projected storm simulation output from the latest generation of 'weather generator' models which have been designed to utilise the UKCIP09 regional climate change model output. It is probable that future shellfish management will need to be based upon a proactive model which is responsive to changing threats. A better understanding between rainfall events and storm spills is one area where the responsible agencies may be able to provide industry with an early warning system which could allow selective harvesting i.e. proactive shellfish management (see also Section 6.5).

9.3 Harmful Algal Blooms

The MCCIP Report Card 2007/2008 (MCCIP, 2007) indicated that Harmful Algal Blooms (HABs) in the last 50 years, especially since the 1980's, have increased in some areas of the north Atlantic as seas have warmed.

Increased nutrient loading from the land could have implications for HABs as considered in Section 6.7 especially in view of the potential hyper-nutrification in St. Aubins Bay. However, the temperature and dynamics of the water movement will be critical in determining whether a bloom becomes established.

As outlined in Section 6.7, HAB's can give rise both to shellfish mortality and cause shellfish poisoning to consumers. To date shellfish and water samples from Jersey analysed for DSP, ASP, PSP toxins have all come back negative. However, Eco-Active 2009 highlighted a number of changes to long term plankton populations in the waters of the English Channel and Channel Islands.

This included:

> "An increase in the occurrence of *Noctiluca scintillans*, a potentially harmful (to fish and invertebrates) phytoplankton species. These trends are likely to continue, due to an increase in warming, and will have an effect on which fish species (both fin- and shell-) can be commercially harvested in the future" (Eco-Active 2009).

9.4 Shellfish Disease Issues

A number of shellfish diseases have a temperature dependant impact either because of increased pathogen virility or increased stress at high temperatures often as a result of a reduced dissolved oxygen carrying capacity. In some circumstances diseases associated with stress may occur following a summer spawning event, again when animals are at their weakest.

Eco-Active 2009 highlights that there is a clear warming trend with 8 of the 10 warmest years on record occurring since 1989. Analysis of sea surface temperature data from St. Helier illustrates this feature in Figure 22 below.

Figure 22. Mean summer sea temperatures for St. Helier (data for St. Helier from Jersey Meteorological Office)

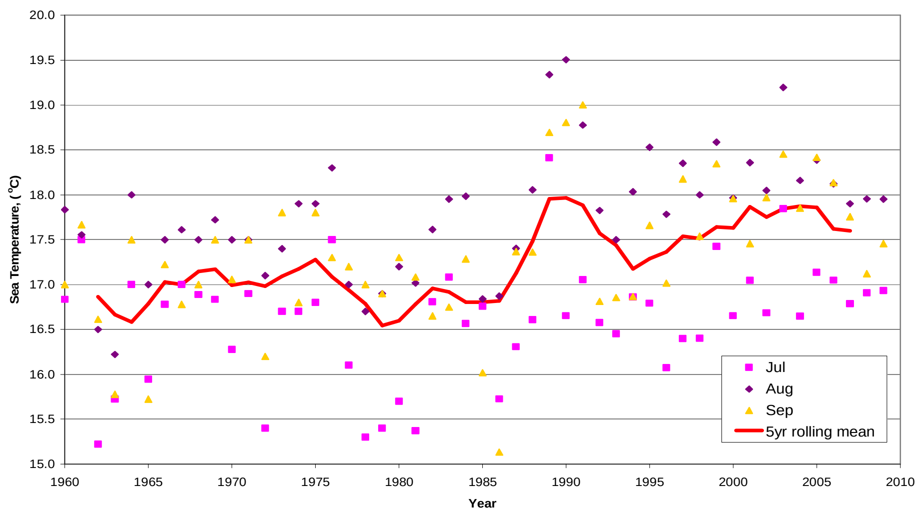


Figure 22 provides the historical summer mean sea temperatures for St. Helier which show that since 1989 summer temperatures have predominantly been above 17.5ºC and with extended periods above 18ºC. This highlights the increased risk posed by climate change.

Oyster herpes virus has been associated with massive 'summer mortalities' which have swept through the French oyster fishery and decimated production over the last couple of years. In 2009 the disease hit Jersey as described in Section 8.

Vibrio harveyi, (a bacterium) and *Xenohaliotis californiensis* (a rickettsia protozoan) are both pathogens of ormers with a well documented relationship between mortality and summer temperatures. Huchette & Clavier (2004) document the spread of *V. harveyi* through the wild ormer population during which testing by Ifremer demonstrated 17ºC as a critical temperature threshold. As this disease is considered endemic, temperature will be a key parameter influencing mortality in 'naive' exposed stock. Work is underway within SUDEVAB

(Sustainable Development of European SMEs Engaged in Abalone Aquaculture) a Framework 7 SME project which has incorporated significant research effort into understanding the disease and in selection of disease resistant stock.

9.5 Public Health

Some infectious shellfish borne pathogens such as *Vibrio parahaemolyticus* are strongly influenced by temperatures. *V. parahaemolyticus* is associated with seafood consumption and has a high level of incidence in Japan with increasing impact in many parts of the US. *V. parahaemolyticus* has been recorded within the English Channel and has been highlighted as a significant potential threat by Cefas and Ifremer. Whilst there have been no reported outbreaks from UK stocks, *V. parahaemolyticus* is routinely isolated by Cefas in shellfish samples. The level of impact in the environment and within seafood products have been shown to be temperature dependent with rapid growth occurring at temperatures >16˚C. Wagley and Rangdale (2007) highlight the risk that global warming may lead to an increase in incidence of seafood associated food poisoning from this pathogen. In view of the summer sea temperatures in Jersey (Figure 22) exceeding 16˚C for extended periods there is a potential to support this pathogen. Fortunately to date no incidences of this disease have been recorded in Jersey (see Section 6.6).

A major cause for concern about this bacterium relative to other microbes is that *V. parahaemolyticus* is not efficiently removed by the cleansing depuration process employed with most shellfish. Croci *et al.* (2002) working with mussels showed that depuration of *V. parahaemolyticus* was much less effective than for the *E. coli* indicator. Indeed Chae *et al.* (2009) showed that increased temperatures (22ºC) decreased depuration efficacy at removing *V. parahaemolyticus* from oysters which means that purification of contaminated shellfish may be problematic.

Excessive seaweed growth and decay could also be a potential threat to human health threat as was demonstrated by the high profile *Ulva* (green sea lettuce) deposits on Brittany beaches. High nutrient levels in the seawater and warm summer temperatures can, under suitable conditions, allow massive build-ups of weed which once deposited on a beach can rapidly rot and generate poisonous hydrogen sulphide. Hydrogen sulphide, which smells of rotten eggs, is not only toxic to invertebrates but was reported to have killed dogs, a horse and placed a council worker in a coma. Although the human health risk on Jersey beaches is probably quite limited, beach management will need to consider this issue especially in terms of odour nuisance value.

9.6 Productivity

Shellfish growth is a function of both food availability and species specific temperature requirements. Climate change could influence both phytoplankton levels and the temperature regime which will impact upon productivity with unknown consequences. In addition seed availability could well be adversely affected by climate change.

The blue mussel is a cold water species and is therefore under threat from warming seas. A level of 27^{o}C has been suggested as an upper long-term temperature limit for the blue mussel which is unlikely to be reached. However, the growth rate of mussel larvae increases progressively above 5^{o}C to a maximum at around 16^{o}C which is already exceeded by summer temperatures in Jersey waters.

Whilst it is possible that seed mussel availability might be compromised by increased sea temperatures, it should be noted that wider ecosystem effects can also indirectly impact upon commercial species. This has been demonstrated by the decline of the blue mussel in the Waddensea which has been attributed to milder winters which allow increased predation by the green shore crab upon the small young mussel spat in the late spring. The increased sea temperatures in that region have had the added effect of encouraging the settlement of Pacific oysters, a temperate species, resulting in a potentially long-term change in the marine ecosystem of the Waddensea.

9.7 Non-Native Species

The major concern with non-native species is their potential to become 'invasive' if they become established and out compete indigenous species. It is generally accepted that only a 10^{th} of non-native species become established and of them only a 10^{th} then go on to impact the ecosystem and become invasive. However, because of the high potential of these species to alter either species or habitat biodiversity and their associated economic impact they feature as a major cause of concern.

As the distributions of non-native marine species are limited by water temperature, future temperature increases could enable more species to invade and become established so replacing current species. The vector of movement for non-native animals into an area has become the major emphasis for regulators with increasingly stringent controls on ballast water and stock movements such as aquaculture imports.

In the UK the seaweed *Sargassum muticum* (Japweed), the Chinese mitten crab and the slipper limpet are at the top of the list of undesirable non-native species listed within Schedule 9 of the Wildlife and Countryside Act. Both *Sargassum* and the slipper limpet are now common along French and Jersey coastlines as is wild settlement of the Pacific oyster which is seen in the UK by the conservation agencies as an emerging non-native invasive species. Consideration of non-native issues by the Marine Biological Association in the ECO-ACTIVE report did not however specifically mention slipper limpets or Pacific oysters. There may in fact also be considerable confusion over what is considered a native or non-native, often arising from differing interpretations or definitions of the term non-native. For instance *M. edulis* may be considered by some to be a non-native species with *Mytilus galloprovincialis* possibly being the regional shore mussel (Societe Jersiaise, pers. comm.).

A review of the impact of slipper limpets with case studies from Brittany is provided in FitzGerald 2007a. The slipper limpet first settled in French waters following the Normandy invasion in WWII. Migration around the French coast has then been through aquaculture movements and larval dispersion. Population levels in the Bay of Mont St. Michael, St. Brieuc Bay and the Bay of Brest are considered highly problematic with significant impact upon both the native oyster and scallop fisheries. Biomass estimates of slipper limpets for these areas are staggering with a calculated 450,000t in St. Brieuc Bay, 150,000t in Mont St. Michael Bay and 120,000t in the Bay of Brest (all these estimates are historical and subject to recent growth).

The high rate of growth has continued despite industrial scale removal (30,000t/yr) of slipper limpets from St. Brieuc and Mont St. Michael Bays. Under these circumstances of superabundance the slipper limpets form a carpet on the seabed which lays down pseudofaeces and cements the seabed into a cohesive mud/shell layer which can actively prevent dredging. Scallops in particular can suffer a high level of infestation on their shells which can limit their ability to swim and poses additional handling costs to fishermen.

Blanchard and Ehrhold (1999) estimated large quantities of slipper limpets in Mont Saint Michel Bay, the Cotentin region and offshore of the Channel Islands. The impact of warming temperatures upon the slipper limpet is well known with successful recruitment above $10^{o}C$ and the ability for multiple spawning above $15^{o}C$. However, the potential for runaway growth is also dependant on site specific features especially as the sessile slipper limpet does not perform well on high energy mobile sediments.

Figure 23. Slipper limpet settled on a Jersey mussel (Source: Aquafish Solutions Ltd.)

Consultees for the Jersey Aquaculture Strategy did not view slipper limpets as a major concern although it is suggested that baseline monitoring should be established to assess the level of the problem and the position of 'hotspots.' The view that slipper limpets were not yet seen as a pest for aquaculture was confirmed by Fisheries and Marine Resources although they did state that settlement on whelks is causing a problem for commercial fishermen due to the difficulties that this causes with grading (S. Bossy, pers. comm.). It is accepted that current management options to remove slipper limpets are likely to be ineffective.

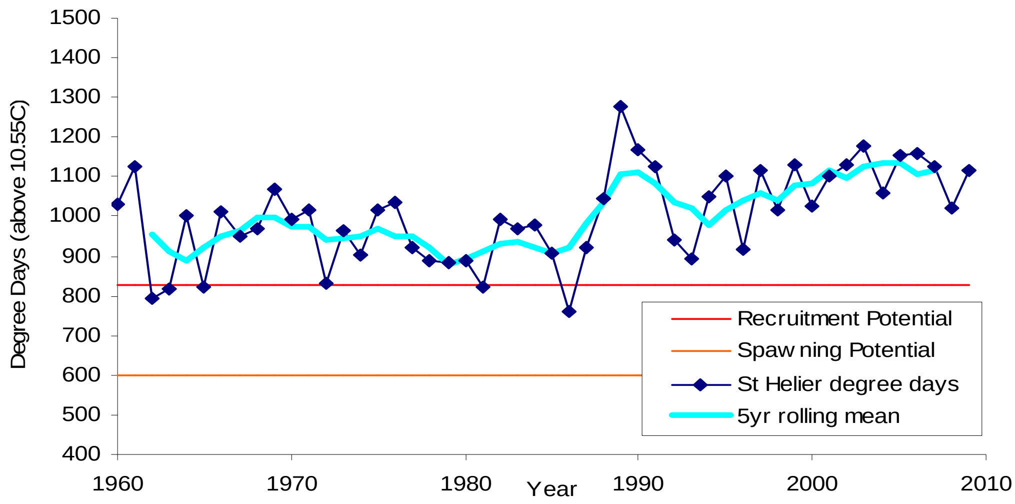
Strategy Option: Undertake baseline monitoring of invasive non-native species such as the slipper limpet to ascertain if impacts are increasing on marine activities such as aquaculture or commercial fishing.

Recently in the UK the wild settlement of the Pacific oyster has also raised concerns about potential impacts of this major aquaculture species prompting restrictions to the granting of future permits to culture diploid stock in Special Areas of Conservation.

A Pacific Oyster Protocol (POP) Project was undertaken to try and harmonise a joint conservation / industry management approach towards this species (Syvret & FitzGerald, 2008; Syvret *et al*., 2008). Adoption of the POP has not yet taken place and the Pacific oyster remains a highly contentious species as the ecosystem services and economic value of the Pacific oyster are considered by many industry members to outweigh the concerns. The attitude towards the Pacific oyster in France is notably different.

The POP study analysed historical sea temperatures from around the UK mainland in order to assess conditioning, spawning and recruitment potential based upon the biological 'degree day' requirements of the Pacific oyster. This methodology has been used to provide an assessment of the settlement potential for Jersey based upon St. Helier water temperatures as shown in Figure 24 as follows.

Figure 24. Wild settlement of Pacific oyster - Historical sea temperature regime (using St. Helier data provided by Jersey Meteorological Department)



Year	**Conditioning** *(Note 1)*	**Spawning** *(Note 2)*	**Recruitment** *(Note 3)*	**High Recruitment** *(Note 4)*
1960-1969	100%	100%	100%	20%
1970-1979	100%	100%	100%	10%
1980-1989	100%	100%	100%	10%
1990-1999	100%	100%	100%	50%
2000-2009	100%	100%	100%	80%

Note 1: >660 degree days above 10.55°C metabolic baseline

Note 2: 'Conditioning' threshold achieved by September when temperatures >15°C

Note 3: >825 degree days above 10.55°C metabolic baseline

Note 4: 'Recruitment' threshold reached by September when temperatures >18°C

Figure 24 demonstrates that although the temperature regime has long been sufficient to allow spawning and recruitment there has only been a 'high recruitment' potential since the 1990's. This theoretical calculation would tend to be supported by the physical observations as described by Societe Jersiaise (pers. comm.).

A significant level of wild settled Pacific oysters (see Figure 25) have been noted behind St. Aubins Fort and although no concerted baseline data is available, wild occurrence was thought to be widespread by consultees.

