

Shellfish News

Number 23, Spring/Summer 2007



CENTRE FOR ENVIRONMENT, FISHERIES AND
AQUACULTURE SCIENCE

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MANAGEMENT AND SUSTAINABILITY OF INTER-TIDAL SHELLFISHERIES IN SW WALES

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Introduction

Continuing high prices for cockles and mussels are putting increasing pressures on the shellfish resources within the *Carmarthen Bay & Estuaries European Marine Site* (EMS) (Figure 1). The EMS includes the Burry Inlet Special Protection Area, which supports internationally important numbers of wintering oystercatcher and knot, which feed predominantly on the cockle, but also on the common mussel. In addition, the adjacent Pembrey Coast Site of Special Scientific Interest, within the Three Rivers Estuary complex of the EMS, also supports nationally important numbers of wintering oystercatchers. Both Burry Inlet and the Three Rivers Estuary contain significant cockle and mussel stocks, and both are subject to fisheries of varying extent and intensity.

fisheries, within the constraints of the legislative framework currently in place.

The Burry Inlet cockle fishery

Since 1965 the fishery has been managed by the SWSFC under a Regulating Order made under the Sea Fisheries (Shellfish) Act 1967, which allows the issue of a restricted number of licences. Throughout the history of the fishery, only hand raking has been allowed, although access is now allowed by vehicle rather than restricted to horse and cart or donkey. Fishery effort is tightly controlled by the SWSFC via the issue of cockle licences and daily quota.

A limited number of licences (ca. 50) are issued each year for the hand raking of cockles only.

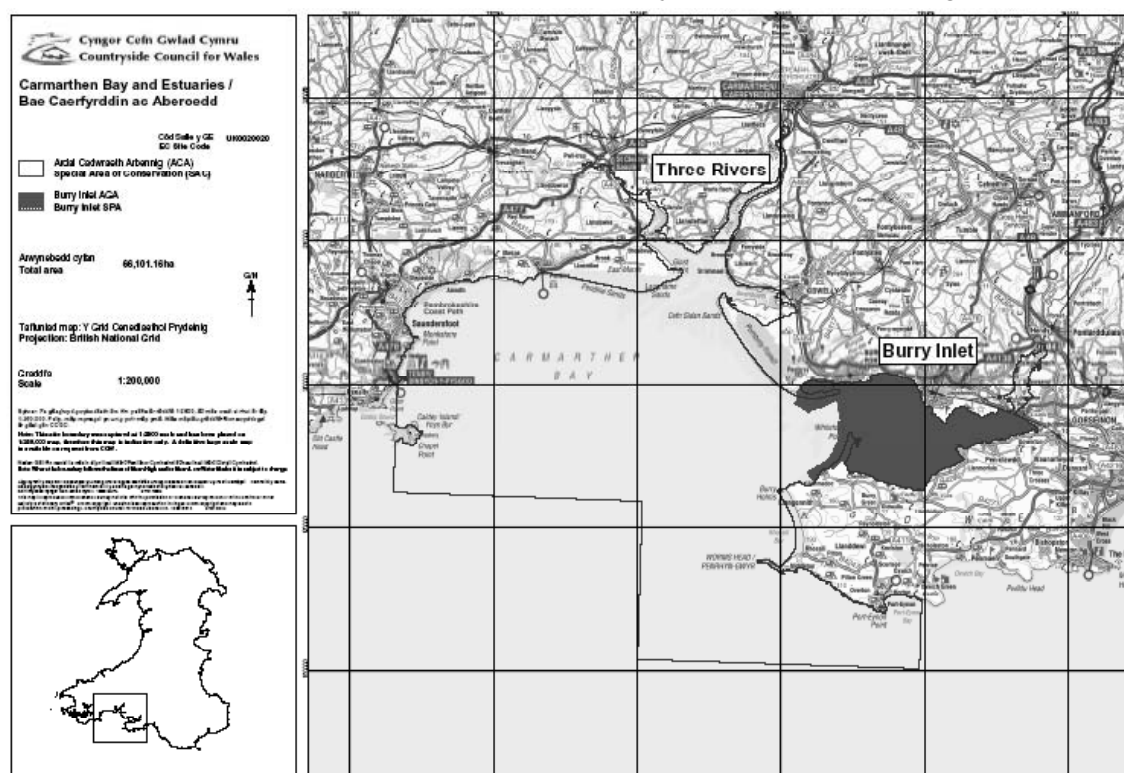


Figure 1. Map of the Carmarthen Bay & Estuaries Special Area of Conservation, the Burry Inlet Special Protection Area, and their cockle fisheries

The Countryside Council for Wales (CCW), as statutory advisor to the Welsh Assembly Government, and the South Wales Sea Fisheries Committee (SWSFC), as regulatory fisheries body, are currently working closely together to ensure the sustainable management of these

Gathering takes place all week except on Sundays to an individual daily quota of 300 kg - 600 kg per person per day. Minimum cockle sizes (17.5mm or 19mm square gauge) are determined via hand riddle size to allow the survival of sufficient spawning stock. Scientific

assessment of the cockle biomass takes place at least once per year by scientists from SWSFC and/or Cefas. From these surveys the level of fishable stock is set at around 33 % of the total fishable biomass. The number of cockle licences (full time or temporary) and daily cockle quota is then broadly set to give rise to the desired fishing effort. As a rule of thumb, the taking of a third of the biomass of adult standing stock each year has proved its worth in the Burry Inlet as a stock conservation rule, and is now being applied to other fisheries, i.e. 33 % to the fishermen, 33 % for bird food, and the remaining 33 % to act as brood stock in order to sustain the fishery.

The Burry Inlet cockle fishery has been recognised by a Marine Stewardship Council (MSC) accreditation, the first molluscan fishery in the world to receive such an accolade. Independent certifiers have found that its management gives rise to a sustainable fishery in both fishery and ecological terms which reflects social good practices.

The Three Rivers Estuary cockle fishery

Cockle stocks in the neighbouring Three Rivers Estuary are naturally more variable than in the Burry Inlet thereby setting management challenges. The level of harvestable cockle here is via the standard minimum size, gathering by hand only, and no night fishing along with



Figure 2. Permitted Cockle gatherers at Llanstephan in the Three Rivers Estuary in August 2005

seasonal opening and closure of specified beds. Furthermore, a permit scheme is now in place, which is the means by which catch returns are collected from named individuals. Permits are available to everyone upon request, free of charge, reflecting the limit of current Sea Fishery Committee powers under byelaw. This contrasts to the Regulating Order powers in the Burry Inlet under a separate statutory power, which allows the SWSFC Committee to restrict access by means of a chargeable licence and to recover, in full, the costs of management.

In 2005, following an unprecedented settlement of cockles in 2004, up to 2,000 cockle gatherers fished the Three Rivers Estuary in August 2005 and 8,200 tonnes of cockles were removed under SWSFC permit and a gathering regime that allocated different gathering areas for each tide / day and left an area to lie closed (Figure 2). The fishery was closed again in December 2005 under byelaw 24, which allows for 'Temporary Closure' for the protection of shellfish purposes. Surveys in early April established there to be over 1,000 tonnes of cockles in the Three Rivers Estuary; however, these suffered 50% mortality over the subsequent 3 months during a mass mortality event (see below).

In consultation with CCW and Carmarthenshire County Council, the SWSFC was to again open a more limited fishery in 2006 mainly based within the area left closed during 2005. However, the cockle mortality event gave rise to temporary public health closure, following the lifting of which it was decided that these remaining cockles should be protected in order that they act as a 'broodstock' for the population and to provide a valuable food source for migratory birds this winter.

Further regulation of cockle fishing effort is now being sought via a Regulating Order, akin to the one already in place for the Burry Inlet. The requirements include the Competent Authority, in this case the Welsh Assembly Government, to undertake an Appropriate Assessment (AA) in accordance with the provisions of Regulation 48 of the Conservation (Natural Habitats, &c.) Regulations 1994. Regulation 48 requires the Competent Authority to ascertain that this activity will not adversely affect the integrity of the EMS concerned, and if so, the AA will furthermore establish at what extent and intensity the activity can be reconciled with the

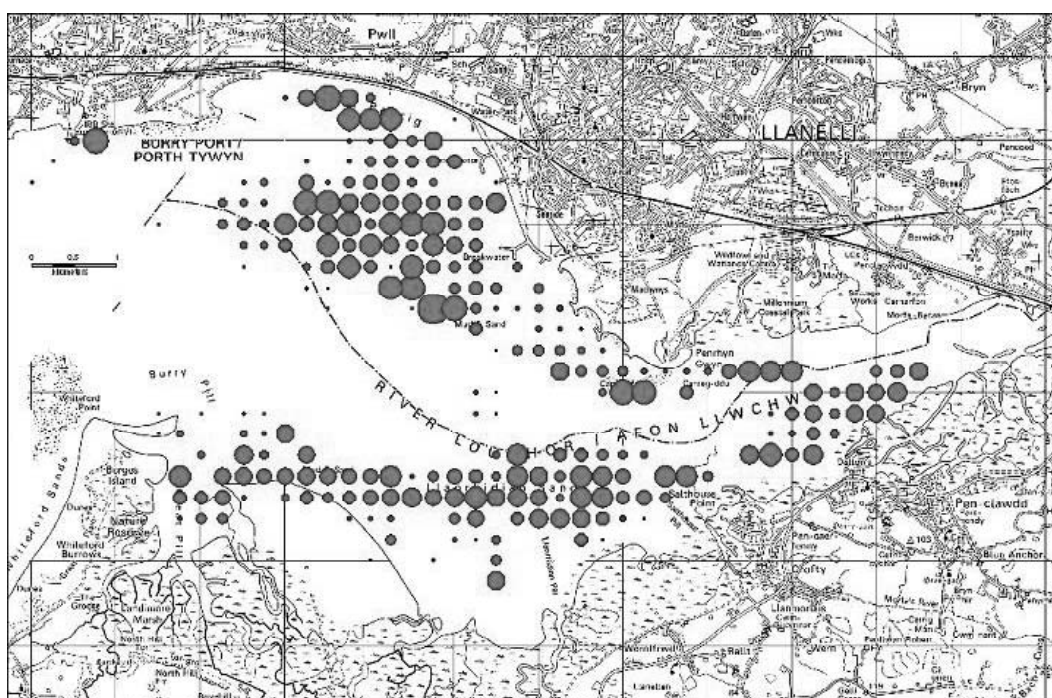


Figure 3. Distribution and density of cockles (>2mm) in the Burry Inlet, with a square root transformation. Maximum density (the largest dot) was 2501 cockles/0.1m²