Strategy Option: Undertake baseline monitoring of wild settlement of Pacific oysters to assess if levels of recruitment increase due to factors such as climate change.

Societe Jersiaise provided feedback with respect to biological records of wild settlement. The earliest record was from 1982 (Grouville) which is of uncertain provenance as Portsmouth Polytechnic who undertook comprehensive surveys did not list it in any of their reports between 1982 and 1994. There is a record from Guernsey in 1984 and two further records from Guernsey and Herm in 1994. The first logged Jersey record was in 2007 (Les Minquiers) by Paul Chambers, although wild settlement on Jersey is thought to have been present unrecorded dating back to the early 1990s.

Figure 25. Wild settled Pacific oyster in Jersey intertidal zone (Source: Aquafish Solutions Ltd.)

The importance of biosecurity in prevention of other hitch-hiker non-native species should not be underestimated as the accidental introduction of species such as the American Oyster Drill and *Ocinebrellus inornatus* could have a significant impact on both commercial fisheries and the wider ecosystem. Smaal *et al.* (2005) mention the impact of the predatory non-native gastropod *Ocinebrellus inornatus* which has struck French cultured oyster stocks. It is not known whether climate change will favour growth of this new species although importation of French stocks will need to be conducted with caution to prevent introduction to Jersey.

9.8 Ocean Acidification

The absorption of atmospheric carbon dioxide into the ocean has decreased buffering capacity leading to acidification. It is thought that this could have serious implications for the marine ecosystem and in particular organisms which lay down a calcium carbonate shell. The gradual acidification will increase stress on some organisms which rely on calcification which may compromise viability (MCCIP (2009) - Exploring Ecosystem Linkages).

These potential impacts are poorly understood with unknown consequences for Jersey's aquaculture industry. It is possible that shellfish growth rates may be reduced as shellfish will need to expend more energy in secreting shell, alternatively the ecological balance of the whole ecosystem could also be altered.

9.9 Legislation

Jersey Pollution Law's (Section 6.8) commitment to 'no deterioration' will require better definition. This could become problematic where exemption under 'exceptional' conditions becomes more common place as storm intensity increases.

The strong connection between disease and temperature means that climate change will have a profound impact upon legislative controls. Disease legislation is considered in Section 8.3.

Climate change impact upon non-native proliferation is an area of active legislative developments. A review of the legislation with respect to the Pacific oyster and non-native issues may be found in (Syvret *et al*., 2008). A brief overview of recent legislative developments is provided in respect to the Alien Species in Aquaculture regulation and the Water Framework Directive (WFD):

- The WFD is currently under consultation in the UK with a proposal by UKTAG for a non-native species 'red-list' which includes both the slipper limpet and the Pacific oyster. As wild growth of these species is widespread in Jersey waters it is probable that marine waters would struggle to achieve good ecological status if this approach were to be adopted for Jersey. In contrast, the French authorities' attitude towards these non-natives within the WFD is quite different with an acceptance that the Pacific oyster is 'naturalised' and therefore not perceived with the same degree of concern as with the UK authorities. As Jersey waters cannot be separated from the influence of larval influx from French slipper limpet and Pacific oyster sources a pragmatic view towards this component of the WFD would favour a more 'French' approach.

- Council Regulation (EC) No 708/2007 "concerning use of alien and locally absent species in aquaculture" was adopted on 11 June 2007 and came into force in the UK on January 2009. This piece of legislation primarily concerns movements of aquaculture species but could have a major implication for Pacific oysters as it provides a potential means of controlling new seed movements.

The Pacific oyster is specified in Annex IV of the regulation as a long term aquatic alien species for which not all articles apply. However, some relevant articles do apply and there is latitude for Member States to decide whether additional restrictions are required for such long-used species.

Article 4 (which applies to long-used aliens) states:

> *"Measures for avoiding adverse effects*
>
> *Member States shall ensure that all appropriate measures are taken to avoid adverse effects to biodiversity, and especially to species, habitats and ecosystem functions which may be expected to arise from the introduction or translocation of aquatic organisms and non-target species in aquaculture and from the spreading of these species into the wild."*

Article 9 applies to 'non-routine' movement controls which will require a Risk Assessment (RA) which is specified in Annex II. A non-routine movement is the movement of an aquatic organism which does <u>not</u> have:

> *"a low risk of transferring non-target species and which, on account of the characteristics of the aquatic organisms and/or the method of aquaculture to be used, for example closed systems as defined in 3, does not give rise to adverse ecological effects;"*

This implies a movement that *could* give rise to an adverse ecological impact would require a RA. It is possible that such a requirement could be applied to Pacific oyster seed movements on a regional basis according to the potential threat posed to the receiving waters. In some areas the movement could be considered of low risk as there may already be existing wild impacts regardless of any commercial addition. Alternatively in some areas the movement could also be considered low risk because the receiving waters are still significantly cold and well below the threshold for potential recruitment. In contrast, other areas may be considered at high risk and require a RA as the level of wild population is low but the potential for recruitment is high.

In summary, the 'Alien Species in Aquaculture' regulation should help provide some protection from inadvertent new non-native species introductions. However, regulators and industry will need to agree what model of the WFD to adopt in order not to limit use of the non-native Pacific oyster which is the mainstay of the Jersey aquaculture industry.

9.10 Summary of Climate Change Implications to Aquaculture

Table 5 provides a subjective assessment of potential climate change impacts on Jersey aquaculture based on the following:

- 'Short Term' factors which are already having an impact.
- 'Medium Term' factors where effects are starting to be seen yet not specifically in Jersey.
- 'Long Term' factors where predictions indicate problems could occur.

Table 5. Summary climate change Impact Matrix

Factor	**Short Term**	**Medium Term**	**Long Term**
Water Quality	**X**		
HABs		**X**	
Shellfish Diseases	**X**		
Public Health		**X**	
Productivity			**X**
Non-Native Species		**X**	
Ocean Acidification			**X**

As climate change could have a profound impact upon the aquaculture industry it is considered to be a major uncertainty factor. The periodic review of the aquaculture strategy will need to provide a revised assessment of the potential impact of climate as changes occur.

Strategy Option: A periodic review should be undertaken of climate change predictions to assess potential impacts on the Jersey aquaculture industry and other marine stakeholders.

Section 9. Strategy Option(s)

Section	Strategy Option(s)	Benefit / Importance	Output or Outcome	Cost or Funding Requirement	Timeframe for Implementation
9.1	Undertake baseline monitoring of invasive non-native species such as the slipper limpet to ascertain if impacts are increasing on marine activities such as aquaculture or commercial fishing.	**Moderate**	Assessment of invasive non-native species.	**Moderate**	Long term – 10 years+
9.2	Undertake baseline monitoring of wild settlement of Pacific oysters to assess if levels of recruitment increase due to factors such as climate change.	**Moderate**	Assessment of changes in wild settlement of Pacific oysters.	**Moderate**	Long term – 10 years+
9.3	A periodic review should be undertaken of climate change predictions to assess potential impacts on the Jersey aquaculture industry and other marine stakeholders.	**Moderate**	Assessment of threats or opportunities for Jersey marine stakeholders.	**Moderate**	Medium Term – 5 to 10 years + Long term – 10 years+

SECTION 10 – ENVIRONMENTAL IMPACTS

10.1 Introduction

There is a widespread acceptance that there are a number of potentially conflicting demands between the marine environment and mans' use of the coastal zone. Balancing these needs is the essence of Integrated Coastal Zone Management (ICZM) to which the States of Jersey have made a commitment and which is being developed within the Fisheries and Marine Resources (F&MR) Department.

Pressure on the marine environment is highlighted by aquaculture activities within the sensitive Ramsar area on the South East Coast of Jersey. The Island Plan 2002 identified shellfish farming as one of a number a 'traditional' activities that should be permitted to continue within the Ramsar area. States authorities consider that the Ramsar designation has presented no impact on traditional activities which can all be accommodated into the "wise use" description and Jersey has benefited from the site acting as a significant attraction for tourism with many people taking advantage of the guided walks and tours of the area.

The presumption towards maintaining aquaculture is conditional upon a supportive Environmental Impact Assessment (EIA) before a licence can be granted. The recent consultation for the revised Island Plan asked whether continued aquaculture should be allowed subject to consideration of environmental impact, for which there was overwhelming support with only 15% of respondents disagreeing. One respondent pointed out that "*molluscan shellfish farming is probably the most environmentally sensitive and sustainable method of producing high value and high quality foodstuffs*." Although shellfish farming perhaps may be more sustainable than other terrestrial farming systems, it should be recognized that an EIA includes human as well as ecosystem aspects and as such are influenced by perception and to a degree public opinion.

This section reviews the Ramsar designation and some of the potential environmental impacts that have been associated with aquaculture. It should be noted that much of the detailed consideration of potential environmental impacts in the following Sections relate primarily to the current intertidal aquaculture areas with limited consideration of other settings. Clearly, any future development of aquaculture in onshore or offshore settings will present new potential threats which will need to be assessed in an appropriate manner.

10.2 Ramsar Designation

10.2.1 Ramsar Development

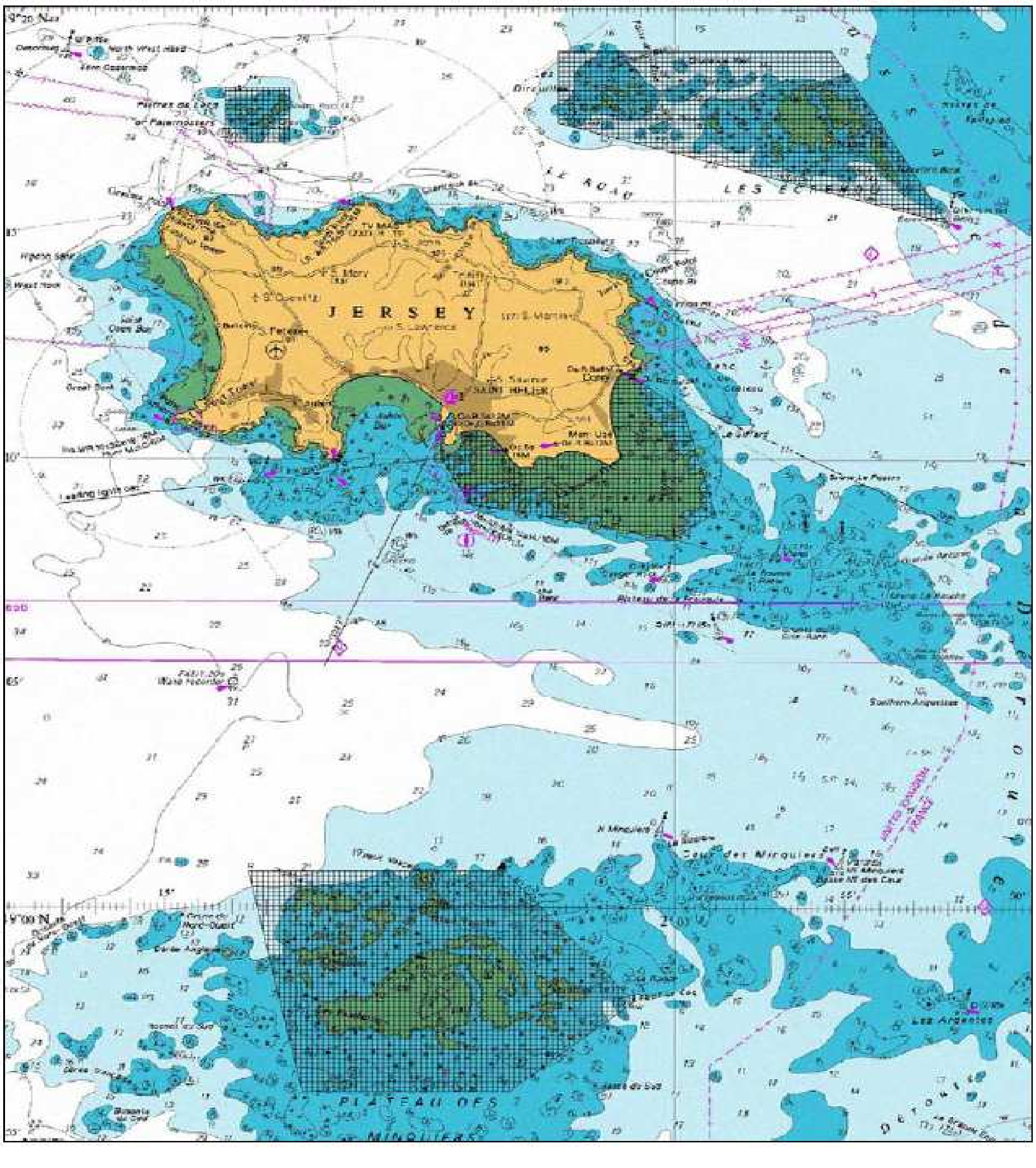
Detailed consideration of the Ramsar sites and the South East Jersey Ramsar site in particular can be found in the Marine Biodiversity ICZM report (Le Claire, 2005) and the PML Applications report (Linley *et al.*, 2009), although a summary is presented here to provide context for the aquaculture strategy.

There are currently four designated Ramsar areas as defined in Table 6 and shown in Figure 26.

Table 6. Overview of the Jersey Ramsar Sites (Source: Pienkowski, 2005)

Ramsar code	Site name	Country	Area (ha)	Date designated
UK23001	South East Coast of Jersey, Channel Islands	Jersey	3,210.50	2000
UK23002	Les Minquiers	Jersey	9,575.00	2005
UK23003	Les Écréhous & Les Dirouilles	Jersey	5,575.00	2005
UK23004	Les Pierres de Lecq (the Paternosters)	Jersey	512.00	2005

Figure 26. The Jersey Ramsar Sites



The south east coast was designated in 2000 whilst the offshore reefs of Les Minquiers, Les Ecrehous and Les Dirouilles and Les Pierres de Lecq (the Paternosters) were accepted in September 2004 and ratified in February 2005.

Designation under Ramsar is based upon eight criteria which encompass both water bird and ecosystem related aspects. These criteria are described in relation to the South East Jersey Ramsar area in Linley *et al*. (2009). Only two of these criteria (supporting >20,000 water birds and >1% of a specific population) do not apply to the South East Jersey Ramsar area.

The total intertidal aquaculture concession area of 69 hectares covers 2.15% of the South East Jersey Ramsar site of 3,210 hectares and 0.37% of the combined intertidal Ramsar areas of 18,756 hectares. Although the magnitude of the aquaculture use is relatively small the close proximity to the sensitive marine features of the Ramsar area on the South East Coast of Jersey is a cause for concern.

Future development of the Ramsar area is also a possibility with further extension of the South East Coast Ramsar considered a priority (Pienkowski, 2005). The sheltered tidal embayments of St. Catherines and St. Aubins Bays are considered to support extensive eelgrass beds, significant nursery areas for fish and provide a valuable habitat for winter shore bird populations. Mapping on the basis of eelgrass would translate into an extension of the Ramsar boundary to incorporate St. Catherine's Bay as far as the breakwater (Section 10.2.2).