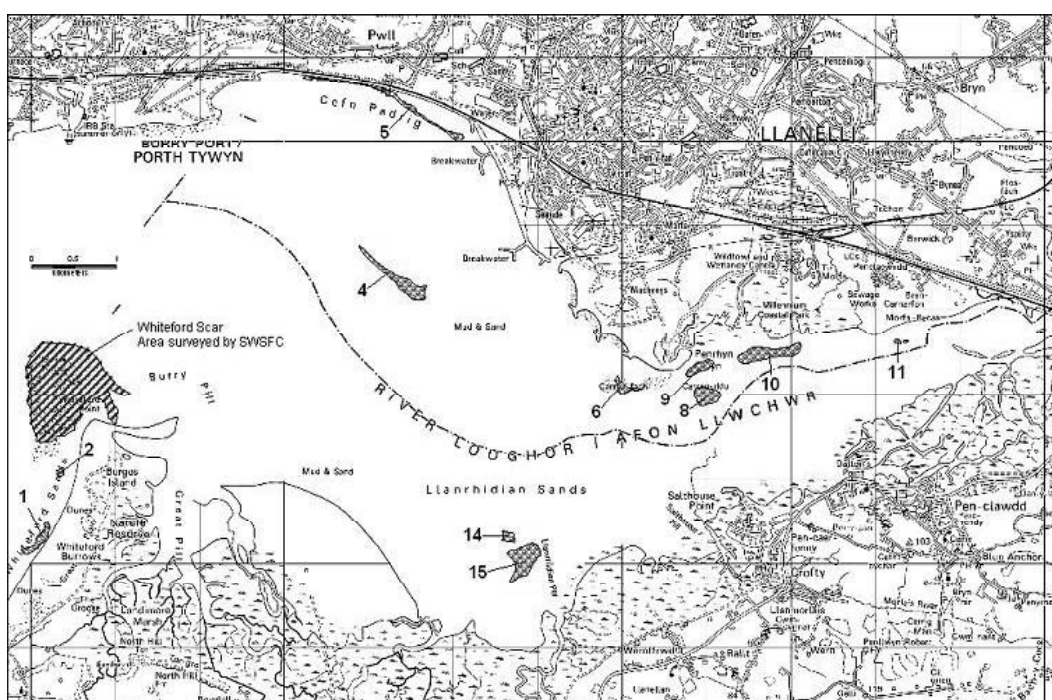


Figure 4. Locations and extent of surveyed mussel beds in the Burry Inlet

Conservation Objectives for the site. As the measure will result in better control of effort, greater accountability and therefore improved fishery and environmental management, the AA is expected to give positive results.

Mass mortality of cockles in the Burry Inlet and the Three Rivers Estuary

In 2006, mass mortality of cockles occurred for the fourth consecutive year in both the Burry Inlet and areas of the Three Rivers Estuary, thus

threatening both fishery and nature conservation interests. The cause is not yet known, but it seems likely that it is multi-factorial with factors such as higher than usual cockle recruitment and subsequent high stocking densities, pathogens, climate change, changes in discharges and inputs all implicated. Certainly a factor or a combination of them appears to be stressing the animals to the point of mass mortality. Finding the cause(s) for the mass mortality is central to

the management of the cockle stocks within both a fisheries and nature conservation context.

CCW and the SWSFC over the last two years have synchronised cockle and mussel stock assessment in the Burry Inlet SPA (Figures 3 & 4) and the adjacent Three Rivers Estuary where wading birds are likely to migrate.

Further assessments are planned this year including low tide bird surveys to assess the distribution and behaviour of waders. These data are essential prerequisites for developing a more holistic management of birds and their food (see below) and informing Appropriate Assessment of fishery management decisions as now required following the ECJ Waddensea Judgement; but there is an apparent wider research need when the mass mortalities are considered.

The CEH bird food model

The Centre for Ecology and Hydrology (CEH), with CCW support, has developed a behaviour-based model to predict the food requirements of wintering oystercatcher and knot on the Burry Inlet SPA. The model allows the impacts on bird survival and condition to be explored under different potential management scenarios.

Bird foraging choices can be predicted based on previous bird behaviour studies, cockle and mussel stock surveys and low-tide bird surveys. Bird distribution changes significantly in response to poor cockle stocks: birds may switch to feed on mussels and other food sources in the Burry Inlet, or move to cockles elsewhere including the Three Rivers Estuaries.

Future modelling work will allow us to predict (and test the predictions) whether there is enough food for waders with certain stock size, meat contents and distributions. This would help fisheries and conservation managers explore different management scenarios and their outcomes and may lead to agreed management 'rules' that ultimately cut-down on protracted interagency discussions and uncertainty. This would move aspects of management away from a reactive approach to a more efficient pro-active approach.

Further information

The views expressed in this article are not necessarily those of the Countryside Council for Wales or those of the South Wales Sea Fisheries Committee. *For further information please contact the authors.*

IDENTIFICATION OF SPECIFIC SOURCES OF FAECAL CONTAMINATION WITHIN SHELLFISHERIES

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Introduction

Estuaries make excellent grounds for the farming of bivalves. The environmental conditions and large available food source results in high productivity and rapid increases in shellfish biomass. However, the other common uses of estuaries bring about their own problems with respect to the production of shellfish suitable for human consumption. Estuaries have been and still are used for the disposal of organic waste (i.e. sewage), associated habitats are often important feeder grounds for residential and migratory birds as well as livestock, and they are commonly used for recreation. Consequently the organic loading of estuaries can be quite high and be from a variety of sources and therefore have impact on the contamination levels of localised shellfisheries beds. Contamination can

be direct from point sources or can be more diffuse in origin and currently no regulatory methodology exists that can detect different species pollution incidents or the relative importance of contaminants during mixed and diffuse pollution events. If pollution impacting the shellfisheries industry is to be appropriately managed and problems alleviated, it is essential that new methods and protocols are developed which are resolute enough to be able to identify differences in species specific events, whilst fulfilling the criteria for a useful indicator of potential harmful contamination. This article outlines the use of one candidate technique: Sterol Profiling. The Colne estuary, a very well described Essex estuary with extensive commercial shellfisheries beds, was used during this study to evaluate the use of sterol profiling

in relation to the use of more traditional techniques such as coliform analysis.

Faecal indicator bacteria

Under current EU legislation shellfish waters are monitored and classified using the abundance of *Escherichia coli* in the flesh of the bivalves to indicate potential risk of other pathogens. However, although this faecal indicator bacterium has been widely used for contamination monitoring, enumeration alone gives no suggestion of the source of contamination. Using ratios of *E. coli* with another group of enteric bacteria, the faecal streptococci, has previously been used for source determination. Faecal coliform to faecal streptococci values below 0.7 are indicative of animal waste, whilst greater than 4 points to human sources.

Problems arise with the stability of this ratio since the two groups of bacteria have different survival rates, causing ratios to change differentially. It has been suggested that this method should only be used at the point of discharge, limiting its use for discriminating diffuse and mixed sources.

Faecal Indicator Bacteria in the Colne

The Colne is a shallow well-mixed estuary in Essex, SE England, with a long history of shellfish production, renowned throughout Europe during Roman times for its high quality

native oysters (*Ostrea edulis*). Reduced water quality and disease has led to a decline of the shellfish industry over the past 50 years, but the River Colne still supports significant commercial shellfisheries for oysters, mussels, and cockles. Currently the Colne estuary holds A, B, and C class shellfish beds, reflecting the range of water quality variables observed down the estuary. The head of the estuary (sites 1, 2, and 3) is characterised by inputs from freshwater sources, and has high loads of faecal indicator bacteria which decrease down the estuary (Figure 1) with increasing salinity and distance from the sewage treatment works (Site 2). During wet weather episodes (Figure 1b) loadings of both *Escherichia coli* and faecal streptococci increase in the surface waters at the head and mid-estuary, but increases are rarely seen at shellfish bed sites (Sites 5, 6, and 7)

Faecal Sterols

Numerous different microbial, molecular, and chemical indicators have been used to determine faecal source inputs into aquatic systems, including identification of species specific bacteria, resistance to antibiotics, presence of various viruses, molecular sequencing, and detection of chemicals found in washing powder and household cleaners. However many of these techniques are not feasible due to high costs of analysis, labour, and equipment, and long turnover time before reporting results. This study integrates techniques by incorporating

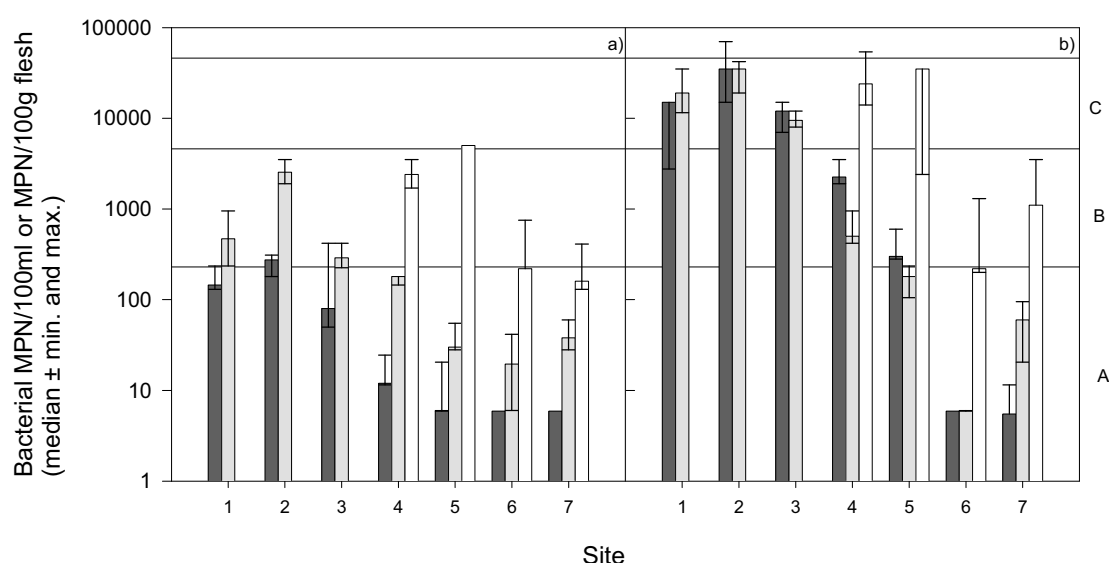


Figure 1: Typical bacterial profile down the Colne estuary from the headwaters to mouth a) following dry weather b) following wet weather. Filled bars are surface water *E. coli*, grey bars are surface water faecal streptococci, and empty bars are shellfish *E. coli*. The labels on the right indicate shellfish classes according to *E. coli* in the flesh.

routine bacterial sampling in shellfish and surface waters with detailed sterol analysis, enabling determination of major input into the sampling site.

Faecal sterols are lipids that are excreted by all animals, but vary according to an organism's diet, ability to synthesise sterols, and composition of intestinal bacteria. The analysis of sterols using gas chromatography/mass spectrometry (GC/MS) follows a process of extraction, saponification, and derivitisation, sterols from sediments or suspended solids in the water column. The resulting sterol "fingerprint" (Figure 2) can be used to determine inputs into a water body. Sterols tend to adhere to charged sediment particles that settle out and persist well in anoxic sediments, therefore also providing historical data on faecal contamination.

Coprostanol (5β -cholestan- 3β -ol), found only in the faeces of higher mammals due to reduction by specific enteric bacteria, has been used to track sewage contamination in a variety of environments. Since coprostanol is found in large quantities in human faecal matter, comprising up to 60% of the total sterols and in relatively small amounts in other common animals its presence is usually indicative of contamination by human sewage. By comparing the coprostanol concentration with that of cholesterol (5β -cholestan- 3β -ol) production via biogenic sources can be ruled out, since the latter does not generally have a faecal origin but is produced in the environment by bacteria. Comparisons with epi-coprostanol can estimate age of sewage. Other sterol groups

include numerous phytosterols, some from digested plant matter indicating herbivorous inputs, and some from marine and freshwater algae and phytoplankton. Fungal sterols, such as ergosterol, are strictly from terrestrial inputs, and may also be associated with sewage inputs.

In upper estuarine sites in the Colne, coprostanol levels are high, accounting for more than 20% of total sterols from the sewage treatment works effluent. Upper outliers (Figure 3) were all measured following wet weather episodes. Epicoprostanol and cholesterol levels are usually very low, indicating recent inputs of human-derived coprostanol rather than biosynthesis *in situ*. Wivenhoe, historically used for oyster culturing, also has significant inputs of sewage, with 13.7% of its total sterols coming from coprostanol. However sites now used for bivalve production show low to negligible coprostanol levels, instead showing dominance of marine sterols such as dinosterol and norcholestadienol (Figure 3), which are key sterol components of phytoplankton.

Although no consistent significant relationship is evident between faecal sterol and bacterial concentrations, sterols are proving to be useful tools in determining sources of inputs to a variety of aquatic systems. They are particularly valuable in estimating cumulative load of faecal contamination, especially in cases where environmental conditions result in rapid bacterial death in the water column despite high faecal inputs, capable of producing poorly graded shellfish in seemingly good water quality. In the Colne estuary surface waters both bacterial and sterol analyses indicate three zones of water

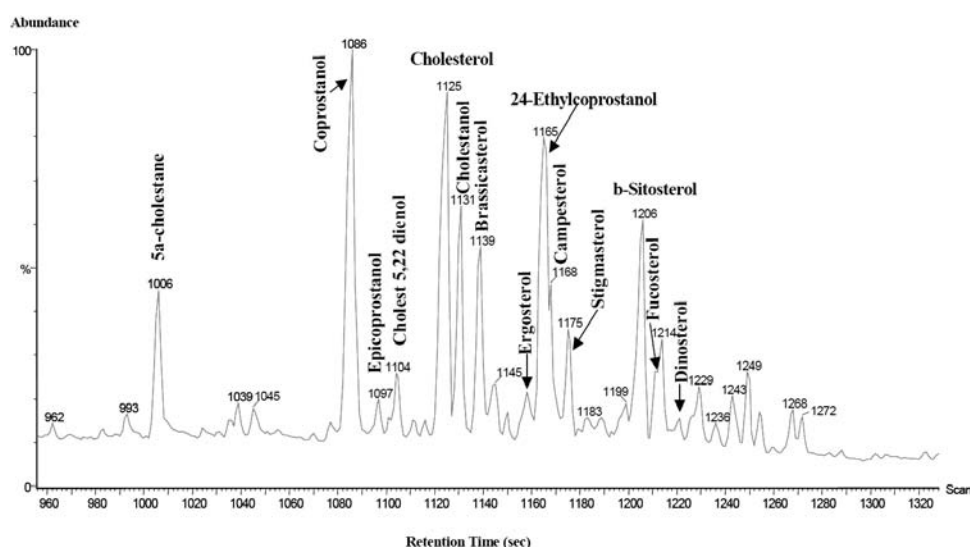


Figure 2: An example sterol profile analysis "fingerprint"

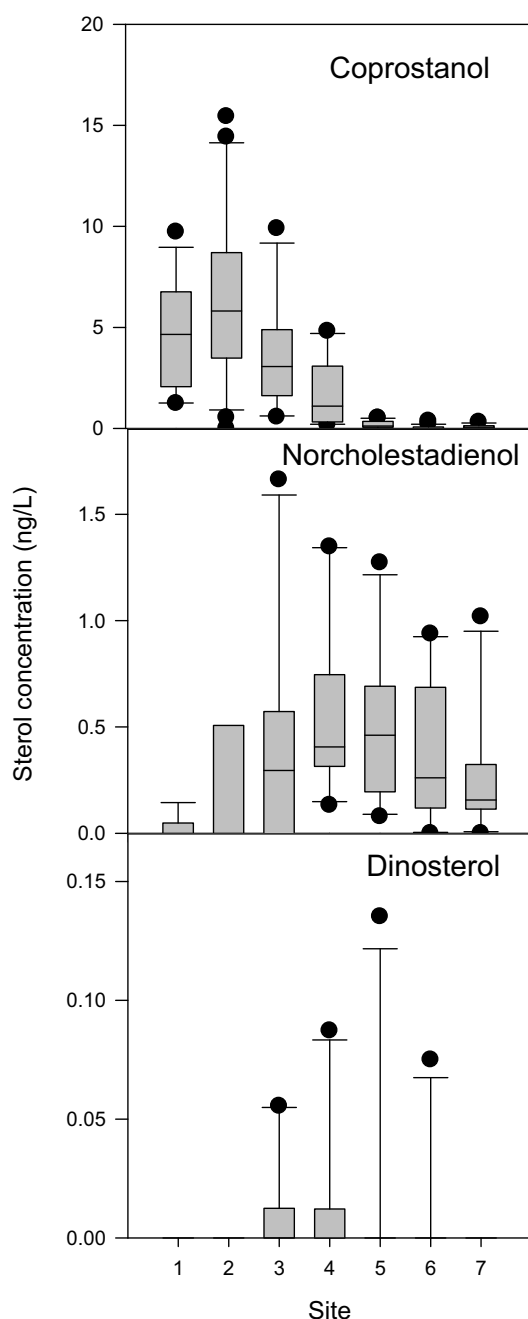


Figure 3: Mean annual coprostanol, norcholestadienol, and dinosterol concentrations in the Colne estuary from headwaters (site 1) to mouth (site 7), with 25th and 75th percentiles (box), 10th and 90th percentiles (bars), and outliers (dots).

quality; the low salinity headwaters dominated by sewage inputs, the high salinity marine dominated inputs towards the estuary mouth where shellfish farming prospers, and the mid-waters which experience highly variable bacterial and sterol inputs suggesting mixed inputs occasionally sewage dominated.

Future Work

Sterol and bacterial analysis at Essex University is on-going to gain detailed understanding of the inputs both spatially and temporally. Further research is being carried out to investigate the persistence and possible cycling of these faecal indicators within surface waters, shellfish, and sediments, and later in context of management practice to help alleviate contamination at impacted sites.

Acknowledgements

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GC-MS facilities at the University of Essex

DEVELOPING AND UNDERSTANDING THE USE OF PRE-BIOTICS IN LOBSTER CULTURE

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Background

In agriculture, immuno-stimulants have been shown to act as excellent alternative substances for antibiotics that can not only protect against disease but also enhance performance. This has opened a market for their potential use in aquaculture where high mortalities during larval phases cause high loss in stock production.

Natural immuno-stimulants (both pre and probiotic substances) have been shown, as dietary supplements in agriculture, to reduce the risk of disease via activation of an organism's innate immune response as well as improving digestibility of various dietary substances. Similar results have also been found in a small number of aquaculture species, however research is limited. Examples of such alternative substances include oligosaccharides such as mannan-oligosaccharide and fructo-oligosaccharide. These have shown the potential to reduce the common diseases such as those caused by *Vibrio* spp., which cause huge problems in all cultured species. There is therefore a clear calling for alternative products such as this in aquaculture.