The Ramsar Convention requires management plans for each site to be developed by the stakeholders. The recently set-up Ramsar Management Committee is currently in the process of developing a management plan for the four designated areas. This plan will set out the management for each of the sites under the principal of conservation and wise use of the resource and at the time of going to press had gone to public consultation.

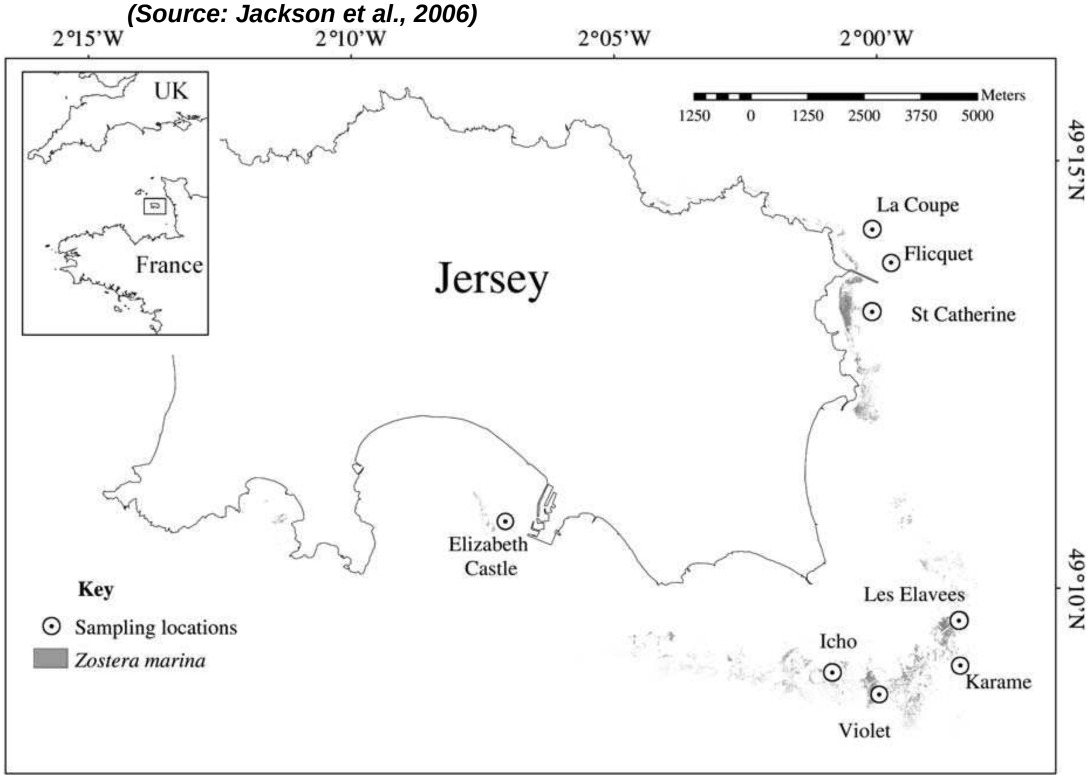
10.2.2 Seagrass Areas

Seagrass, or Eelgrass, is one of the Ramsar priority habitats and has been identified in all of the Jersey Ramsar areas. The capacity of seagrass to maintain an abundant diverse ecosystem is a principal component in its Ramsar designation in supporting seabirds.

Jackson *et al.* (2006) undertook a mapping exercise of subtidal seagrass areas from which it can be seen (Figure 27) that the majority of seagrass areas are around the more sheltered eastern shores of Jersey with the densest areas of growth off St. Catherines Bay.

Some areas of seagrass growth are offshore of the main aquaculture concession area which would tend to present a seaward limit to any future potential development as even 'patchy' fragmented seagrass habitats have been shown to present high species diversity (Jackson *et al.*, 2006).

Figure 27. Distribution of seagrass around Jersey (Source: Jackson et al., 2006)



Although the subtidal *Zostera marina* is recognised as the principal seagrass species of importance a second intertidal species *Z. noltii* also provides ecosystem services and foraging for seabirds such as Brent geese. Although this second species is seasonal it has extensive coverage in the north of Grouville Bay and is the basis for a restriction on aquaculture from this area. *Z. noltii* has been mapped for the first time as part of the recent PML Applications study (Linley *et al.*, 2009) which highlighted its different distribution from *Z. marina*. As indicated in Section 10.2.1 the PML Applications study recommended that the combined footprint of the two species of *Zostera* be used as the basis for expanding the Ramsar site boundary to improve protection of these habitats

10.3 Environmental Impacts

Environmental impacts will be a function of the proposed activity, the sensitivity of the environment and the proximity of the activity to the sensitive features. Clearly the potential impact of any proposed development will be site specific. It should be noted that aquaculture developments can provide a range of both positive and negative impacts and that the environmental impacts cannot always be judged by impartial criteria as the environmental value of features have a human socio-economic bearing.

10.3.1 Intertidal Bird Related Impacts

Section 10.2 details aspects of the Ramsar designation which are intended to protect major seabird populations. The Brent Goose Action Plan 2008 has also been cited by the Societe Jersiaise as a relevant protection measure for Grouville Bay. The potential environmental impact of aquaculture on bird populations in the South East Coast of Jersey Ramsar site has been highlighted as a major cause of concern. The interactions of aquaculture and bird populations is a potentially complex subject area and outside the scope of this report to cover in detail. However, Section 10.3.1 seeks to give an overview of the interactions between birds and aquaculture activities.

There are differences of view as to whether or not the area has been subject to declining wader bird numbers and the degree to which this might be attributable to the aquaculture industry. One fish farmer respondent for the revised Island Plan pointed out that "*the use of even heavy plant has surprisingly little effect on wading birds I personally have got within meters of stilts and egrets (both types) without disturbance whilst driving a tractor. If however a dog is within half a kilometer the birds rise and depart*."

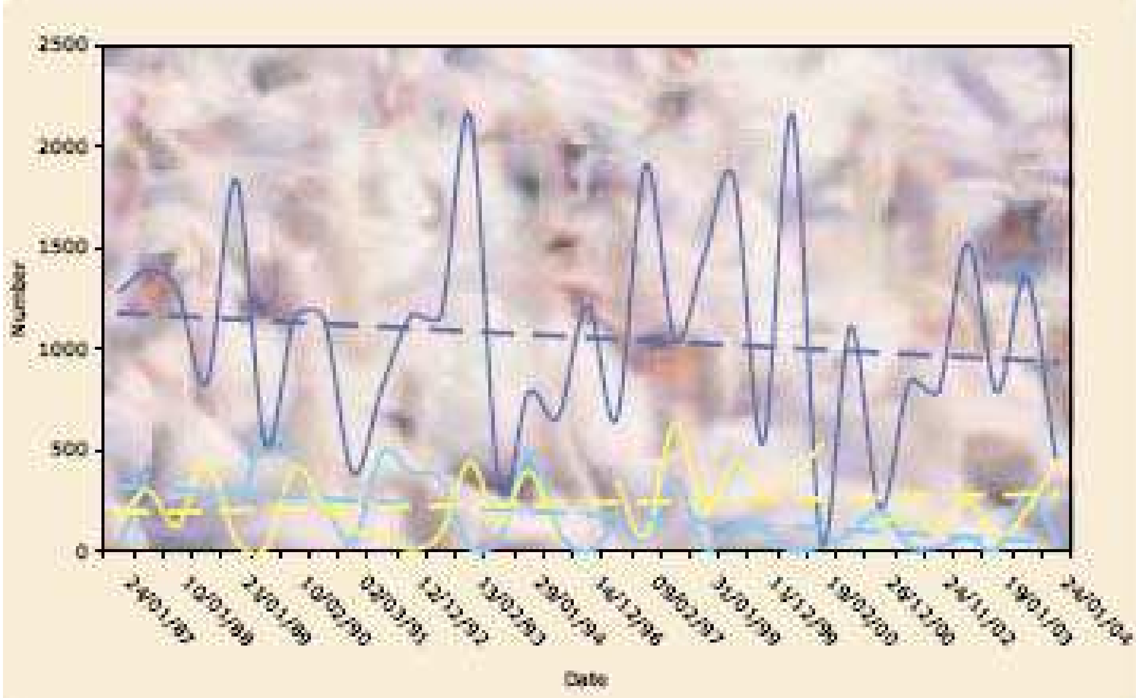
Figure 28. Recreational shellfish gathering/dog walking adjacent to aquaculture concessions (Source: Aquafish Solutions Ltd.)

Societe Jersiaise representatives mentioned that numbers of wader birds are thought to have declined on the east coast and cite the ICZM Biodiversity Report (see below). Representatives of recreational anglers also thought that wader numbers had declined in the area despite the objective of the Ramsar site being to protect them (P. Gosselin & C. Isaacs, pers. comm.). In contrast, Save Our Shoreline representatives (who had read the later PML report) did not view the current aquaculture industry as a threat to the Ramsar site so long as EIA requirements were met for any future proposal (D. Cabeldu, pers. comm.).

As the health of the bird population is at the top of the food web, Ramsar considerations often extend to the wider ecosystem. Anecdotal observations by a consultee suggested a decline in green shore crab numbers in the main concession areas which was thought to possibly be due to the removal of crabs in order to protect mussel stocks. It was questioned as to whether this was an acceptable practice in a Ramsar site. (N. Jouault, pers. comm.).

A Marine Biodiversity ICZM report (Le Claire, 2005) for the States of Jersey cites a bird study for Guernsey which indicated "four out of the ten species of shorebirds declined by over 50% in the period 1992-2000" which was attributed potentially to climate change and increasing recreational beach use. The Marine Biodiversity report also stated that initial results from a similar study on Jersey indicated a declining trend in the south east corner of the Island in Grouville Bay (see Figure 29). There was concern that "*disturbance from aquaculture activities and recreational activities like dog walking and kite surfing may be affecting waders' numbers by reducing their feeding efficiency*."

Figure 29. Potential decrease in seabird populations prior to 2004.



Notes: Counts of wading birds between 1987 and 2004 in Grouville Bay South (dark blue line, trend line dashed), and Grouville Bay North (light blue line, trend line dashed) compared to St. Aubin's Bay West (yellow line, trend line dashed). Source © Unpublished Data collected by the Ornithology Section, La Société Jersiaise.

Source: Jersey's Coastal Zone Management Strategy - Marine Biodiversity, Report for the States of Jersey (Le Claire, 2005).

However, recent results are somewhat contradictory as the 2007-2009 wader bird numbers provided on the Jersey Birds' website as summarised in Table 7 suggest a different picture.

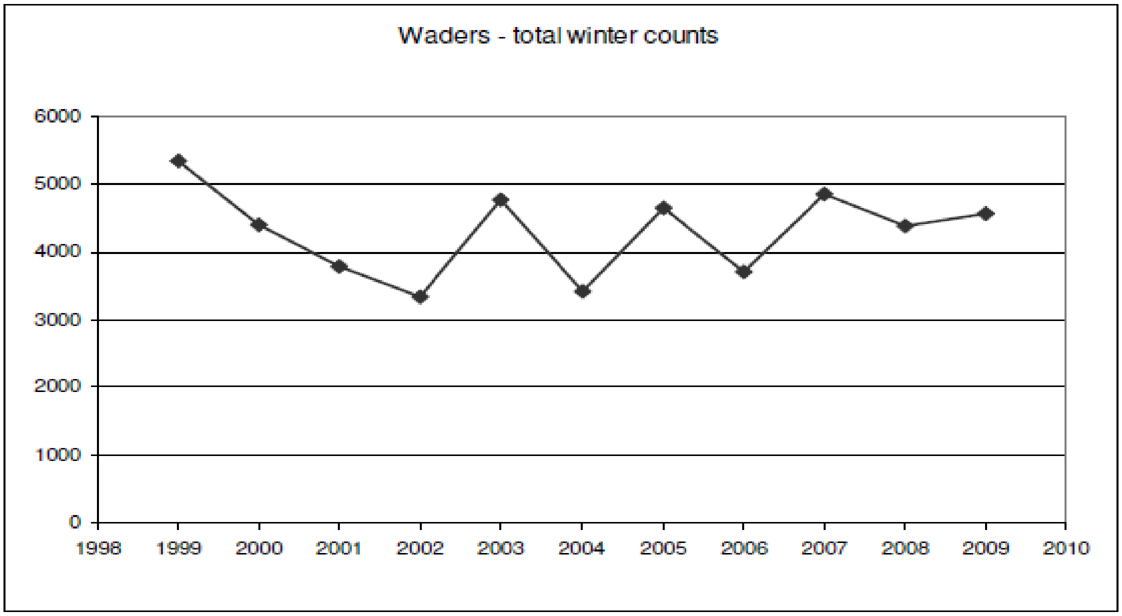
Table 7. A summary of Grouville South wintering bird numbers
(Source: Mick Dryden and Tony Paintin http://www.jerseybirds.co.uk/news/downloads.php)

Area / Bird Group	**2007**			**2008**			**2009**		
	Nov	Dec	Average	Nov	Dec	Average	Nov	Dec	Average
Grouville South - Wader	904	995	950	1166	921	1044	833	1455	1144

This data would not tend to support the declining number of waders in Grouville South as suggested in the Marine Biodiversity ICZM report. The inter-annual variations in bird numbers are large relative to apparent trends and a detailed analysis would be required to try and assess individual species patterns and statistical significance.

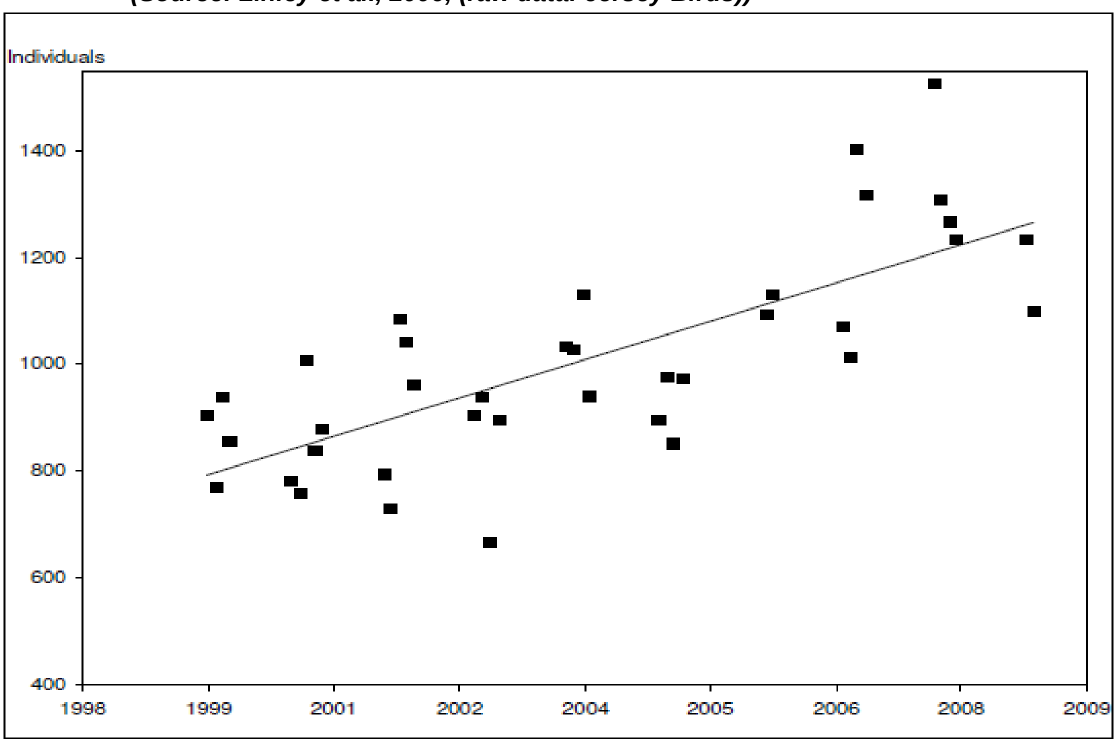
A more comprehensive assessment is included within the recent PML Applications report (Linley *et al.*, 2009) which indicates that although there appeared to have been a general decline in wader numbers up until 2004 there now appears to be an increase and that bird numbers in the Ramsar area are healthy.