Unlike agricultural studies, which used pre-biotics as a direct dietary supplementation in dry feed, the inclusion of immuno-stimulants in larval diets for aquaculture must occur via indirect bio-encapsulation. Live *Artemia* shrimp can be used for this purpose.

Initial dietary supplement studies, using Mannan Oligosaccharide pre-biotics (Bio-Mos® aquagrade – Supplied by Alltech, Lexington, Kentucky, US) at a recommended dosage for dry feed, showed increased growth and survival

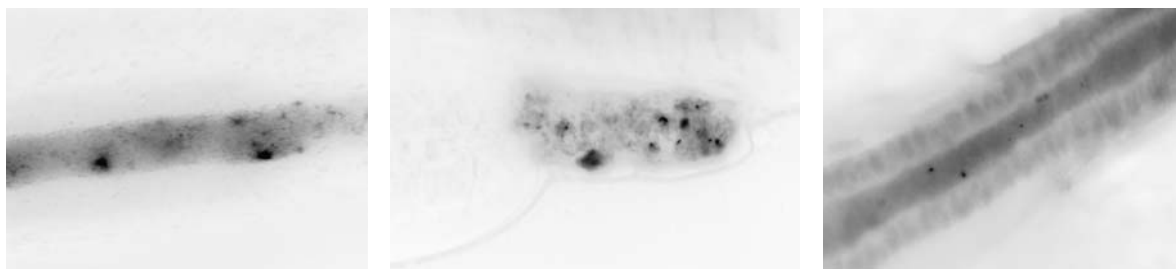
during the larval stages of European lobster culture. This demonstrated the potential of pre-biotics to reduce the effects of bacterial diseases which cause low larval survivability within crustacean culture and also to improve larval growth by increased food breakdown and so nutrient uptake. This work was reported in Shellfish News Number 21 (May 2006).

Further trials were conducted at the National Lobster Hatchery during 2006 to further investigate the use, and improve the understanding of dietary immuno-stimulant supplements.

Fluorescent labelling trials

Research was conducted to determine how, and in what concentration *Artemia* took up the immuno-stimulants. The indirect inclusion of enrichments through *Artemia* makes it difficult to determine at what concentration the given substance is reaching the cultured organism. Fluorescent dye was chosen to label Bio-Mos® in order to trace its route and presence through *Artemia* and subsequently lobster larvae.

The results showed that Bio-Mos® is undoubtedly orally ingested by *Artemia* and slowly broken down over a 24h enrichment period. With Bio-Mos® appearing to pass through *Artemia* within 16 hours of enrichment. It may therefore be suggested that an optimum enrichment time may be lower than previously used in the culture situation. However, further work would be needed to determine optimum enrichment time of other substances in the enrichment media, such as Selco™.



Negative Fluorescent microscope photos depicting the internal gut sections and external views of *Artemia* at various stages through a 24 hour enrichment period.

Gut morphology

Lobster larvae were then fed with *Artemia* containing fluorescently labelled Bio-Mos® for 10 days. Throughout this period samples were taken for analysis to evaluate the presence of Bio-Mos® in the gut. Larval tails were set in wax and sections of 10µm were cut at the University of Plymouth, UK. Sections were mounted onto microscope slides and the wax removed. These unstained sections were analysed for the presence of fluorescently labelled Bio-Mos® and also for physical properties of gut wall lining, using microscopy (carried out at the Marine Biological Association, Plymouth, UK).

From initial viewing of gut section photos there appears to be darker patches in the epithelial folds, this indicates fluorescence. These darkened patches are not visible in the control fed samples. It may be that the Bio-Mos® particle size is too small for the specified magnification and so appears as patches of dark where many particles are present. To validate such conclusions further research is needed to analyse gut villi sections in the epithelial folds.

Other immuno-stimulants

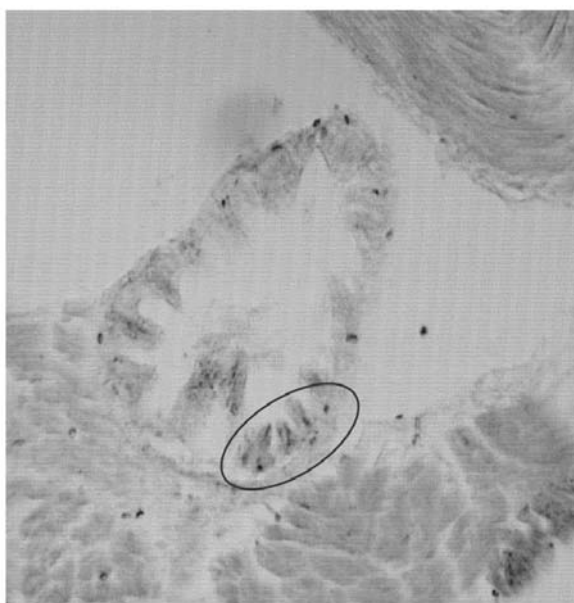
Bio-Mos® is one of numerous immuno-stimulants which have shown the ability to activate innate immune responses when used as a dietary supplementation. It was therefore logical to further study the additional effects of β -glucans and other pre-biotics.



Larval European lobster

Mixed origin larvae were reared in a 12 Kreisel cone recirculation system with a maximum of 2500 larvae per cone. At the moult to stage IV (approximately two weeks of growth) the miniature lobsters were separated into individual rearing pens to prevent cannibalism.

Larvae were fed daily from hatching through to stage IV of growth on 5 *Artemia* per ml of the specified enrichment. *Artemia* were harvested and enriched over a 48h protocol (de-capsulated cysts re-hydrated and hatched for 24h, then hatched *Artemia nauplii* enriched for a further 24h). Four different enrichment diets were used. These were Bio-Mos® alone (Control) and Bio-Mos® supplemented with Macroguard (Biotec Pharmacon ASA, Tromsø, Norway), Beta MAK C85TM and AquaciteTM (both James. A. Mackie (Agricultural), Clackmannanshire, UK). All diets were also enriched with Selco™.



Laser scanning confocal microscopy gut section photos negative colours from larval lobsters tail sections a) fed on a control diet b) fed a fluorescently labelled Bio-Mos® diet. Circle denotes area of Bio-Mos®.

Data collected from this trial showed no significant effect on larval survival and growth with the simultaneous dietary use of pre-biotics and β -Glucans. However, the potential simultaneous use of pre and pro-biotics is a top priority for investigation in future studies. Pre-biotics decrease the number of harmful pathogenic bacteria in the digestive tract whereas pro-biotics increase the number of beneficial bacteria in the digestive tract. Therefore, simultaneous use could potentially have greater positive effects on the growth and survival of cultured crustaceans during high stress larval periods where resistance to pathogens appears innately low.

Immunostimulant inclusion into juvenile diets

In order to understand the use of immunostimulants in aquaculture it is important to consider and examine their exploitation at all stages throughout a culture period. The consideration of artificial diets for juvenile stages of growth which require larger food sources to satisfy nutritional and physical dietary requirements was essential especially when considering the inclusion of immuno-stimulants. Frozen natural foods have proved very successful as juvenile diets; however, these are not practical when the inclusion of dietary additives is taken into account. A pellet was therefore formulated based on previous formulations trialled in tropical spiny lobster (*Panulirus ornatus*) culture.

Four lobster diets were initially trialled, a dry and a wet formulation of each of the two experimental pellets (Control and Bio-Mos®). These preliminary trials showed non-suitability of the wet pellet due to lack of physical stability during the feeding process. A dry pellet feeding

experiment was therefore set up and run for a duration of 8 weeks.

In this experiment survival rate was high but unaffected by the diet fed (Table 1). Despite this, the potential for effects on survival must not be discounted. The scope for a longer trial, which was not feasible in the time scale of this study, would provide the ability to monitor survival over a more realistic period, probably up to a year.

Table 1. Growth and survival responses of Juvenile *H. gammarus*

Lobster Diet and Age	Development response				
	Initial Length (mm)	End Length (mm)	Total Growth (mm)	Growth rate (% day)	Survival (%)
Control-S5	6.12	6.87	0.75	0.41	94.32
BioMos-S5	5.99	7.20	1.22	0.68	93.18
Control-S8	8.04	8.53	0.49*	0.20*	100
BioMos-S8	7.76	8.96	1.20*	0.51*	100
Control-S10	10.04	10.17	0.13*	0.04*	98.75
BioMos-S10	9.69	11.19	1.51*	0.52*	98.13

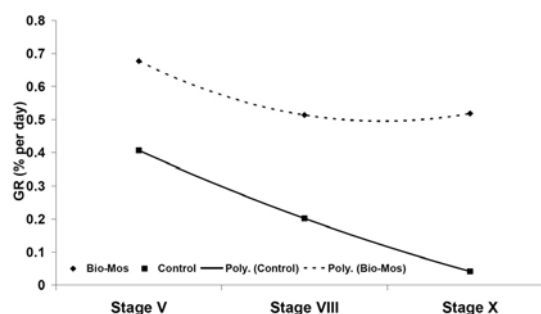
S = Stage of growth

* denotes significance differences

Lobster growth did exhibit a clear response to dietary inclusion of Bio-Mos® during juvenile stages of development studied, with the benefit of increased size being apparent. Maximal growth responses occurred with the inclusion of Bio-Mos® at later stages of juvenile lobster development (VIII-X), with juveniles growing, on average, nearly twice the rate of the control feed at stage V and a huge 12.5 times the rate at stage X of development (Figure below).



Juvenile European lobster



Effects of dietary presence of Bio-Mos® on the growth rate response of clawed European lobsters fed diets with and without the addition of Bio-Mos® for 40 days.

The growth rates obtained in this study are much higher (0.68 %/day) compared to that reported by other studies trialling extruded feeds on lobsters (0.15-0.2 % per day). However, there is a dearth of research pellet feeds available for European lobsters and these studies consider different species, so may not be directly comparable. Even so, there are still definite increases in growth with the inclusion of

Bio-Mos® into juvenile lobster diets in this study which are directly comparable.

Further information

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TIDES BRING FEEDING BONANZA TO MENAI STRAIT MUSSELS

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In recent years, the mussel culture in the Menai Strait (Fig.1) has been on the increase. The fishery has played an important role not only on a national level by contributing significantly to the total UK landings for *Mytilus edulis* (~50% in 2005); locally it is also a noteworthy contributor to the economy and employment market of an underdeveloped area (Objective 1 Region within Europe). In October 2004, a project was started at the School of Ocean Sciences (University of Wales, Bangor), in cooperation with one of the local fishing businesses (Myti Mussels Ltd.) and the European Social Fund to research the dynamics of the food supply to the commercial beds located at the North-Eastern entrance to the Menai Strait.

Food floating with the complex tide

The Menai Strait is an energetic tidal channel lying between mainland Wales and the Isle of Anglesey, and connecting Liverpool Bay to the North with Caernarfon Bay in the South. Because of a large difference in the tidal amplitude between these two ends, there are strong tidal flows that are strongest (up to 2.5 m s^{-1} at spring tides) in the narrow section, The Swellies, and at the South West entrance. This large tidal flow, in combination with the shallow bathymetry of the channel, results in a residual transport of water through the Strait, from the North-East to the South-West. This net flow (mean $\sim 530 \text{ m}^3 \text{ s}^{-1}$) is equivalent to a large river flowing southward from Liverpool Bay through the strait.

The mussels' main food source is phytoplankton which is suspended in the water column and moves passively with the currents. Local production by cell division is limited by the short residence time in the Strait, and is generally small in comparison with the import of new phytoplankton from Liverpool Bay, which is primarily responsible for feeding the mussels on the commercial beds.

Sustaining a large commercial mussel population

Fluorescence measurements, which are used as an indication of phytoplankton concentration, show that the mussel beds have a significant impact on the food concentration (Fig.2) suspended in the overlying water. On the ebb tide, as water is brought in by the tide from Liverpool Bay, the mussels eat out a large

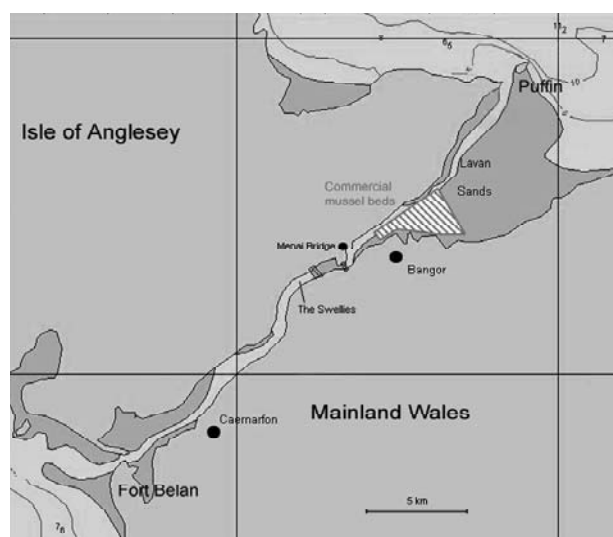


Fig.1. The Menai Strait, showing the location of the mussel beds, inter-tidal areas (darker shading) and depth contours in metres

portion of the phytoplankton. On the flood tide, when the already depleted water flows back over the mussels, they further feed on the remaining food in suspension. In observations, a strong tidal signal can be seen, with the mussels eating almost half the amount brought in from Liverpool Bay over the period of a tidal cycle.

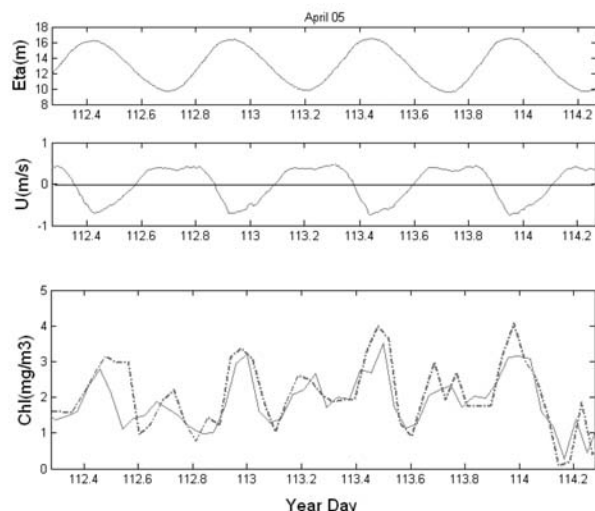


Fig.2. Observations made at the Southern edge of the mussel beds on April 23 - 25 2005. Top: tidal elevation (m); centre: depth mean velocity (m s^{-1}) with flood currents in positive direction; bottom: surface (solid) and bottom (dashed) Chlorophyll concentration (mg m^{-3})

The effects of strong mussel feeding can be seen not only in local measurements over the mussel beds, they were also observed during a spatial survey of the Menai Strait (Fig.3). A strong horizontal gradient along the channel is apparent, with concentrations decreasing from the Northeast entrance towards the

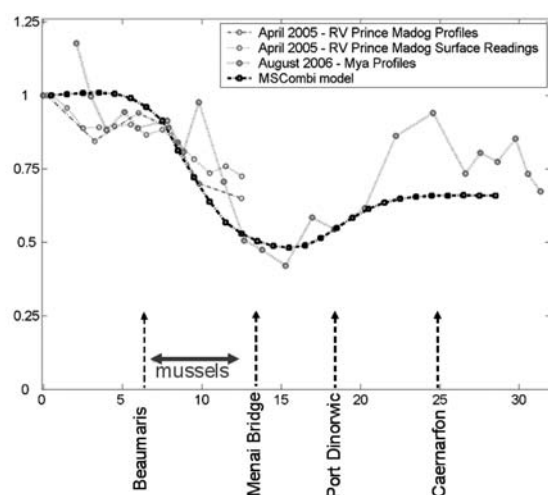


Fig.3. Longitudinal section of normalized Chlorophyll (mg m^{-3}) in the Menai Strait from observations in April 2005 and August 2006, and modelled concentrations from numerical simulation. Approximate length of mussel beds has been indicated

South. A small rebound in food concentrations towards the Southwest is seen due to local production and because of the import of food from Caernarfon Bay. Estimates of conversion efficiencies indicate that this reduction in food concentration is consistent with the quantity of mussels produced in the area.

Representing an ecosystem in its simplest form

In order to test whether these patterns were mainly driven by the tidal transport and plankton import, a small 1-dimensional numerical model was developed. This numerical model included only basic physics and biology. The strait topography is simulated in a simplified form with a wide end to mimic the Lavan Sands in the North, a narrower mouth at the South, and a very narrow, shallow section in the centre (The Swellies). The currents within the modelled system are driven by elevations specified at the open ends. The biology is simulated through adding a plankton sink over the beds to simulate the mussel feeding, and a realistic net growth parameter to mimic the phytoplankton reproduction.

Despite these severe simplifications, the simulations (example shown in Fig.4) correspond well with the observations. The currents and elevations of the tides agree well with the observed tidal amplitudes, phases and velocities. When observing at a point in space over time, it can be seen that the semi- and quarter-diurnal signals observed in the field can also be realistically modelled. Moreover, looking at a single instant over the length of the Strait, the decline of Chlorophyll and its rebound towards

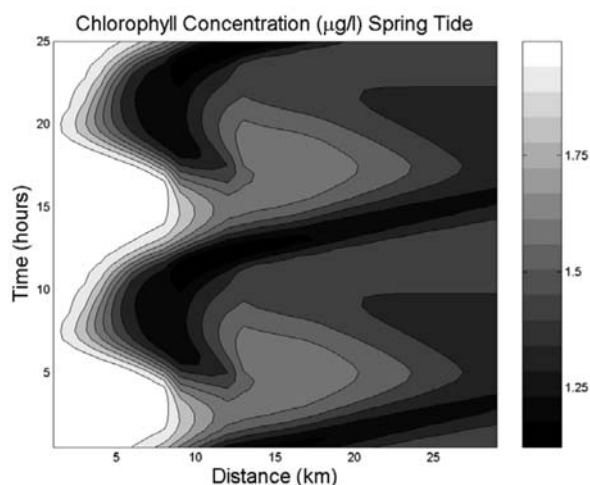


Fig.4. Contour plot of modelled Chlorophyll ($\mu\text{g/l}$ or mg m^{-3}) versus distance and time at spring tide

the Southern end are also represented in the model. Over the mussel beds, the modelled differences in phase between the elevation and phytoplankton concentration are close to those observed (approx. 70°- 80°). Moreover, when scaled to the concentration at Liverpool Bay, the model and observations of the horizontal gradient also agree well (Fig.3). The underestimate of the rebound in the Southern area of the ecosystem can be attributed to the lack of food input at the Southern boundary in the model.

The observations and the model indicate that ~ 50% of the imported phytoplankton is removed by mussel filtration. Given the presence of other filter-feeding organisms in the Strait, especially in the Swellies, it is thought that there is only limited scope for expansion to mussel production without unbalancing the ecosystem and threatening the survival of a number of rare species which reside in the Swellies.

Further information

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FRESHWATER PEARL MUSSEL RESTORATION

Dr. John Taylor, Fish Culture Team Leader, Environment Agency Wales

A species in decline

The Freshwater Pearl Mussel (FWPM; *Magaritifera margaritifera*) is endangered and under serious threat of extinction throughout its European range. It is one of two *Margaritifera* species to appear on the International Union for the Conservation of Nature and Natural Resources red data list. The decline in numbers is due to several factors relating to human activity including over-fishing, habitat destruction and pollution. Recent surveys have demonstrated that there has been no juvenile recruitment in populations in England and Wales for several years and that numbers are decreasing at a rate of 50% every 10 years.