Figure 30. Potential increase in seabird populations since 2004. (Source: Linley et al., 2009, (raw data: Jersey Birds))



This increase in wader numbers also appears to be reflected in Brent geese numbers as shown in Figure 31. The detailed picture for specific sites appears more complex with observations that Brent geese might be moving inland to forage on grass as opposed to the usual diet of seagrass and *Ulva* (Linley *et al.*, 2009). There are suggestions that this change might be as a result of increased pressure on French overwintering sites.

Figure 31. Potential increase in Brent Geese populations. (Source: Linley et al., 2009, (raw data: Jersey Birds))



As a general comment it has been widely recognised in the UK by the RSPB that a number of bird species are in decline or threatened by climate change. In particular kittiwakes, arctic terns, guillemots and shags are under threat by the decline in sand eel availability which are in turn thought to have been affected by climate change influence on the food web (http://www.rspb.org.uk/climate/wildlife/seabirds/seabirddanger.asp).

It is important that any long term changes in the Ramsar bird populations are understood rather than drawing simple cause and effect linkages with adjacent aquaculture activities which could give rise to knee-jerk responses. The newly formed Ramsar Management Committee will need to provide an evidence based assessment of potential changes within the Ramsar site in relation to any potential impacts if stakeholder engagement is to be maintained.

Regulators hope to define the maximum size of the industry in terms of hectares within the intertidal Ramsar site to ensure wise use of the zone and conservation of the natural environment. At present there is general agreement within the aquaculture industry that the current size of the concession areas (including proposals in the process of licensing) are about right, however there may be some future resistance to acceptance of an arbitrary and non-site specific limit.

Strategy Option: Formation of a joint working group with input from Jersey Aquaculture Association, States of Jersey and Fisheries and Marine Resources' officers (Impact Assessment Group) to assess potential aquaculture activities which may impact upon the Ramsar site. (This could be included in recommendations for the Code of Good/Best Practice)

10.3.2 Intertidal Benthic Impacts – Enrichment

Aquaculture developments can have an impact on both an area's physical characteristics (e.g. sediment grain size distribution in relation to current speed) and chemical features (e.g. sediment dissolved oxygen profile in relation to organic enrichment). To some degree these potential features can be influenced or mitigated by farm and equipment design along with stocking density.

The high current velocity around the South East Coast of Jersey and the openness of the marine environment should limit the potential for organic enrichment from pseudofaeces and faeces in the concession areas. However, some other marine users believe that where trestles and bags have sunk over time, together with the placement of trestles across the dominant tidal currents, there is a tendency for sedimentation to occur which may result in species changes in the sediment underneath the trestles. Seaweed build-up on trestles was also thought to slow currents and increase sedimentation rates (P. Gosselin & C. Isaacs, pers. comm.). The Societe Jersiaise (pers. comm.) however report that they have data which suggests that there is no evidence of abnormal sedimentation patterns within the concession area.

Section 10.4.1 outlines the biotope types on the South East Coast of Jersey which will determine the sensitivity of the sediment to enrichment and grain size. The main species type *Lanice conchilega* is an annelid worm which is both a filter feeder and a deposit feeder upon faeces from echinoderms and molluscs. In this respect current levels of deposition from aquaculture do not appear to compromise performance. This species also favors fine sand with a high mud content (10-40%) which again should be complimentary to moderate aquaculture production.

Baseline work comparing *Lanice conchilega* density, grain size distribution and organic carbon would be beneficial. Section 3.3 identifies a Strategy Option to consider increased production intensity with associated environmental monitoring. Samples could be obtained beneath production systems and adjacent to production areas to assess the influence on benthic species and whether enrichment levels are having an adverse impact (e.g. high mud content with high organic carbon levels, often anoxic, creating loss of species diversity and abundant levels of opportunistic deposit feeding species such as *Capitella capitata*). It should be noted that massive organic enrichment of sediments beneath production areas can not only impact the wider ecosystem but also create an oxygen sag which can impact on aquaculture production (Section 10.3.6).

10.3.3 Intertidal Benthic Impacts – Physical Disturbance

Whilst concession holders might dispute the level of impact that their equipment might present it was recognised that there was no baseline data with which to assess any impact claims. It was suggested that perhaps these aspects could be encompassed within a Code of Good Practice if it could help reduce the need for extensive and prolonged EIAs (T. Legg, pers. comm.).

Figure 32. Purpose designed aquaculture tractor with wide tyres for reduced impact on benthos (Source: Aquafish Solutions Ltd.)

Section 10.4.1 outlines the biotope types which will determine the sensitivity of the sediment to physical disturbance. Although the main species type *Lanice conchilega* is a fairly ubiquitous annelid worm which can recover well from disturbance – a further rarer bivalve species has been highlighted to the south east of the concession area which may be more sensitive to physical disturbance (P. Chambers, pers. comm.).

10.3.4 Intertidal Ecosystem Impacts

Eco-system Services– It is widely recognised that filter feeding shellfish provide a range of beneficial 'ecosystem services.' These can include:

- *Providing additional shelter/habitat for other species with the potential to increase diversity and also increase fisheries carrying capacity.*

Ruesink *et al.* (2005) reviews the impacts of oyster culture around the world from an ecosystem and economic perspective: "*Lenihan et al. (2001) used the native oyster C. virginica to compare fish and epibenthic invertebrate (blue crab, mud crabs, grass shrimp, and amphipods) assemblages on experimentally constructed reefs with assemblages on soft-sediment bottom in Pamlico Sound, North Carolina. Fish abundance was 325% greater, and epibenthic invertebrate abundance was 213% greater per trap placed on reefs than on the unstructured sand/mud bottom, a finding consistent with observational studies*."

- *Improved water quality through the removal of solids and microbes.*

Ruesink *et al.* (2005) also state: "*Recent experimental results indicate that transplants of native oysters can significantly increase water quality in small bodies of water, such as tidal creeks (Nelson et al. 2004). Therefore, the probability is high that introductions of oysters that survive at high densities could improve water quality*."

- *Nitrogen and carbon removal from the water column*.

The use of 'nitrogen credits' has been proposed in a fashion similar to that for 'carbon credits' whereby removal of nitrogen is equated to a financial equivalent for its removal. Computer model assessments (Section 10.4.2) for Strangford Loch indicated that 6,000m^2 of mussel culture would remove 445kgN/yr equating to a land based removal cost of £25K/yr.

This approach to the use of aquaculture for environmental benefit has been tested in Sweden where a council tested using mussel farming to absorb nutrient whilst also providing bird feed thereby returning nutrients from the sea to the land.
(http://longislandsoundstudy.net/wp-content/uploads/2010/02/Lindahl_presentation.pdf)

There is also extensive work in the US assessing this approach with ongoing consideration within Long Island Sound as part of an integrated catchment management scheme where modellers are working with the regulator and producers.
(http://longislandsoundstudy.net/2010/02/nutrient-remediation-workshop/)

It is interesting to consider that aquaculture production may well be ecologically neutral or even beneficial with respect to the wider marine environment. In view of the current concerns of nutrient loading in St. Aubins Bay it may well be that increased aquaculture production in this area may provide a more 'green' solution than increased waste water treatment (with increased associated sludge disposal) on land.

10.3.5 Intertidal Visual Impact

It is a difficult to provide an objective assessment of visual impact. As indicated in Section 10.2.1 the intertidal aquaculture concessions amount to 2.15% and 0.37% of the South East Jersey Ramsar site and total Ramsar areas respectively. Despite this, visual impact was one feature which raised strong opinions during the consultation process from some consultees. Societe Jersiaise representatives indicated that deliveries of steel trestles may be placed for a period of time on the beach prior to deployment and that redundant netting can be found near some concessions that should be removed as part of good housekeeping in this respect (N. Jouault, pers. comm.).

Figure 33. Collection of old trestle steelwork prior to disposal (Source: N. Jouault)

The existing concession requirements place an onus upon operators to remove redundant equipment and keep the beach tidy and it remains within Fisheries and Marine Resources authority to refuse reissue of licences where this is not maintained (S. Bossy, pers. comm.). The Fisheries and Marine Resources Panel have stakeholders from a range of marine activities who raise concerns if issues arise. The work of the Panel often allows problems to be resolved informally on the beach (M. Taylor, pers. comm.).

Some consultees questioned the aesthetic impact of evenly constructed and maintained equipment. Whilst there was an acceptance that impacts had to be balanced against other positive benefits of the industry to the Island, there was concern about how the visual impact was assessed. As visual criteria were already used and described for land developments and land character zones, it was suggested that visual character assessment should be carried out as part of an EIA for any new aquaculture applications to assess if impacts are significant (C. Isaacs, pers. comm.).

The JAA believe that the concession areas occupy a relatively small area and are only visible for a very limited period presenting minimal visual impact. One respondent from the consultation for the revised Island Plan pointed out that the aquaculture concessions had a visual impact restricted to low tide exposure (usually less than eight days per month for an average of two hours per day when exposed). The Societe Jersiaise (pers. comm.) point out that some, rather than total, exposure of the concessions is possible on all tides.

10.3.6 Intertidal Aquaculture Impacts

Aquaculture operations have the potential to have an adverse impact on adjacent concessions if biomass levels exceed the carrying capacity of an area. The carrying capacity will be determined by the level of food availability (primary production), water quality and hydrodynamics within the harvest area. As filter feeding shellfish remove phytoplankton from the seawater there is a potential that 'up-current' stock preferentially grow at the expense of 'down-current' stock if the carrying capacity is exceeded. Furthermore, metabolic by-products from shellfish stock can impose an oxygen sag on waters which could also retard growth or in severe circumstances give rise to mortality. It should be noted that the physical, production and ecological carrying capacity of an area may differ (i.e. maximum production, optimum production and best production without unacceptable adverse impact on the wider environment). Computer based modelling tools are available to help calculate the carrying capacity as described in Section 10.4.2.

Adverse environmental conditions such as low dissolved oxygen levels and high temperatures can often give rise to increased stress and trigger disease related mortalities. This can have a domino effect and create mass mortalities such as the 'summer mortality' events which have been experienced in France with the Oyster herpes virus. This emerging disease has had a significant impact on the French shellfish industry and to some extent within Jersey in 2009 (see Section 8).

Section 3.3 identifies a Strategy Option to consider increased production intensity with associated environmental monitoring. It is suggested aquaculture production limitations should be based upon site specific data rather than transposed from other settings. Real data can then be used to 'calibrate' computer screening models which should therefore result in meaningful outputs that will be of benefit to the aquaculture industry whilst protecting the marine environment. Such an approach to environmental assessments would also be in line with Resolution VII.21(15) of the Ramsar Convention which states the following:

"Urges all Contracting Parties to suspend the promotion, creation of new facilities, and expansion of unsustainable aquaculture activities harmful to coastal wetlands until such time as assessments of the environmental and social impact of such activities, together with appropriate studies, identify measures aimed at establishing a sustainable system of aquaculture that is in harmony both with the environment and with local communities."

(Source: 7th Meeting of the Conference of Contracting Parties, May 1999 – Societe Jersiaise, pers. comm.).

10.3.7 Non-Native Species

Aquaculture has been implicated in the transfer of non-native species (e.g. the slipper limpet) or in some cases can involve the culture of a non-native species (e.g. the Manila clam and Pacific oyster). Some non-native species in certain settings can have an adverse impact on the environment giving rise to changes in species or habitat diversity. It should be stressed that only around a 1/10th of non-native species become established and of those only around 1/10th then become 'invasive' giving rise to problems.

The slipper limpet (*Crepidula fornicata*) has long been considered a 'pest' species on a number of fisheries species (native oyster, blue mussel and scallop). Although the slipper limpet is widespread in Jersey waters and in particular off La Collette (Linley *et al.*, 2009), the only significant impact noted to date by Fisheries and Marine Resource is due to settlement on whelks allowing undersize stock to be retained in a catch (S. Bossy, pers. comm.). Although aquaculture has been blamed for the transfer of slipper limpets to form founding colonies in the 1970s along the French coast, new recruitment is now self-sustaining with the planktonic spread of larvae.

The Pacific oyster (*Crassostrea gigas*) has been used in European aquaculture for decades, however, since 1989 the incidence of wild settlement has increased in the UK leading to pressure from the conservation agencies for greater controls on the use of this species in aquaculture. Proposals for aquaculture development in a number of Special Areas of Conservation (SACs) were denied leading to the formation of a Pacific Oyster Protocol (Syvret *et al.*, 2008). Unlike some areas of the UK where wild settlement is still a rare or occasional occurrence settlement in Jersey is regular (see Figure 25, Section 9.7) and any controls would be of limited value if larvae also reach Jersey waters from France.

Both the slipper limpet and the Pacific oyster have been placed on the red list by UKTAG for the WFD. It is understood that France has a different attitude towards the non-native species aspect of the WFD and is unlikely to list the Pacific oyster which it now considers as 'naturalised'. Clearly the widespread nature of both the slipper limpet and wild settled Pacific oysters along the French coast would influence the ecological status of most coastal waters if listed. Although Jersey is working towards the WFD there is no current view on the non-native component as to whether a UK or French model is likely to be adopted (W. Peggie & S. Le Clare, pers. comm.).

Climate change would appear to have influenced the success of slipper limpet and Pacific oyster recruitment as described more fully in Section 9.7.

The Manila clam (*Tapes philippinarum*) and Pacific oyster were identified by Societe Jersiaise as non-native introductions via aquaculture (P. Chambers & N. Jouault, pers. comm.s). Both of these species have now established populations in Jersey waters with little impact at present. Some non-native species such as the drill *Ocinebrellus inornatus* would damage both commercial stocks and native species if they became established in Jersey waters. Societe Jersiaise representatives are keen to see more controls to prevent the accidental introduction of new non-native species.

Strategy Option: Consideration should be given to incorporate non-native species inspections for stock imports into a Code of Good Practice.

10.3.8 Offshore Entanglement

Whilst current intertidal aquaculture structures present little threat to the movement of larger marine species future deployment of offshore structures such as fish cages could present a risk of entanglement for certain species. Section 4 indicates that the potential for offshore finfish cages in Jersey waters is limited owing to the high current velocity and exposure of this environment although it is possible that future equipment development may allow cage aquaculture in these waters. As with any major new proposed aquaculture development an EIA would have to consider any such potential risk on a case by case basis.

10.3.9 Onshore Riverine Loading

Traditional open finfish farms abstract freshwater from a water course which flows by gravity through a series of ponds before discharging back into the water course. Clearly these farms present a faecal, organic and nitrogen load to the watercourse and an associated oxygen sag with the discharge. Any potential operation would need to meet pollution law requirements and undertake an EIA.

Some species such as certain amphibians are sensitive to nitrate levels which are already in high concentrations within fresh water courses due to agricultural input into groundwaters. Jersey is the only place in the British Isles where the agile frog (*Rana dalmatina)* is found leading to its protection under the Conservation of Wildlife (Jersey) Law 2000.

Nutrient loading to the marine environment is also a cause for concern owing to its impact on WFD indicator species as demonstrated in a recent study of St. Aubins Bay (Holmes, 2010). Assessments of nutrient loading from Jersey have shown that 40-50% of the nitrate originates from fresh water courses and the States of Jersey are in the process of considering expensive nutrient removal schemes using waste water treatment systems to help reduce this impact. Within this context it is likely that any new onshore aquaculture development will need to have strict controls on nutrient loading (see Section 2).

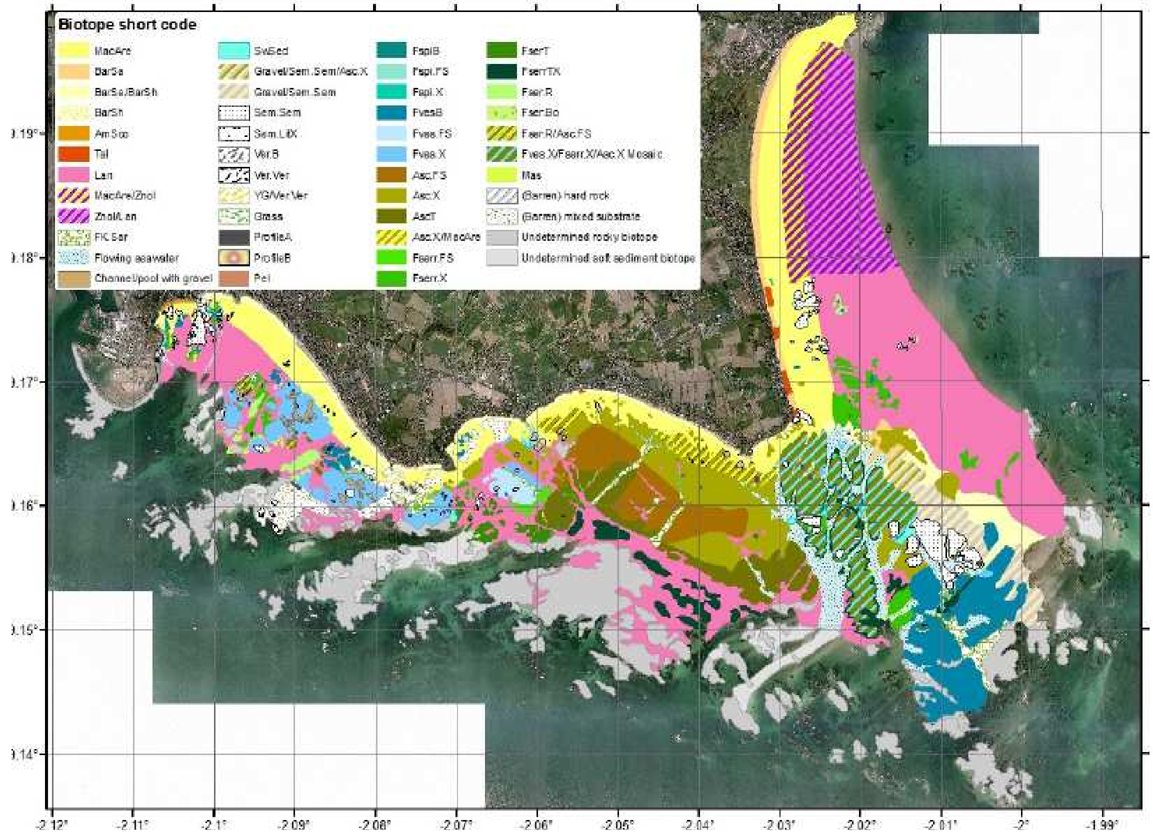
10.4 Environmental Impact Assessments

10.4.1 Baseline Surveys and Monitoring

A key component of any EIA for an aquaculture application will be to establish existing baseline conditions prior to any proposed development as this will have a key bearing on establishing the sensitivity of the existing environment. The consideration of whether a project with have a 'Likely Significant Effect' is very much a function of the nature of the proposal and the area designation and associated features requiring protection. An assessment will then be geared to the site specific requirements.

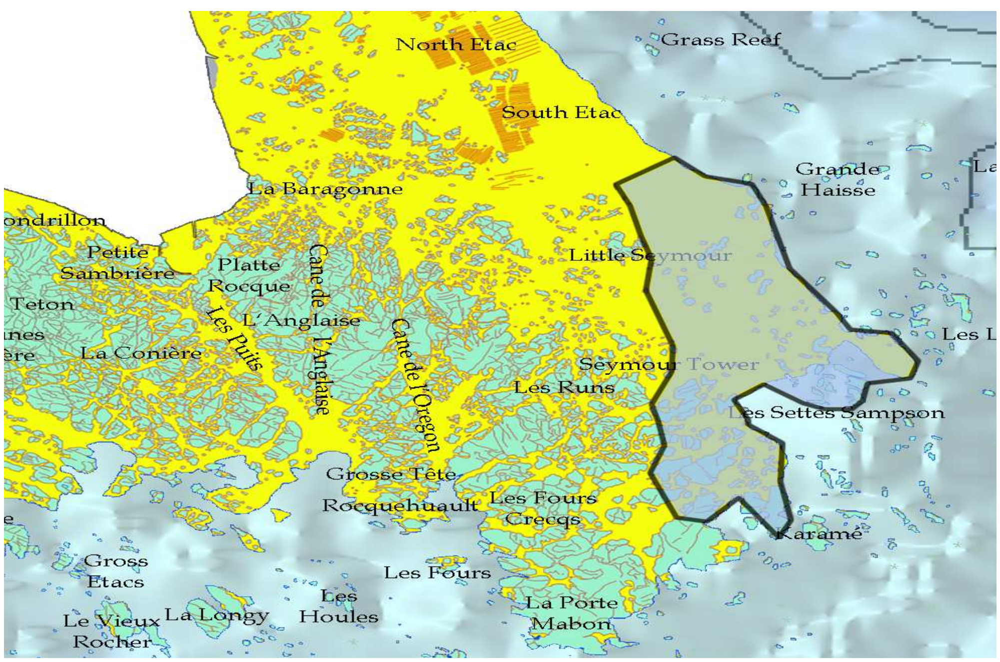
Some key work on biotope mapping within the South East Jersey Ramsar site has already been undertaken by PML Applications Ltd. (Linley *et al.*, 2009). The biotope map from this report (shown in Figure 34) shows that aquaculture concessions are primarily placed upon 'Lan' (*Lanice conchilega* in littoral sand). *L. conchilega* has a widespread distribution around the UK and Ireland and is not overly sensitive to impact from sediment effects (Section 10.3.2) and physical disturbance (Section 10.3.3) and is unlikely to be a highly sensitive biotope with regard to current aquaculture practices.

Figure 34. Biotope map of the South East Coast of Jersey Ramsar Site (Source: Linley et al., 2009)



Societe Jersiaise representatives during the consultation process expressed their concern that: "oyster/mussel farms at Grouville should not spread any further south into the ecologically sensitive area which runs from Petit Seymour, east of Seymour Tower, to Icho" (see Figure 35).

Figure 35. Ecologically sensitive area of SE coast as identified by Societe Jersiaise (Source: P. Chambers)



This area is stated to be an "internationally recognised as an outstanding area of seashore, both visually and in terms of biodiversity. It is home to a number of rare or very rare species including Britain's only known population of the large bivalve mollusc *Mactra glauca* the Glaucous trough-shell (as shown in Figure 36). The coarse sediment (which is non-coherent) and shallow burrowing nature of most animals leaves them vulnerable to disturbance by tractors' wheels".

Figure 36. Mactra glauca (Glaucous trough-shell)
(Source: Conchological Society of Great Britain & Ireland)

It should be noted that representatives from Jersey Aquaculture Association questioned the accuracy of the Societe Jersiaise map and the sensitivity of the highlighted area. It is important to resolve these differences of view about the biotope sensitivity if future impact assessments are to be meaningful.

Strategy Option: 'Impact Assessment Group' to review baseline studies with appropriate 'ground truthing' in order to better define the potential sensitivity of the aquaculture/Ramsar area.

Other baseline considerations of aquaculture impact on sediment quality and benthic species could perhaps be considered within the Strategy Option outlined in Section 3.3.

10.4.2 Computer Modelling

A further requirement of EIAs is prediction of the potential affect of the proposed project upon the environment. Comparative studies can go a long way in demonstrating potential impact (or otherwise) from similar developments in similar settings. However, modelling does provide a useful tool in modelling a range of scenarios under both 'normal' and 'worst case' conditions.

A variety of computer modelling systems for aquaculture have been developed for use by both operators and regulators in order to manage stocks effectively within the carrying capacity of a particular area. Typically these models require input variables of the physical environment (e.g. current speed) and water quality (e.g. chlorophyll content, suspended solids, particulate organic matter, dissolved oxygen levels and temperature). Using input values for farm dimensions and biomass the models can assess a range of factors such as productivity (e.g. growth rate and product size), impact (e.g. resultant dissolved oxygen levels) and even ecosystem services (e.g. nitrogen removal – see Section 10.3.4).

The Sustainable Mariculture in northern Irish Lough Ecosystems (SMILE) are a consortium who have worked for a number of years on developing large scale models to assess the carrying capacity and interactions between aquaculture and the marine environment (http://www.ecowin.org/smile/). Whilst these models are comprehensive and area specific others are more generic in nature.

Some models are available free through the internet (http://www.farmscale.org/). The FARM model is designed for modelling a specific farm in terms of its production and impact. The WinShell model is designed to provide species specific growth/production assessments. The ASSETS model is designed to help with atrophic assessment but was intended for helping with estuarine trophic status and might not be applicable to open waters. The EcoWin2000 is an ecological model utilising hydrodynamic, biogeochemistry and population dynamic components.

It is suggested that a suitably calibrated aquaculture model could help to provide a valuable screening tool within a potential EIA Protocol (Section 10.6). For example a proposal to increase the extent of a concession could be modelled to assess carrying capacity effects and in terms of its potential to impact upon adjacent concession growth rates and oxygen sag. A model supported by both regulators and industry could allow the development of an iterative approach whereby multiple scenarios could be undertaken to provide a sensitivity analysis.

Strategy Option: Review by Fisheries and Marine Resources of aquaculture modelling systems in order to assess whether they could assist at the screening stage of the EIA process.

Concern was raised that although computer modelling may work satisfactorily in semi-enclosed marine systems they might struggle with the complex dynamic system in Jersey's open water coastal setting (J. Shrives, pers. comm.). The FARM modellers maintain that the key aspects of the model can be applied within open waters and that the output from hydrodynamic grid models can be used as input variables for the aquaculture modelling.

Section 6 outlines both the limited extent of offshore water quality data and the potential for future water quality surveys to support modelling of a potential Bellozanne long sea outfall. It is suggested that procurement of modelling for St. Aubins Bay will probably encompass the South East Coast Ramsar site allowing potential extension to incorporate parameters of value for aquaculture modelling. This approach could help support modelling as a management EIA screening tool on a cost effective basis.

Strategy Option: Liaison by Fisheries and Marine Resources with Transport and Technical Services to investigate the potential to expand the scope of any potential offshore modelling to encompass aquaculture related outputs.

10.4.3 EIA Process

The legislative aspects of an EIA are considered in Section 10.5.1 below whilst this sub-section outlines the process.

In planning terms the requirements for an EIA are well defined and briefly described as follows:

- *Screening* - is an EIA required?
- *Pre-scoping* - what information is needed? (could include an informal consultation)
- *Scoping* - formal approach to consultees.
- *EIS* – final statement.

Although not all stages are a statutory requirement they are often accepted as best practice for a developer. It is uncertain at what stage a developer makes their plans public as unlike UK law where there are specific requirements for the notification of the public, the Planning and Buildings (Environmental Impact)(Jersey) Order 2006 does not appear to have an equivalent clause.

There are some areas of confusion in terms of the EIA definitions and requirements (Section 10.5.1) and potential Codes of Good Practice (Section 10.5.2) could help to provide screening information that would streamline an EIA process as proposed in Section 10.6.

10.5 Policy and Legislation

10.5.1 EIA Legislation

Environmental Impact Assessment requirements are set out under European Law within Council Directive 85/337/EEC "*on the assessment of the effects of certain public and private projects on the environment*." In the UK this is transposed into national law through a series of regulations which are often sector specific (i.e. public infrastructure, agriculture, marine works etc.). In Jersey EIA requirements are encompassed within the Planning and Buildings (Environmental Impact) (Jersey) Order 2006. Jersey is also subject to other agreements such as the Valletta Convention which seeks to protect sites of archaeological interest and to which Jersey was a signatory in 2000 as well as the Aarhus Convention covering access and sharing of information (Societe Jersiaise, pers. comm.).

EIA legislation sets out the requirements for an applicant and provides the framework for a process which is outlined in Section 10.4.3 and which is similar for Europe, the UK and Jersey. However, there are differences between definitions of 'Environmental Impact Assessments' and 'Environmental Impact Statements.' UK law refers to an 'Environmental Impact Assessment' which includes a non-technical summary known as an 'Environmental Impact Statement' – whereas in the Planning and Buildings (Environmental Impact)(Jersey) Order 2006 the process is referred to as an 'Environmental Impact Statement' with the non-technical summary known as an 'Environmental Statement'.

This has led to some confusion both in industry and between States of Jersey Departments as to the distinction between EIS and EIA. Within the Planning context there was a consistent understanding that an EIA is the 'process', whilst an EIS is the 'document' that comes out of the process (A. Scate & S. Le Clare, pers. comm.s). However, there were other interpretations where an EIS was seen as potentially applying to installations of >0.5ha above HW as distinct from an EIA which could be of any size in the planning jurisdiction above or below HW.

It is possible that these differences in interpretation have arisen from differing needs for the 'Prescribed developments' listed in Schedule 1:

> 1. Agriculture (4). "To develop or construct an installation to rear of fish."
>
> 11. Other projects (12). "Any development on land covered or, in the normal course of tides, from time to time covered by sea water."

For example "installation" includes any structure whether embedded or temporarily placed on the surface but does not include ranching (S. Bossy, pers. comm.) suggesting aquaculture systems not using "installations" would not need an EIA. However, concern has been raised from a JAA Member that a proposal for managed ormer beds (see Section 4.3) with no installation and of <0.5ha may still require an EIA (T. Legg, pers. comm.).