Unique lifecycle

During its unique lifecycle the FWPM uses juvenile salmonids as a host for its glochidial

stage. Glochidia encyst on the gills of salmonids and develop over winter to a juvenile stage capable of surviving when it is released from the fish and settles into the substrate. It is estimated that the survival rate from release of glochidia to juvenile settlement is well below one hundredth of a percent.

Studies in the UK have shown that it is possible to collect juveniles after they are released from their salmonid hosts and culture them in semi-natural environments to several years of age. However survival rates have been low.

Recent work in North America (Virginia), using small re-circulating systems and specially prepared diets have shown that it is possible to achieve very high survival rates of juvenile mussels (up to 70%) over a 12 month period,



Adult mussels collected from the hatchery River Wye



Broodstock mussel tank at Cynrig



Semi-natural juvenile culture baskets, Mawddach hatchery

although growth appears to be reduced compared to the wild.

Breeding programme

The Environment Agency Wales, in conjunction with CCW, English Nature and local Wildlife Trusts, have embarked upon a programme of long-term restoration of the FWPM through the Forum of the FWPM Recovery Group. At present EA Wales Conservation and Hatchery staff have collected adult mussels from 6 Rivers in Wales where populations are failing, with the intention of establishing a breeding programme. Restoration efforts will involve stocking out of "infected" fish and culturing juveniles past the "bottleneck" stage of high mortality.



Juvenile re-circulation at Glasbury hatchery

Since 2004, over 200 adult mussels have been successfully translocated to the three EAW hatcheries and survival has been excellent. Some river strains have successfully spawned and reproduced and in the spring of 2006 approximately 100,000 juveniles were collected at Mawddach hatchery.

These juveniles are being cultured in a combination of semi-natural and intensive systems to gauge the best possible conditions for survival. Survival figures for cultured juveniles will be estimated later in the year when sampling will be less damaging.

THE AUSTRALIAN STUD OYSTER – A THOROUGHbred

Peter Hoare

This article first appeared in The Grower, December 2006. [The Grower is the newsletter of the Association of Scottish Shellfish Growers. Editor, Janet Brown (j.h.brown@stir.ac.uk)]

Introduction

The stud oyster, sire of a long line of large, luscious, seductively-proportioned and sensuously-hued seafood to tempt the palate is a reality, but only in Australia!

Selected lines of superior oysters that grow faster and look better have been developed as a result of a landmark agreement to commercialise the successful selective breeding programme developed by Tasmania's scientists.

The new technology has been adopted via Australian Seafood Industries (ASI). A company established by the Tasmanian Oyster Research Council, the South Australian (SA) Oyster

Research Council, and SA Oyster Growers association. This will ensure both oyster growers and consumers benefit from higher-yielding, faster growing and more uniform Pacific oysters, with the shape and the colour favoured by local and overseas markets.

Closed systems

Tasmania and South Australia are among the few places in the world where Pacific oysters are farmed in a closed system. In most other parts of the world, stocks are recruited from the wild, so they cannot be improved by genetic selection. Scientists from CSIRO Marine Research and the Tasmanian Aquaculture and Fisheries Research Institute (TAFI) at the University of Tasmania,



The stud oyster

began selectively breeding Pacific oysters in 1995, with grant funding from the Fisheries Research and Development Corporation and other (Aus) Commonwealth funds. Considerable financial support was also given by the industry (the oyster farmers!) itself.

Genetic variation

The selective breeding programme has taken advantage of the abundant genetic variation that exists in Tasmania's wild and farmed Pacific oyster stocks. It began with a few fast growing oysters and six family lines and now involves

more than 100 families, each containing some 6000 oysters. In close collaboration with the industry and TAFI, all families were spawned at commercial hatcheries in Tasmania, moved to TAFI for 12 –15 weeks before being transferred, at 2mm, to a nursery site in Northern Tasmania. At 15 – 20mm they were grown out at five farm sites, three in Tasmania and two in SA. So far a 25% reduction in the growing period has been achieved. Selection for maturity and uniformity of size has contributed to a further reduction in production costs due to reduced handling. Other benefits include the development of Pacific oyster strains suited to particular farm locations, and the eradication of deleterious traits such as shell deformities.

In related research, molecular markers have been developed so that Pacific oyster families can be identified through DNA analysis. A genetic map of the chromosomes locating major Pacific oyster genes has also been developed.

The profitability, resilience and sustainability of the Australian Pacific oyster industry is reliant on the continued success of selective breeding, the adoption of new and improved growing technology and the development of new markets. ASI continues to be at the forefront of selective breeding (of oysters) worldwide. The state of the art breeding programme is ongoing with continued R&D with strong links with research agencies both in Australia and overseas.

Further information

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STATUS AND PERSPECTIVES OF THE AQUACULTURE INDUSTRY IN CHILE, WITH SPECIAL REFERENCE TO MOLLUSCS

Roberto Flores Aguilar and Pamela Leal Medina

Introduction

In the 2006 State of the World Aquaculture report of FAO, based on statistical information of 2004, China occupies the first place in world aquaculture production with more than 41 millions tonnes or 69% of the total volume. Among the top ten producing countries, Chile is the only non-Asian country, occupying tenth

place with a total production of 694 thousand tonnes (1.2% of world production) and sixth place in value.

During 2006, recent information indicates that the Chilean aquaculture sector generated US\$ 2,361 million dollars in exports, of which 93.5% was salmonids, 2.72% mussels, 2.05% *Gracilaria*

algae, 1.25% scallops, 0.3% abalone and the remainder in products such as oysters, turbot and other species.

In Chile, during 2005, 15 species were being cultured commercially corresponding to fish, molluscs and algae, of which an important percentage corresponds to introduced species, among them salmon, trout, and the genus *Haliotis* (abalone).

Fish production

The main resources harvested at a national level correspond to Atlantic salmon, rainbow trout and Coho salmon, contributing respectively 55.1%, 24.8% and 20.5% of the total harvest. The principal regions of fish production are the X and the XI th region. Japan is the main market, followed closely by USA, and then 29% goes to the European Union, and 12% to Latin America.

Scallops

Chile is the third largest world producer of cultured scallops, after China and Japan. The accumulated harvest in 2006 was 1,942 tonnes. The Tongoy growing area produces in the order of US\$ 20 million of this product and this level of production is expected to continue, making an important contribution for the regional economy. This resource is harvested principally in III and IV region (north of Santiago city), with production of 87% and 13%, respectively.

Nowadays 93% of the scallop exports (*Argopecten purpuratus*) are to the French market, the industry is expected to continue working towards exporting major volumes to USA, Italy and Spain.



Lifting lantern nets containing juvenile scallops

Regarding marketing, the industry is trying to diversify to avoid depending almost exclusively on the French demand and to obtain a better level of prices, through the development of prepared products with a higher added value.

For 2007, an increase of between 10% and 15% is expected in production, which will depend on the merging of companies dedicated to the culture of this species. A moderate industry growth is expected.



Seaweed cultivation

Algae

Algal production in Chile is mainly based upon the exploitation of wild stock and commercial scale cultivation remains restricted to *Gracilaria chilensis*. In Chile this is known as "pelillo". Recently, production has fallen by 25.1% in comparison with 2005. The major quantities of *Gracilaria* produced are in the X region, which represents 88% of the total resource harvested.

Mussels

Figures from the Mussel Culture Association of Chile A.G. (AmiChile) show that during the year 2006 mussel exports of *Mytilus chilensis* reached a total of US\$ 64.3 millions, a 60% higher figure than the US\$ 40.5 million dollars exported during 2005.



Barrel container to grow abalone, as used in small farms

In terms of volume, 27,104 tonnes of mussels were exported in 2006, with a growth of 45 % compared with the 18,785 tonnes of the previous year. The average price rose from US\$ 2.15/kg to US\$ 2.38/kg for this product. The main destinations for mussel exports were Spain, Italy, France, USA, Germany and Holland.

During 2006, 96% of the mussels exported were a frozen product and 4% a canned product. The mussel industry has the USA among its main markets, a country to which whole vacuum pack product is exported together with a minor quantity of half shell product. This resource is farmed principally in the X region of Chile, where good growing grounds are found with protected bays, channels and fjords.

For 2010, 375,000 tonnes per year are expected to be achieved and, for this amount, knowledge of the biological, sanitary and environmental and productive processes must be improved. Also, it is necessary to build new processing plants for the amount of product expected to be produced.



Red abalone cage in a sea-based farm

The permanence of small mussel farmers is very important and represents a social challenge for the industry with the appearance of big capital ventures.

Abalone

In Chile the commercial development of the Abalone is based on two introduced species the red abalone *Haliotis rufescens* and the Japanese abalone or EZO abalone, *Haliotis discus hannai*. In general, there is a shift from Japanese abalone to culture red abalone.

In 2006, 304 tonnes of abalone were produced, with a value of US\$ 6.840 million dollars. The average size of abalone product from Chile is 100 to 120 grams, which equates to approximately an 8 cm sized abalone. Cultured abalone production has increased at a rate no less than 50% per annum over the last 6 years. This rate of increase is expected to continue for the next five years at least, since many of the existing farms are building up their inventories. The abalone main markets are Japan (90.2% of Chilean exports), USA (6.3%), Taiwan (2.4%), with other Asian countries accounting for the rest of the Chilean exports.

Whole frozen abalone (shell on) was by far the most important form of Chilean product accounting for 82% of the production in 2006; live abalone is second at 16% of production, and canning third at 2%.

Prices have risen, with US\$ 29.2 dollars obtained for fresh (live) product in 2005 and 2006, and in 2006 frozen product fetched \$ 24.3 US dollars.