The uncertainty over the potential need for an EIA/EIS is further complicated by possible Ministerial involvement as Article 2(4) of Planning and Buildings (Environmental Impact)(Jersey) Order 2006 states that the Minister can determine that an EIA is not required if he is satisfied that by virtue of the nature, size or location the development is unlikely to have a significant effect on the environment. Conversely, the Minister can require an EIA for any aquaculture proposal even if under 0.5 hectares in size.

In the UK the Marine Works (Environmental Impact Assessment) Regulations 2007 have a screening opinion which if it is deemed that an EIA is not required can allow the project to be carried out. It is unclear to what degree the Jersey Ministerial intervention is supported by F&MR advice on the EIA/EIS requirement, possibly mirroring this UK screening approach.

Strategy Option: States of Jersey Departments need to internally clarify legislative definitions and EIA/EIS requirements. Consistent guidelines could then be issued to potential applicants providing an overview of the process with transparency in the decision points and timelines.

10.5.2 Codes of Practice

Codes of Good or Best Practice (CoGP/CoBP) are becoming much more commonplace as the aquaculture industry strives to demonstrate a responsible and sustainable approach to its operations and methods of production. The Association of Scottish Shellfish Growers (ASSG) have a CoGP in place for Members which apparently has been well received by growers, but has limited weight as it is voluntary and has no audit procedure (Walter Spiers, Chairman, ASSG, pers. comm.). A copy of the ASSG CoGP can be downloaded from their website on www.assg.org.uk/ but includes the following sections:

- Establishing a Shellfish Farm;
- Locational Planning;
- Site Access;
- Navigational Safety;
- Visual Impact (landscaping);
- Noise and Light;
- Odour;
- Mariner Birds and Other Wildlife;
- Carrying Capacity;
- Introduction of New Species and Disease;
- Husbandry and Harvesting;
- Monitoring;
- Depuration.

In Jersey there is certainly the potential to link the legislative requirements for an EIA with the licensing aspects of shellfish concessions. Concession licence requirements place certain duties upon operators to maintain concession areas. It is likely that a higher tier of operational management via a CoGP will place a higher burden of responsibility upon an operator. However this might then offer some benefits to the industry member with respect to the duration of concession licensing and the potential for a 'fast-tracked' EIA process. This would in effect give a CoGP the type of weighting that the ASSG CoGP lacks at present.

This 'carrot and stick' approach would require work from both industry and regulators to establish a workable scheme with sufficient checks and balances and with appropriate enforcement. A suggested starting point would be the product certification and accreditation measures considered in Section 7.2 which are essentially based upon environmental sustainability criteria.

For example, an operator working within a CoGP would use husbandry practices that would minimise environmental impact and which could then be used as mitigating evidence that would then ease the 'screening' process. Similarly an acceptance of a staged trial development for a new operating regime with a commitment to appropriate monitoring might allow an operator to get going with a scheme allowing generation of real site specific data, whilst providing the regulator with some reassurance that a full licence would be conditional upon demonstrating no adverse environmental impact.

A schematic of a possible EIA Protocol is provided in Section 10.6.

Strategy Option: Jersey Aquaculture Association working with Fisheries and Marine Resources to develop Codes of Good or Best Practice for general aquaculture operations.

Strategy Option: Fisheries and Marine Resources to arrange incorporation of Codes of Good or Best Practice as part of the aquaculture application process and in use as mitigation for standard applications with respect to EIAs.

10.6 EIA Protocol for Aquaculture

Key:
CoGP = Code of Good Practice

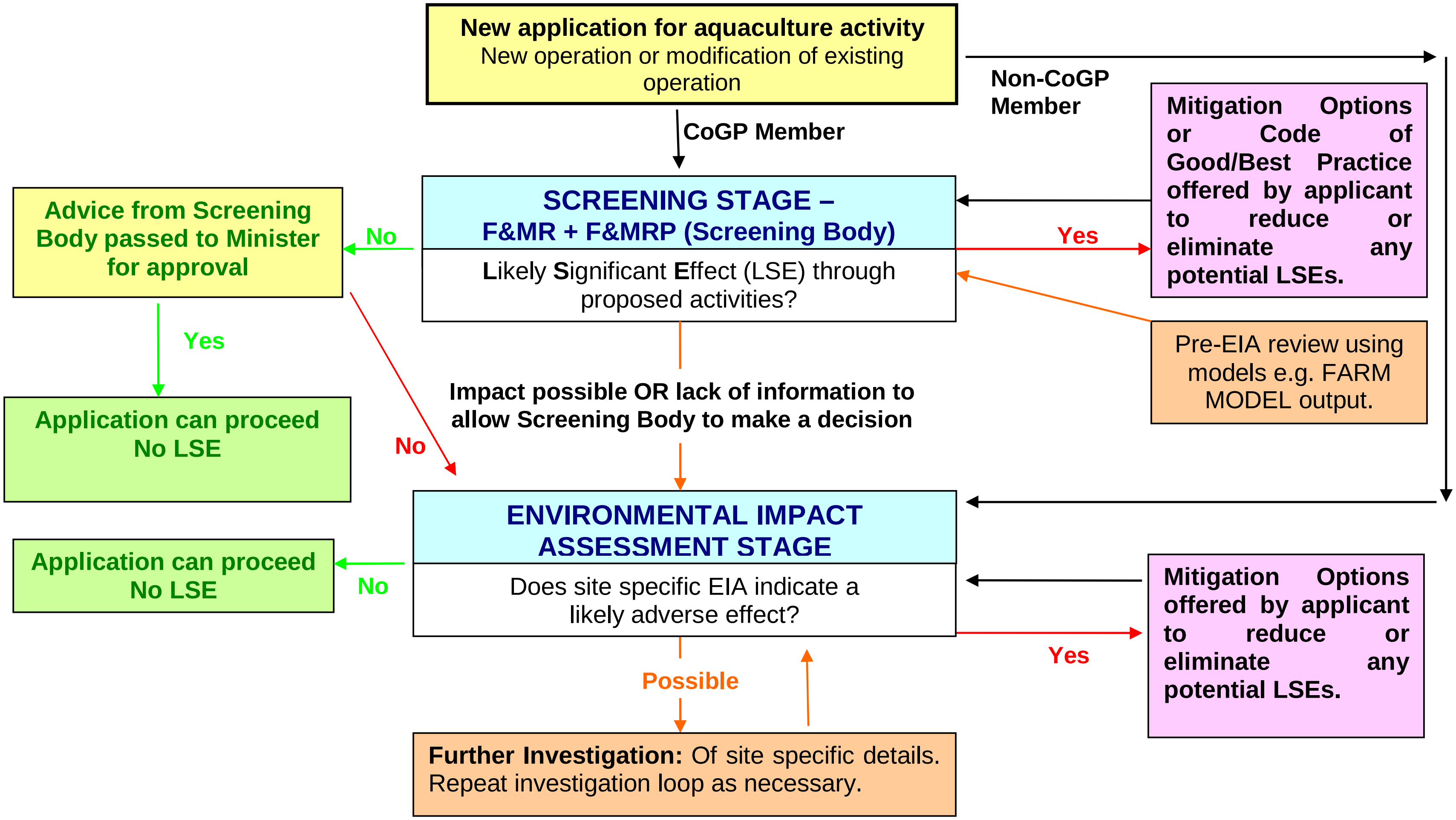
F&MR = Fisheries and Marine Resources

F&MRP = Fisheries and Marine Resources Panel

LSE = Likely Significant Effect

Environmental Impact Assessment Protocol for Aquaculture

Flow diagram describing a potential process that could be adopted with any aquaculture application to assess if an EIA is required.



Section 10. Strategy Option(s)

Section	Strategy Option(s)	Benefit / Importance	Output or Outcome	Cost or Funding Requirement	Timeframe for Implementation
10.1	Formation of a joint working group with input from Jersey Aquaculture Association, States of Jersey and Fisheries and Marine Resources' officers (Impact Assessment Group) to assess potential aquaculture activities which may impact upon the Ramsar site.	**High**	Recommendations for inclusion in the Code of Good/Best Practice.	**Moderate**	Short Term – less than 5 years
10.2	Consideration should be given to incorporate non-native species inspections for stock imports into a Code of Good Practice.	**Moderate**	Recommendations for inclusion in the Code of Good/Best Practice.	**Low**	Short Term – less than 5 years
10.3	'Impact Assessment Group' to review baseline studies with appropriate 'ground truthing' in order to better define the potential sensitivity of the aquaculture/Ramsar area.	**High**	A common acceptance of area sensitivity.	**Moderate**	Short Term – less than 5 years
10.4	Review by Fisheries and Marine Resources of aquaculture modelling systems in order to assess whether they could assist at the screening stage of the EIA process.	**Moderate**	Supporting the potential development of an EIA 'screening' tool.	**Low**	Short Term – less than 5 years

10.5	Liaison by Fisheries and Marine Resources with Transport and Technical Services to investigate the potential to expand the scope of any potential offshore modelling to encompass aquaculture related outputs.	**Moderate**	Supporting the potential development of an EIA 'screening' tool.	**Low**	Short Term – less than 5 years
10.6	States of Jersey Departments need to internally clarify legislative definitions and EIA/EIS requirements.	**High**	Guidelines to potential applicants providing decision points and timelines.	**Low**	Short Term – less than 5 years
10.7	Jersey Aquaculture Association working with Fisheries and Marine Resources to develop Codes of Good or Best Practice for general aquaculture operations.	**High**	Code of Good or Best Practice for industry.	**Moderate**	Short Term – less than 5 years + Medium Term – 5 to 10 years
10.8	Fisheries and Marine Resources to arrange incorporation of Codes of Good or Best Practice as part of the aquaculture application process and in use as mitigation for standard applications with respect to EIAs.	**High**	Streamlined application process for aquaculture applications.	**Minimal** to **Moderate**	Short Term – less than 5 years + Medium Term – 5 to 10 years

SECTION 11 – SWOT ANALYSIS AND INTERPRETATION FOR THE JERSEY AQUACULTURE INDUSTRY

Strengths	Opportunities
➢ **1** - High quality / very good growth. ➢ **=2** - Sustainability. ➢ **=2** - Existing performing aquaculture businesses. ➢ **=3** - Tourism linkage / external awareness. ➢ **=3** - Genuine Jersey. ➢ **=3** - Operating at European levels of oyster production. ➢ **=3** - 'Disease Free' status (*see also Weaknesses*). ➢ Range of products but mostly oysters. ➢ Public acceptance. ➢ Export products. ➢ Minimal importation. ➢ Environmental monitors i.e. 'Sentinels'. ➢ Industry body exists. ➢ Some product development assistance e.g. JEDI. ➢ Currency fluctuations. ➢ 'Wise use' of Ramsar. ➢ Member of the Ramsar Management Committee (as JAA)	➢ **1** - Modest expansion. ➢ **=2** - Benefit from decrease in French oyster production. ➢ **=2** - Potential for hatchery/nursery for shellfish seed production. ➢ **=2** - New species both indigenous and non-indigenous. ➢ **=3** - Local market. ➢ **=3** - Freshwater aquaculture & re-circulation technology. ➢ Can fulfil international environmental criteria (MSC, WWF Dialogues, Ecological Performance Standards). ➢ Political will to generate export products. ➢ Generic marketing. ➢ Indirect access to European research (SUDEVAB).
Weaknesses	**Threats**
➢ **=1** - Transport (*grouped*); o **=2** - Costs for finished product & price changes. o **=3** - Transport times for finished product & weight restrictions. o **=2** - Transport monopoly, availability & continuity of availability. ➢ **=2** - Lack of competitive government support. ➢ **=2** - Aquaculture vs. agriculture definition and perception i.e. difference in treatment of sectors. ➢ **=3** - High cost area for labour and infrastructure. ➢ **=3** - Onshore facility permits – planning issues. ➢ **=3** - Short concession times (6-9 years). ➢ No government research. ➢ **=3** - Intermittent poor water quality. ➢ 'Policeman' approach of Fisheries. ➢ Public conflict with the environment use. ➢ Currency fluctuations. ➢ **=3** - Internal competition. ➢ Perception of not 'wise use' of Ramsar. ➢ Lack of grant support for industry or research. ➢ **=3** - Issues over security re. scallops on concessions & policing of areas. ➢ 'Disease Free' status hinders some shellfish movements e.g. seed importation (*see also Strengths*). ➢ Reliance on CEFAS advice. Lack of cooperation with IFREMER.	➢ **1** - Transport costs. ➢ **2** - Declining water quality. ➢ **=3** - Disease e.g. Oyster herpes virus / emergent diseases. ➢ Slow legislative process e.g. update of seaweed harvesting regulations. ➢ **=3** - Administrative & planning delays. ➢ Environmental monitoring effect as a driver for government spending on the environment. ➢ External competition. ➢ Competition for space with fishermen. ➢ Environmental change (storms / temperature). ➢ Market perception e.g. with respect to water quality. ➢ Seed availability. ➢ Pollution e.g. heavy metal contamination. ➢ Lack of new available sites. ➢ Requirement for EIAs for shellfish culture activities. **Key:** Number before the item indicates the relative priority with No. **1** of the **3** being most important based on the total number of votes received across all rankings. Where two items had the same number of votes then this is indicated by an **=** sign.

Based on SWOT Analysis Ver3.doc

11.1 Introduction

In order to describe in a structured and concise manner the current status of the Jersey aquaculture industry as viewed by the Jersey Aquaculture Association (JAA) Members a 'Strength, Weaknesses, Opportunities and Threats' Analysis was developed. The initial draft of the SWOT Analysis was presented at a meeting of JAA Members and the various categories were discussed and alterations and additions made where necessary.

The JAA Members were then asked to rank in terms of importance their top three items from each category so as to provide a basic assessment of their perception of the current status of the sector. These results have been collated and analysed and are presented on the SWOT Analysis (see previous page) and described in the following section.

11.2 Interpretation of SWOT Analysis

Strengths:

- **Existing performing aquaculture businesses;** One Jersey Aquaculture Association Member stated that given the current businesses exist without the capital grant assistance of the competition that this indicates the robustness of the operations in Jersey. Indeed, by way of an example, the production of around 830 tonnes in 2008 of Pacific oysters by the Jersey industry equates to almost 80% of the total UK production for the equivalent period.

- **Range of products but mostly oysters;** The Jersey Aquaculture Association state that the relative size of the oyster industry which compares directly with the entire UK production and is one sixth of the entire Irish production, the strong local sales of scallops and turbot, small scale seaweed sales, and potential for new species such as ormers, indicates the strength and depth of the current industry.

- **High quality / very good growth;** Examples given by the Jersey Aquaculture Association are the Jersey oyster which is generally regarded as a high grade product and which can be grown to market size in eighteen months which is approximately half the time taken in most French Departments. This has significant benefits to the Jersey industry in terms of production cycle times. An on-shore example was the production of high quality, high value, farmed turbot which are sold to high-end restaurants and hotels as well as at the farm gate where they are individually boxed for customers

- **Public acceptance;** Meetings and discussions with other marine stakeholders during the formulation of the Jersey Aquaculture Strategy revealed that in general the existence of the industry is considered to be part of the culture of the Island and had a positive role to play in helping to ensure diversification of the Island's economy. Whilst some visual impact through intertidal culture activities was highlighted this was not considered to be significant at present levels of production.