Twenty-five companies are involved in abalone culture in Chile. All are in a development phase, both in respect of infrastructure and building up their abalone stock.

Most of the abalone farms in the North were land-based grow-out operations. An important characteristic of the farms in the North is that almost all of them were fully integrated, possessing a hatchery, nursery and grow-out operations. Most of the farms in the South were in-water grow-out operations, with only one performing land-based grow-out.

In water growers normally employ a barrel culture system, and only the larger production companies, with inventories over 2 million abalone, used the cage based grow out systems. These were either plastic moulded cages or iron-galvanized structures covered with netting.

Most of the land-based grow out firms are very new, with six of the 13 land-based farms in operation for less than three years. This meant that they had not yet completed a full production cycle with their own juveniles. Most of them had purchased seed from another grower to speed up the production and start selling product in a shorter lead-time.

Producers reported that abalone remain in the nursery for between 3 and 10 months and are then introduced to production systems at different sizes, dependent primarily on the type of culture system used. Land based systems place abalone of 10-15 mm shell length into the production system, and the abalone remain there for 24-48 months. In-water cultivators initially stock young abalone of 17-24 mm in their systems. The abalone remains in the grow out systems for 3-5 years from larvae to market size, the range reflecting the variability in growth rates. Abalone feed is the biggest constraint for the

industry. Some producers are searching for a better supply of algae, as the solution to feed supply, while other companies are of the opinion that a better manufactured diet is the way forward for the abalone culture industry.

For the in-water farmers in the South, most of whom purchased abalone seed from the North, seed quality was considered by most to be the main constraint.

Another important constraint is that the farmers believe that they have had regulations imposed upon them that are designed for other cultured species, which does not necessarily reflect the needs of the abalone farming sector.

Chile has a significant potential to increase its abalone production due to the numerous areas with low population density that are ideal to produce abalone. In the South it is possible to start an in-water farm without the high infrastructure costs associated with land-based operations. Other positive factors include government support to invest in abalone, with relatively low conflicting activities for coastal or ocean use.

The abalone industry is expected to grow both in-water and in land-based farms, both in the North and the South as the basic commercial technology is now well established and Chile possesses favourable environmental, economic and institutional conditions. A survey revealed that feed availability and quality is currently the key to the development of a substantial abalone culture industry in Chile.

In conclusion, there is a good future for mollusc aquaculture in Chile. More and better science is needed to address the sustainability of the industry, with emphasis on the environment.

An important challenge is to ensure that micro and small businesses share in the benefits from this flourishing new industry.

Further information

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GOING NATIVE AT SEASALTER SHELLFISH

By Martin Syvret

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John Bayes of Seasalter Shellfish (Whitstable) Ltd. has recently been awarded funding through the EU Financial Instruments for Fisheries Guidance (FIFG) and the Marine and Fisheries Agency (MFA) for a pilot project designed to investigate pond production of native oyster spat. The project has been developed in response to a recent Defra/Seafish sponsored study by Cefas that concluded that it was feasible to try and restore native oyster stocks in the UK.

Food of the poor

The native oyster, *Ostrea edulis*, or flat oyster as it is also known, was once a major commercial fishery, peaking in the mid 1800's after the end of the Napoleonic Wars. Indicative, if not wholly reliable, figures for numbers of oysters passing through Billingsgate at the time put the level at about a staggering 500 million. The first official oyster statistics were not produced until 1886 by which time production levels had dropped dramatically to around only 40 million per annum. This reduction in supply saw prices rise by about seven to eight times their original level from 1860 to 1889 and it was at this stage therefore that the oyster changed from a food of the poor to a dish more commonly associated with the wealthy. A comprehensive history of the remarkable decline of this fishery can be found in 'The English, The French and THE OYSTER' by Robert Neild. Today the stocks of this once abundant species remain at very low levels. Two centuries of over exploitation, TBT

(tri-butyl tin) pollution in the 1980's, mortalities due to severe winters in the 1930's and 40's, competition from exotic pests such as the slipper limpet in conjunction with the parasitic disease *Bonamia* have all meant that current standing stocks, and thus broodstock, are so depleted that a natural recovery of the native oyster has been made much more difficult.

NOSAP

Although now at much reduced levels the native oyster is still a commercially important species for many fishermen especially those in south west England, the Solent and in Essex. This decline led in the late 1990's to the development of a Biodiversity Action Plan for this species, the Native Oyster Species Action Plan (NOSAP), for which the lead agency is currently the Shellfish Association of Great Britain. The aims of NOSAP are to increase the abundance and geographical range of this threatened species where biologically feasible. It was therefore following the feasibility study and as part of this Action Plan that Seasalter, Seafish and the SAGB have developed and helped fund a project to investigate the potential for producing large numbers of native oyster spat at an economic cost that would allow their relaying as broodstock in areas free of disease and thus help to regenerate fisheries in those areas.

Methodology

The numbers of spat needed means that normal hatchery production methods are not economically viable and so Seasalter have turned to a method previously used with success in Ireland whereby mature broodstock are held and spawned in managed outdoor ponds. The resultant larvae are settled onto a suitable settlement substrate, or cultch, such as cleaned cockle shells and then grown on until they are of a sufficient size that they can be re-laid on existing native oyster grounds. After relaying the growth and survival of these spat will be monitored. The project started in early summer 2006 when the first mature 'ripe' broodstock were introduced (spawning season is July to September). In spring/summer 2007,



Native oyster larval production ponds at Seasalter



John Bayes sampling for Native oyster larvae in the ponds

the process will be repeated incorporating modifications and improvements gleaned from the first spawning season.

Pond Construction

To carry out this project, three 70m x 8m butyl lined-ponds are being constructed at the Seasalter site in Reculver, Kent. Due to the sizeable amount of shell that will be required to act as cultch in the ponds it will be necessary to employ a mechanical digger together with a small dump truck and an agricultural-type elevator. 'Ripe' parent broodstock oysters will be held in the ponds using Japanese lantern-type trays suspended below the water surface. The larvae produced by this broodstock will go through their development in these ponds feeding on the natural phytoplankton in the pond water.



Native oyster seed

Training Centre

The main initial focus of this two year FIG project will be to refine the pond management techniques, efficiency and economic viability of producing native oyster spat using this extensive, low technology method. As this progresses other areas around the UK that are suitable for the relaying of spat produced in ponds will also be assessed and identified. One of the main eventual aims of the project is that Seasalter will become a training centre for industry in the practical methods of how to construct and manage these ponds. Through this approach the lessons learned during the project can then be used to help other areas that have suffered similar declines in native oyster numbers. It is hoped that this pilot oyster regeneration project will help to encourage the formation of other co-operative partnerships in traditional oyster areas and that they, along with the native oyster, will be able to benefit from the European Fisheries Fund that is due to be introduced in 2007.

PREVENTING THE DISEASES OF CIVILISATION: SHELLFISH, THE OMEGA-3:6 BALANCE AND HUMAN HEALTH

Anthony Robson, Institute of Environmental Sustainability, Swansea University

Shellfish, Omega-3 and Human evolution

The human brain cannot develop normally without a reliable supply of several nutrients, notably omega-3 (docosahexaenoic acid (DHA)), iodine and iron. Shellfish, fish and shore-based animals and plants are the richest dietary sources of the key nutrients needed by the brain. The consumption of most shore-based foods required no specialized skills or tools, shellfish such as mussels and cockles are still (commercially) hand picked today. The presence of 13% body weight as fat in human babies appears to be the product of a long period of sedentary, shore-based existence by the line of hominids destined to become humans, and became the unique solution to insuring a back-up fuel supply for the expanding hominid brain. Hence, survival of the fattest (omega-3 babies) was the key to human brain evolution.



Geoduck (*Panopea abrupta*) and clams are two examples of the numerous edible herbivorous intertidal shellfish (Photograph by Anthony Robson)

Western diet today

The omega-3:6 balance in the Western diet has changed substantially in the last 50+ years. Seafood (omega-3) consumption has decreased, while omega-6 consumption has substantially increased. Mechanisation has allowed the human consumption of oils from seeds (also confusingly labelled vegetable oil/fat) and nuts high in omega-6 fats. Even worse, the hydrogenation of seed, nut including soya oils, producing trans-fats removes even more omega-3 from the oils (see Table).

The Western diets current mean omega-3:6 ratio of 1:17 can be up to 1:30 and this, coupled with excess food energy (being over weight - a huge buffer against obtaining omega-3:6

Estimated fatty acid composition of foods by category

Food	Approximate omega-3: 6 ratio	Food	Approximate omega-3: 6 ratio
Shellfish		Fats, Spreads and Oils	
Mussel, blue	5.5:1	Flaxseed	4.2:1
Oyster, Pacific	10.6:1	Butter, unsalted	1:8.7
Clam	3.5:1	Olive	1:12.8
Scallop	8:1	Margarine, 80% fat	1:9.4
Abalone	12.9:1	Flora®, omega 3 plus	1:4.4
Lobster	17.2:1	Flora®, pro-activ	1:4.8
Shrimp/Prawn	4.7:1	Pure®, with soya	1:9.8
Crab, blue	4.9:1	Corn	1:46
Fish		Groundnut	No omega 3
Salmon, Atlantic	4.6:1	Sunflower/Vegetable	1:199
Cod, Atlantic	7.2:1	Nuts and Seeds	
Mackerel, Atlantic	6.6:1	Walnut	1:4.2
Tuna, skipjack	6.4:1	Peanut	1:5185
Seaweed		Hazelnut	1:90
Wakame	6.1:1	Brazilnut	1:587
Laver	6.2:1	Almond	No omega 3
Green Vegetables		Cocoa, butter	1:28
Spinach	5.3:1	Sunflower	1:473
Broccoli	2.3:1	Sesame	1:57
Kale	1.3:1	Fruit	
Meat		Orange, Florida	1:2.8
Chicken, no skin	1:7.9	Banana	1:1.7
Turkey, no skin	1:12.7	Grains	
Pork, loin, no fat	1:28	Bread, whole-wheat	1:23
Beef, sirloin	1:6.6	Rice, white, long-grain	1:4.8
Lamb, leg	1:3.5	Pasta	1:8.2
		Oats	1:21.8

diet balance) is the cause of the “diseases of civilisation” including heart disease, thrombosis, arrhythmia, strokes, cancer, mental ill-health, arthritis, asthma, menstrual cramps, type II diabetes, infertility and obesity.