- **Tourism linkage / external awareness;** The JAA consider that the industry's activities are a promotional aid to the Island as a whole, helping to raise its profile, enhancing the reputation of food production in the Island and through this helping to generally promote tourism.

- **Export products;** Pacific oyster production in particular is a major export product with the majority of Jersey production being exported to mainland France.

- **Minimal importation;** The production of shellfish and finfish in the Island is generally based on the import of seed or fry from overseas as no local hatchery exists. Part-grown shellfish stock is not normally imported as growth rates in Jersey tend to be higher than other production areas such as mainland France.

- **Sustainability;** Considered by JAA Members to be a major Strength of the industry. Examples of this sustainability include the harnessing of natural resources as the main feed for shellfish and no use of chemicals or therapeutants.

- **Environmental monitors i.e. 'Sentinels';** The quality of the marine environment and the status of the shellfish and finfish culture sector are intrinsically linked. As such both these sectors act as sentinels for the marine environment in that they are an indicator of the health of the wider marine environment.

- **Industry body exists;** The Jersey Aquaculture Association represents all aquaculture producers in the Island.

- **Some product development assistance e.g. JEDI;** The Jersey Export Development Initiative and the new Small Exporters Grant are available which provide some assistance to industry in increasing export sales.

- **Genuine Jersey;** The 'Jersey Brand' is considered by the JAA to be a significant asset to the industry and it seems clear that this is a strong promotional tool. The reputation of Jersey aquaculture produce as being a premium product should therefore be protected by the industry itself by ensuring that produce placed on the market remains of a high quality.

- **Currency fluctuations;** The current low value of Sterling can be viewed as making Jersey exports more competitive when exporting into mainland Europe.

- **Operating at European levels of oyster production;** As stated previously the production of Pacific oysters in Jersey is significant when compared to countries such as the UK or Ireland.

- **'Wise use' of Ramsar;** The JAA feel that the current aquaculture techniques and operations are in general a responsible and sustainable use of the Ramsar site and complement well its conservation objectives.

- **Member of the Ramsar Management Committee (as JAA);** The Jersey Aquaculture Association has recently been appointed to the Ramsar Management Committee and has stated that this is a pro-active response to environmental concerns and that it will actively participate in the formulation of consensus policies in this respect.

- **'Disease Free' status;** This refers to the *Bonamia* and *Marteilia* Approved Zone status of the Island waters and not for Oyster herpes virus which is an emerging disease that is present in the Island (see Section 8.3 for discussion of this issue). *See Weaknesses*.

Weaknesses:

- **High cost area for labour and infrastructure;** Costs of labour and infrastructure in general in the Island are considered to be higher than those faced by competitors in areas such as mainland Europe.

- **Transport costs for finished product & price changes;** Transport issues in general are perceived as being one of the major Weaknesses and Threats to the industry. Carriage costs for industry vehicles are considered to be high and subject to regular changes. One JAA Member estimated that their freight costs were approximately £60,000 per annum at current production levels. Another example quoted was of a freight cost of £266 to ship over one tonne of fish feed.

- **Transport times for finished product & weight restrictions;** Examples were given by JAA Members of difficulties encountered over weight restrictions on vehicles shipping bulk loads of Pacific oysters to France.

- **Transport monopoly, availability & continuity of availability;** Only Condor currently operates a freight service to France. Timetable is limited and does not match peak times of demand (e.g. pre-Christmas exports to France). Availability is a problem at busy times such as the Easter period.

- **Onshore facility permits – planning issues;** In one example given a Jersey Aquaculture Association Member was informed during a planning application process that an agricultural shed on their property could not be used for grading of oysters without specific and detailed planning permission as advice from the Crown Officers was that 'as the oysters did not grow in the shed or during the grading process, this cannot be regarded as agricultural use'.

- **Short concession times (6-9 years);** Under the Sea Fisheries (Establishment and Regulation of Fisheries) (Jersey) Regulations 1998 the general length of time that concessions are issued for is 6 years. Although 9 year leases are possible these may require additional application procedures (G. Morel, pers. comm.). Reapplication is then necessary.

  Short concession times obviously have implications in terms of industry confidence in investing in stock, equipment and infrastructure although Fisheries and Marine Resources state (S. Bossy, pers. comm.) that if concessions have been operated appropriately then reapplications will be successful.

  In an example cited by the Jersey Aquaculture Association regarding ormers it was stated that to grow the ormers to market size requires at least 4 years and a commencement time of mid-June at the latest. If therefore an application misses the opportune timing, then the first crop may still be attaining full market size at the time of the next renewal.

- **Lack of competitive government support;** The existence of JEDI and Innovation from EDD was welcomed but stated as being limited in the support that it could provide especially when compared to the funding levels available to competitors.

- **No government research;** There was a general view that little is done to help support research with an example given of what was considered a relatively small contribution that was offered towards the Oyster herpes virus investigation, an issue viewed by industry to be a major risk. Linked to this is the Weakness that more cooperation does not take place with Ifremer whilst there is an over reliance on advice from Cefas.

- **Intermittent poor water quality;** Analysis by industry of the Bellozanne outfall was stated as having recorded *E. coli* levels of up to 550,000 per 100ml. *See also Threats.*

- **'Policeman' approach of Fisheries;** One Jersey Aquaculture Association Member stated that the 'Policeman' approach of Fisheries relates more to the control of fisheries rather than in practical protection against issues such as poaching on aquaculture concessions.

- **Public conflict with the environment use;** Access to the marine resource is becoming increasingly competitive.

- **Currency fluctuations;** Any strengthening of Sterling will make Jersey exports into mainland Europe less competitive.

- **Internal competition;** Due to the limited availability of certain resources such as concession areas there is therefore competition in this respect. Also, if production of species such as scallops or ormers increases then there may also be increased competition for local markets for sale of produce.

- **Perception of not 'wise use' of Ramsar;** An exclusion area was discussed in light of an area proposed by the Societe Jersiaise. The implementation of exclusion areas would need consideration and discussion on a case by case basis to assess if aquaculture activities were having a significant detrimental impact on the marine environment. However it was agreed that without baseline mapping of species it is difficult to assess if specific species such as the bivalve *Mactra glauca* will be impacted by aquaculture activities. In terms of EIAs it was also considered that baseline studies would be needed in order to assess any Likely Significant Effect on biota through aquaculture activities.

- **Lack of grant support for industry or research;** The differences between the UK and Jersey were highlighted with respect to access to grant funding such as the European Fisheries Fund (EFF).

- **Issues over security re. scallops on concessions & policing of areas;** Concerns were highlighted with regard to scallop concessions where there is no practical enforcement of recent legislation to prevent boats travelling through a concession with scallops aboard. One JAA Member involved in scallop cultivation stated that they would prefer to see diving banned on concessions although again enforcement would be an issue.

- **Aquaculture vs. agriculture definition and perception i.e. difference in treatment of sectors;** The JAA highlighted potential inequalities between sectors e.g. with respect to planning applications.

- **'Disease Free' status hinders some shellfish movements e.g. seed importation;** Current *Bonamia* and *Marteilia* Approved Zone status restricts imports of scallop and mussel seed from areas considered positive for these diseases. *See Strengths.*

- **Reliance on Cefas advice. Lack of cooperation with Ifremer;** Given the Island's close proximity to mainland Europe, and the fact that the majority of the export products in terms of shellfish are exported to France, there is seen to be an over reliance on advice from Cefas in the UK whereas a more natural partner in this respect may in fact be the French Research Institute for Exploration of the Sea (Ifremer).

Opportunities:

- **Modest expansion;** JAA Members consider that there is scope for a modest expansion of Pacific oyster culture in the intertidal zone and this is stated therefore as being a significant opportunity for the industry given large scale reductions in production in other main oyster growing areas due to disease issues. Density measurements were discussed with an example given of the French system of bag limits per hectare i.e. not based on an oyster density. It was also stated that a major constraint on expansion was a lack of shore-based facilities for grading and processing for the shellfish sector as well as for production for the finfish sector.

- **Benefit from decrease in French oyster production;** The reduced availability of French Pacific oysters should result in increased prices and demand for product delivered to the French market.

- **New species both indigenous and non-indigenous;** Ormer culture or ranching was stated as an example of a new species to aquaculture in the Island that showed significant possibilities. Ormer culture does however require seaweed as a feed source which will require a legislation update.

  The slow legislative process is therefore seen as a Threat in this respect. Resistant oyster strains with respect to Oyster herpes virus were discussed and industry stated a need to access any new developments i.e. “level playing field with the French industry” if they were to remain competitive.

- **Local market;** Pacific oysters are sold to the local market in relatively small amounts compared to the tonnages exported. Conversely almost all of the blue mussel, King scallop and turbot produced by the Jersey aquaculture industry are sold locally. Other benefits therefore include reduced ‘food miles’.

- **Can fulfil international environmental criteria (MSC, WWF Dialogues, Ecological Performance Standards);** WWF Codes of Good Practice being actively investigated. Industry has the capacity to fulfil these types of criteria. Main decision would be which management system would be most/best suited to Jersey.

  Correspondence from the Jersey Aquaculture Association has described possible Ecological Performance Standards. These might be used to identify, for instance, what the current density is of lugworm casts on a site and whether these change over time. This would allow an easily recordable and practical assessment of any changes in an ‘indicator’ species over time in relation to aquaculture activities.

- **Political will to generate export products;** EDD were stated as having supported export initiatives.

- **Generic marketing;** Potential noted for product marketing highlighting the common strengths and attributes of the sector as a whole.

- **Indirect access to European research (e.g. EU FP7 Project - SUDEVAB);** The SUDEVAB Project was highlighted as a current research project on the culture of the ormer (European abalone) which could have benefits to the Island’s industry with respect to commercialising the cultivation of the ormer and in tackling known issues such as disease. See *Threats*.

- **Freshwater aquaculture & re-circulation technology;** There was agreement that this might be an area of expansion although doubts were raised as to whether glasshouses might become free to use in this respect.

- **Potential for hatchery/nursery for shellfish seed production;** The potential for hatchery development was discussed and there was general support for the concept although it was stated that any such development would need to be phased in so as to ensure security of seed supplies i.e. to limit risk. Interpretation centre possibilities were discussed although this might raise issues with planning due to possibilities of increased traffic.

  Subsequent correspondence with the JAA has however highlighted some concerns that any such development might detract from efforts to support the industry with other current Weaknesses and Threats. The economic feasibility of running an Island-based hatchery was estimated and described as being marginal at a steady state production level based on information that was available at that time. Syvret in a private study concluded that a hatchery for an individual operator would be uneconomic to run and any co-operative hatchery venture would require careful consideration based on land values and labour costs in Jersey. Subsequent updated information from Ormer & Scallops of Jersey Ltd. has highlighted their increase in hatchery output of both ormer seed and now Pacific oyster seed. The JAA will no doubt study this development with interest in terms of the potential it holds for supplying other growers. Seed mortality levels, growth rates and costs of production will however need to be carefully assessed in order to ascertain if this will become an economically viable venture for the future.

  The Strategy will therefore still highlight the possibility of investigating the practicality and economic feasibility of an Island-based hatchery as part of a hybrid-facility but notes the concern raised that this might decrease or deflect effort from other serious issues facing the industry (see also Sections 2.3.5 and 7.2.1).

Threats:

- **Declining water quality;** Viewed as a major Threat to the industry with a potential link to another Threat of possible poor market perception of what has been to date regarded as a premium quality product. The Strategy considers that the economic and financial impacts of downgrades and consequent effects on market prices achieved should be evaluated (see Section 6.5). Some Jersey Aquaculture Association Members disagreed with the Transport and Technical Services standpoint that information regarding spills was communicated to industry especially for any discharges away from the main growing areas.

  The occurrence of norovirus was discussed and it was agreed that this was a current issue and could be a major developing issue. Industry attitude to proactive management of beds e.g. temporary closures was discussed. Overall the feedback was that Grade A waters were still the preference. Maintenance dredging/TBT was not viewed as a problem. *Also viewed as a Weakness*.

- **Disease e.g. Oyster herpes virus / emergent diseases;** The most obvious example of the potential impacts on industry of emerging diseases has been that of the Oyster herpes virus in 2008 and 2009 that is reported to have caused up to 80% mortalities in juvenile stock with only oysters larger than 110g remaining unaffected. This has impacted both diploid and triploid stocks. The two main oyster growers estimated that their concession use had been reduced by between 10 and 20% due to this disease issue.

  Management plans are now in place e.g. seed imports stopped between certain periods; reduced densities; oysters moved further up the beach; stress induction through frequent turning being tested as a possible method to limit the build up of virus levels.

  Main issue for ormers seems to be *Vibrio harveyi*.

- **Slow legislative process e.g. update of seaweed harvesting regulations;** New legislation in Jersey requires drafting by Law Officers. The availability of Law Officer time is limited and so any requests for new legislation are subject to a competitive bidding process. An example cited of the potential impacts of this bidding system is that amendments such as that requested by industry on the ancient seaweed harvesting laws were not viewed in 2007 and 2008 as being of sufficient priority to be granted law drafting time when compared to other legislation.

- **Administrative & planning delays;** Three examples were given by JAA Members. The first was of an application for shore-based facilities that had been on-going for 5 years. The second was of a 3 year application to obtain permission for a breeding shed. The third was of an application for a co-operatively managed Grade A area in 2009 for which it was stated that the administrative processes and the EIA that would have been required made it impossible to implement this in time for the major export season to France. Whilst no conclusions can be drawn from individual planning applications these applications have caused significant operational difficulties for the JAA Members concerned.

- **Transport costs;** *See Weaknesses*.

- **Environmental monitoring effect as a driver for government spending on the environment;** Described as the possible disincentive to support the development of the aquaculture industry if this will lead to the incurrence of additional cost factors.

- **External competition;** It was stated that 'Hand dived scallops' were advertised as being available in certain outlets all year round and highlights the misleading trade descriptions sometimes used in marketing produce purported to come from shellfish farms. In effect dredged scallops are being marketed as aquaculture products and one JAA Member highlighted this as the single biggest threat to their business (see Section 4.2).

- **Competition for space with fishermen;** Space in the marine environment is a limited resource for which there is increasing demands from a variety of stakeholders. There have been disagreements with the commercial fishing sector previously over rights to fish over/within concession areas but these have largely been resolved through direct negotiation or through the Fisheries and Marine Resources Panel. Recent legislation changes have now removed the defence of 'navigation' if damage is caused to aquaculture equipment on a concession.

- **Environmental change (storms / temperature);** Sea water temperatures have been highlighted in Section 9 on Climate Change as having increased over the last few decades. Climate change and changing weather patterns may also lead to an increased frequency of sudden storm events. These potential threats with respect to environmental changes could impact on the aquaculture industry and other marine stakeholders through changes in water quality, frequency/occurrence of algal blooms (e.g. HABs such as PSP, DSP, ASP), shellfish diseases, public health, productivity, non-native species proliferation and ocean acidification.

- **Market perception e.g. with respect to water quality;** *See 'Declining water quality'*.

- **Seed availability;** Seed availability is considered to be a limiting factor on any expansion of scallop, mussel and ormer cultivation. King scallop seed has been successfully imported previously from Scotland and Ireland but currently there are difficulties in sourcing seed from areas of an equivalent Approved Zone status as Jersey. Small scale trials are believed to have been carried out in Jersey waters to collect wild scallop spat but these proved unsuccessful and this practice is therefore not widespread. Mussel seed is available in France but again cannot be imported due to the Approved Zone status. Ormer seed is now being produced locally (see Sections 2.2.3 and 7.2.1) but the costs of production vs. sale price it is believed are yet to be established. Seed is also available through commercial hatcheries such as France Haliotis in Brittany but to date no application has been made to try and import this seed into Jersey. The implications of the new Aquatic Animal Health Regulations are discussed in Sections 4.4 and 8.3.

- **Pollution e.g. heavy metal contamination;** In addition to the faecal contamination aspects of the declining water quality described by the JAA there is also the current potential for other pollution sources to contaminate commercial shellfish stocks. Possible sources of contamination may include the Energy from Waste facility being constructed at La Collette or other Waterfront developments if not properly planned and monitored.

- **Lack of new available sites**; This is seen as a potential threat both for intertidal culture and for onshore culture.

- **Requirement for EIAs for shellfish culture activities;** The requirement for an EIA on any developments over 0.5 hectares is seen as a major and unnecessary burden on the industry and was considered to be disproportionate to the level of risks to the environment generally encountered in shellfish cultivation activities. One example that was given was of a 0.7 hectare holding site application that requires an EIA. A major concern was that in the future an EIA might become a requirement on re-application/renewal of concessions.

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APPENDIX

List of Appendices

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Appendix 2. Microalgal requirements for a hatchery;

Estimation over a 6 week period of the microalgae needed to rear 1 million Pacific oyster spat with two different species of microalgae.

Appendix 3. Commission Regulation (EU) No. 175/2010;

A flow chart describing the actions under Reg. No. 175/2010 together with a supporting explanation.

APPENDIX 1 – Consultee Listing

Title	Name		Description of role/interest
Mr	Duncan	Berry	Transport & Technical Services
Mr	Jason	Bonhomme	Commercial fisherman
Dr	Simon	Bossy	Head of Fisheries and Marine Resources
Mr	Dave	Cabeldu	Save Our Shoreline
Dr	Paul	Chambers	Societe Jersiaise
Ms	Nina	Cornish	Environmental Management
Mr	Dave/Gary	Cowburn	Fish Farmer - Jersey Turbot
Dr	Tim	du Feu	Head of Water Resources
Deputy	Rob	Duhamel	Assistant Minister for Environment
Mr	Grant	Feltham	Oyster farmer
Mr	Steve	Fisher	Transport & Technical Services
Mr	Peter	Gosselin	Panel member - Jersey sea anglers
Mr	Chris	Gould	Scallop farmer
Mr	Dan	Houseago	Assistant Director - Rural Economy
Mr	Chris	Isaacs	Jersey recreational fisherman
Mr	John	Jackson	Livestock Adviser - Environmental Management
Mr	Nicolas	Jouault	Societe Jersiaise (former Panel member)
Mr	Chris	Le Boutillier	Panel member - Inshore Fishing - North coast
Ms	Sarah	Le Claire	Assistant Director - Environmental Policy
Mr	Trevor	Le Cornu	Oyster farmer - Seymour Oyster Company Ltd.
Mr	Chris	Le Masurier	Panel member - Oyster farmer - Jersey Oyster Company
Mr	John	Le Seelleur	Oyster farmer - Seymour Oyster Company Ltd.
Mr	Tony	Legg	Oyster / Ormer farmer - Jersey Sea Farms
Mrs	Linda	Lowseck	States Veterinary Officer
Captain	Paul	Minnack	Harbour Master
Mr	Greg	Morel	Marine and Coastal Officer
Mr	Derek	Morris	Facilities Manager - Jersey Water
Mr	Alex	Navarre	Oyster farmer - Royal Bay Oysters & Heritage Shellfish Ltd.
Mr	Iain	Norris	Horticultural Adviser - Environmental Management
Mr	William	Peggie	Assistant Director - Environmental Protection
Mr	Ashley	Pinel	States Veterinary Assistant
Miss	Nathalie	Porritt	Panel member
Mr	Martyn	Proper	Save Our Shoreline
Ms	Kate	Roberts	Water Resources - Environmental Protection
Mr	John	Rogers	Chief Officer - Transport & Technical Services
Mr	Andrew	Scate	Chief Executive Officer - Planning & Environment
Mr	Jonathan	Shrives	Fisheries Officer - Research and Development
Mr	Steve	Smith	Head of Health Protection Services
Mr	Justin	Surcouf	Scallop / Ormer farmer - Ormer & Scallops of Jersey Ltd.
Mr	Ian	Syvret	Panel member - Jersey Inshore Fishermen's Association
Mr	Mike	Taylor	Panel member (Chairman)
Mr	Don	Thompson	Panel member - Jersey Fishermen's Association

Mr	Robert	Titterington	Scallop farmer
Mr	Dennis	Van Der Vliet	Transport & Technical Services

Version Dated: 07 May 2010

Key:	Fisheries and Marine Resources Panel
	Jersey Aquaculture Association Members

APPENDIX 2 – Microalgal requirements for a hatchery

<u>Skeletonema</u>; Week 1 - Spat weight ~0.5mg each

1,875,000 spat @ 0.5mg each	=	937,500mg x 0.4mg algae dry weight per mg biomass
	=	375,000mg dry wt. of algae per week required
Skeletonema cells	=	0.032mg dry weight per million cells
Therefore total *Skel*. needed	=	375,000mg ÷ 0.032
	=	11,718,750 cells per week
Average harvest conc. of *Skel*.	=	~7,000 cells per microlitre
Therefore vol. of *Skel.* required	=	11,718,750 ÷ 7,000
	=	**1,674 litres per week <u>or</u> 239 litres per day**

Week 3 – After mortalities

1,562,500 spat @ 2.0mg each	=	3,125,000mg x 0.4mg algae dry weight per mg biomass
	=	1,250,000mg dry wt. of algae per week required
Skeletonema cells	=	0.032mg dry weight per million cells
Therefore total *Skel*. needed	=	1,250,000mg ÷ 0.032
	=	39,062,500 cells per week
Average harvest conc. of *Skel*.	=	~7,000 cells per microlitre
Therefore vol. of Skel. required	=	11,718,750 ÷ 7,000
	=	**5,580 litres per week <u>or</u> 797 litres per day**

Week 6 – 2-3mm spat after mortalities and to achieve 1 million spat at ~6mm

1,250,000 spat @ 5mg each	=	6,250,000mg x 0.4mg algae dry weight per mg biomass
	=	2,500,000mg dry wt. of algae per week required
Skeletonema cells	=	0.032mg dry weight per million cells
Therefore total *Skel*. needed	=	2,500,000mg ÷ 0.032
	=	78,125,000 cells per week
Average harvest conc. of *Skel*.	=	~7,000 cells per microlitre
Therefore vol. of *Skel.* required	=	78,125,000 ÷ 7,000
	=	**11,160 litres per week <u>or</u> 1,594 litres per day**

<u>Tetraselmis</u>; Week 1 - Spat weight ~0.5mg each

1,875,000 spat @ 0.5mg each	=	937,500mg x 0.4mg algae dry weight per mg biomass
	=	375,000mg dry wt. of algae per week required
Tetraselmis cells	=	0.20mg dry weight per million cells
Therefore total *Tetra*. needed	=	375,000mg ÷ 0.20
	=	1,875,000 cells per week
Average harvest conc. of *Tetra*.	=	~1,000 cells per microlitre
Therefore vol. of *Tetra.* required	=	1,875,000 ÷ 1,000
	=	**1,875 litres per week <u>or</u> 268 litres per day**

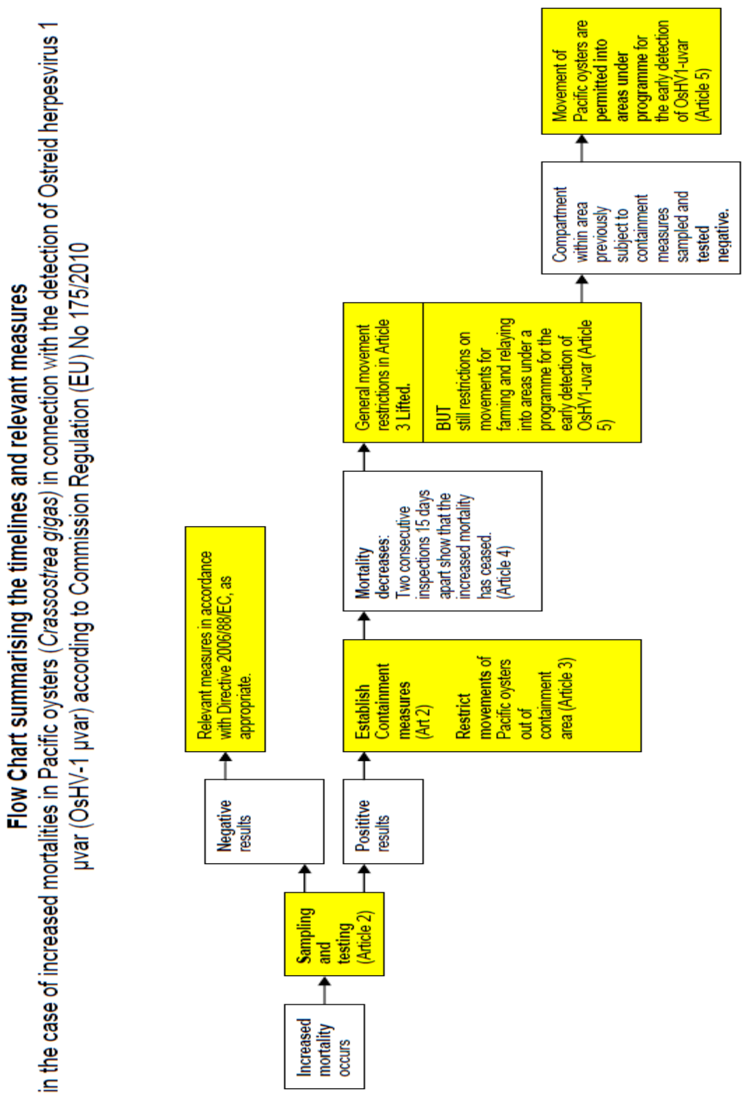
Week 3 – After mortalities

1,562,500 spat @ 2.0mg each	=	3,125,000mg x 0.4mg algae dry weight per mg biomass
	=	1,250,000mg dry wt. of algae per week required
Tetraselmis cells	=	0.20mg dry weight per million cells
Therefore total *Tetra*. needed	=	1,250,000mg ÷ 0.20
	=	6,250,000 cells per week
Average harvest conc. of *Tetra*.	=	~1,000 cells per microlitre
Therefore vol. of *Tetra.* required	=	6,250,000 ÷ 1,000
	=	**6,250 litres per week <u>or</u> 893 litres per day**

Week 6 – 2-3mm spat after mortalities and to achieve 1 million spat at ~6mm

1,250,000 spat @ 5mg each	=	6,250,000mg x 0.4mg algae dry weight per mg biomass
	=	2,500,000mg dry wt. of algae per week required
Tetraselmis cells	=	0.20mg dry weight per million cells
Therefore total *Tetra*. needed	=	2,500,000mg ÷ 0.20
	=	12,500,000 cells per week
Average harvest conc. of *Tetra*	=	~1,000 cells per microlitre
Therefore vol. of *Tetra.* required	=	12,500,000 ÷ 1,000
	=	**12,500 litres per week <u>or</u> 1,786 litres per day**

APPENDIX 3 – Commission Regulation (EU) No. 175/2010



Source: http://ec.europa.eu/food/animal/liveanimals/aquaculture/oyster_regulation_flow_chart.pdf

Commission Regulation (EU) No 175/2010 implementing Council Directive 2006/88/EC as regards measures to control increased mortality in oysters of the species *Crassostrea gigas* in connection with the detection of Ostreid herpes virus 1 µvar (OsHV-1 µvar)

Background

Increased mortality in Pacific oysters of *(Crassostrea gigas)* was detected in several areas in France, Ireland in 2008 and in 2009 also on Jersey (UK). The Member States concerned took measures to control the emerging disease situation, mainly based on the restriction of movements of *Crassostrea gigas* out of the areas affected by increased mortalities.

The increased mortalities were originally attributed to a combination of adverse environmental factors together with the presence of bacteria of the genus Vibrio and the presence of the Ostreid herpesvirus-1 (OsHV-1) including a newly described genotype of that virus named OsHV-1 µvar. While the causes of the mortalities still remain uncertain, the epidemiological investigations undertaken in 2009 suggest that OsHV-1 µvar play a major role in the mortalities.

In view of the re-occurrence of the emerging disease situation in 2009 and its possible further recrudescence and risk for further spread in spring and summer 2010, and on the basis of the experience gained, the Commission adopted Commission Regulation (EU) No 175/2010 **implementing Council Directive 2006/88/EC as regards measures to control increased mortality in oysters of the species Crassostrea gigas in connection with the detection of Ostreid herpes virus 1 µvar (OsHV-1 µvar)** to ensure a harmonised approach between Member States as regards measures to control this emerging disease situation.

As there are still great uncertainties as regards this emerging disease situation, the temporary measures provided for in Regulation (EU) No 175/2010 shall only apply until the **end of 2010**. On the basis of the experience and knowledge gained, the Commission in cooperation with the affected Member States and stakeholders will re-assess the disease situation and the measures taken.

Regulation (EU) No 175/2010

The measures of Regulation (EU) No 175/2010 **only apply to Pacific oysters** *(Crassostrea gigas)*.

If increased mortality in Pacific oysters *(Crassostrea gigas)* is detected, the competent authorities of the Member States shall take samples to test for the presence of OsHV-1 µvar. If OsHV-1 µvar is detected a containment area must be established. Movements out of the containment area of Pacific oysters *(Crassostrea gigas)* shall be banned, unless an exception is foreseen in Article 3 of Regulation (EU) No 175/2010. Consignments of Pacific oysters *(Crassostrea gigas)* which are allowed to leave a containment area and intended for farming or relaying areas must be accompanied with an animal health certificate (see Annex II to Commission Regulation (EU) No 175/2010) (See Articles 2 and 3).

The containment measures and the movement restrictions laid down Article 3 can be lifted following two consecutive inspections 15 days apart showing that the increased mortality has ceased (See Article 4).

Pacific oysters *(Crassostrea gigas)* originating from areas which previously have been subject to containment measures are subject to additional animal health requirements, including certification, if introduced for farming or relaying purposes into a Member State or compartment in which a programme for the early detection of OsHV-1 µvar is established, as long as OsHV-1 µvar is not detected in that Member State or compartment (See Article 5).

Programmes for the early detection of OsHV-1, which shall include targeted sampling and testing of all farms/mollusc farming areas covered by the programme, must be sent to the Commission with the aim to have them declared to the Standing Committee on the Food Chain and Animal Health (SCFCAH). (See here for a list of declarations.)

Source: http://ec.europa.eu/food/animal/liveanimals/aquaculture/oyster_mortalities_en.htm