A healthy dietary allowance for DHA and eicosapentaenoic acid (EPA) omega-3s for current US diets was estimated at 3.5 g day⁻¹ for a 2000-kcal diet. This allowance for omega-3s can be reduced to one-tenth of that amount by consuming fewer omega-6 fats; oils and

spreads high in omega-6, e.g. sunflower/soya oils and spreads. Obviously it is insufficient to tell the public to eat more shellfish (omega-3) without telling them that seafood including mussels, oysters, salmon and mackerel can contribute to the Western World's current unhealthy 1:17 omega-3:6 ratio if the seafood is canned or cooked in seed or nut oils (most oils are high in poly-unsaturates). These oils can far outweigh the omega-3 goodness in fish.

Treating the symptoms not the cause of preventable diseases

Unfortunately, the Western World is currently focused on treating the symptoms of omega-3:6 diet imbalance rather than preventing the cause of these preventable diseases. For example, the cholesterol myth: "cholesterol is a major cause of heart disease" which incorrectly assigns an associated risk factor as a causal factor with unproved assertions. This is based on research in the 1950s when cholesterol was the only thing that could be measured in our blood. The work popularised the link between serum cholesterol and heart disease, to such an extent that the two became synonymous in the public mind. Good fats are those that lowered cholesterol, and bad fats are those that raised it – a message that "still" obscures important omega-3:6 balance truths. Serum cholesterol was, is and always will be nothing more than a poor surrogate marker for heart disease. No one has ever demonstrated how elevated levels of cholesterol in the blood actually cause heart disease. The liver converts most foods to acetate, and it converts excess acetate to fats and cholesterol. Thus, excess food energy increases cholesterol synthesis, and unburned food calories (exacerbated by lowered metabolism caused by omega-3:6 diet imbalance and lack of physical exercise) are causal risk factors for atherosclerosis, obesity and type II diabetes and the associated risk factor, elevated blood cholesterol. Half the people with heart disease don't have elevated cholesterol levels and half the people with elevated cholesterol don't have heart disease. By contrast we've known how "thromboxane" can kill people (thrombosis caused by omega-3:6 diet imbalance – thick blood that clots quickly) since 1975.

Humans still need to eat SHELLFISH

A multi-million pound drugs industry poorly treats what we can prevent through good nutrition. With modern drugs, many people

now suffer from but don't die from preventable diseases. For the future health of the people in the Western World the shellfish industry must embrace the 30+ years of peer reviewed scientific health facts and advertise the health benefits of eating shellfish (high in DHA and EPA omega-3s) and removing excess omega-6 (seed oils, spreads and nuts) from our diets. It is also important to inform the public that the health benefits of eating shellfish (seafood) outweigh any risks. Advertising shellfish as low in fat is a misnomer, when it comes to seafood the fatter (higher in omega-3s) the shellfish the better. Human breast milk is rich in omega-3 (DHA + EPA). Most formula milk is not. Breast fed babies weight less than bottle fed babies at 1 year of age. Breast fed babies also have better developed brains. Thus Mothers should breast-feed whenever possible and consume enough omega-3 (shellfish - seafood) for them and their baby.

Our old assumptions that the faster growth rate is better, or that maximal growth equals optimal growth are probably not correct. Thus shrimp and bivalve seed producers should concentrate on producing shellfish as high in omega-3 as possible from the fattest "omega-3" broodstock. These shellfish will have a well-developed nervous system e.g. mussels with well developed pallial eyes (ocelli) and cerebral eyes (cephalic eyes) to detect predators.

Humans Getting Bigger and Thicker

In the last century, there was a nutrition driven rise in average human height by 0.4 inches per decade, along with the increase in the "diseases of civilisation" including mental ill health. The brain evolved with DHA (omega-3) in the sea 600 million years ago. Early humans evolved eating shellfish (high in DHA+EPA omega-3s, iodine, iron, selenium and zinc) while living a shore-line existence in Africa. We still use the same DHA for our brain function. Now, as when the hominid brain expanded, herbivorous shellfish such as mussels and clams can help people reach a healthy 1:1 balance of omega-3 and omega-6 fats in their diets, instead of the current Western diets 1:17.

Conclusion

The *status quo* is the tragedy of scientific oversimplification and miscommunication with drugs treating the symptoms of our preventable diseases. The Western World needs to produce and

consume an abundance of shellfish. Historically and now, shellfish and other shore-based foods are the healthiest foods on the planet.

Further Information

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Robson, A. (2006). Shellfish view of omega-3 and sustainable fisheries. *Nature*, 444: 1002.

For a calculation of healthy omega-3:6 ratio in the diet available to download see <http://efaeducation.nih.gov/sig/kim.html>

SHELF-LIFE OF WHOLE, UNPROCESSED CRABS

Anthony Robson, Institute of Environmental Sustainability, Swansea University

Shore crabs (*Carcinus maenas*), velvet crabs (*Necora puber*) and edible crabs (*Cancer pagurus*) caught from around the UK are sent to markets in the UK and Europe where they are sold as fresh cooked crabmeat, canned crabmeat, whole cooked or unprocessed (unkilled) directly from aquaria or on ice. Crabs are sold whole unprocessed despite the fact that the storage and sale of uncooked whole crabs is not recommended in the international code of practice for crabs (Codex Alimentarius Commission, 1983).

Shelf-life of whole, initially live, crabs depended primarily on the storage conditions and the time at which death occurred. Large differences in the time that individual crab species survived particular storage conditions resulted in wide variations in shelf-life. Bacterial spoilage of *Carcinus maenas*, *Necora puber* and *Cancer pagurus*, measured using aerobic plate counts, indicated that on ice at 4°C whole unprocessed

crabs had a shelf-life ~9–11 days, at 4 °C ~13–29 days, in simulated supermarket conditions of sale (on ice at room temperature (20 °C) for 8 h then on ice at 4 °C for 16 h in each 24 h period) ~5–7 days and at 20 °C 2–16 days. Storage of whole unprocessed crabs chilled at 4 °C considerably extended shelf-life compared to crabs stored on ice. Live crabs stored on ice died within 24 h, most likely due to thermal shock and their early death was responsible for their more rapid increase in bacterial numbers compared to crabs stored at 4 °C. No growth of bacteria occurred in the flesh of live crabs stored at 4 °C for between 128 and 504 h. Crab flesh quality deteriorated prior to maximum shelf-life (defined as the time at which bacterial load reached log 5 cfu/g crabmeat) in some instances. The best compromise between high crabmeat yield and long shelf-life is likely to be to transport crabs at 4 °C live to market where they could be stored live at 4 °C without spoilage for <2 weeks before placed on ice at 4 °C, with a potential maximum shelf-life of ~24 days.

Further information

Robson, A.A. (bsrobsont@swansea.ac.uk), Kelly, M.S., Latchford, J.W. (2007). Effect of temperature on the spoilage rate of whole, unprocessed crabs: *Carcinus maenas*, *Necora puber* and *Cancer pagurus*. *Food Microbiology*, 24: 419–424.

Codex Alimentarius. (1983). Recommended International code of practice for crabs. *Codex Alimentarius Commission/Recommended Code of Practice* 9: 28.



Live edible crabs (*Cancer pagurus*) for sale on ice at Swansea Market (Photograph by Anthony Robson)

FAL OYSTERS ARE AN INTERNATIONAL HIT

The following is a press release published by Business Link Devon & Cornwall on 17th January 2007.

Cornish fishermen have been promoting their native 'Fal Oysters' on an international stage thanks to help from the South West Rural Enterprise Gateway (SWREG) and Cornwall County Council.



L to R - Oyster Fishermen, Rob Searle and Tim Vinnicombe back on Cornish shores after promoting the Fal Oysters at Italy's 'Terra Madre' conference.

Members of the Truro Oyster Fishery Management Group are hoping to see increased exports to European countries of their sustainably caught and high quality product, after a recent visit to the major bi-annual Slow Food conference, 'Terra Madre' in Italy, which draws over 6,500 participants from all over the world. The Slow Food organisation was founded in 1989 to counteract fast food and protect the diversity of food, tradition and culture.

In 2003, the oyster fishermen formed a group with local buyers and the fishery regulator, Carrick District Council. The group manages the future of the fishery and have recently accessed support and funds from the SWREG project to help them market the product to wider audiences. Evonne Amblin, Business Link project officer for SWREG Fisheries said, "The work this group is doing is so important for the future of the Fal Oyster Fishery; at one point there were around 80 boats fishing on the Fal Estuary, then in the 1980's disease caused stocks to plummet. The fishery is slowly recovering as supplies gradually increase and currently there are about a dozen fishermen."

Fal Oysters are wild, native oysters found on the sea and river bed of the Fal Estuary and are famed for their distinctive sweet, fresh

and delicate flavour. The oysters are fished in traditional sailing boats as no mechanical power is permitted on the fishery. The Management Group is also currently applying for Protected Designation of Origin (PDO) status, a scheme established by the EU to help protect the names of traditional foods in order to define their authenticity and preserve their place of origin and traditional methods of production.

Objective One Fisheries programme manager, Clare Leverton said, "Fal oysters really are an exceptional product, distinctive to the region and of a very high quality. The fishing techniques couldn't be more sustainable - which is the buzz word in the food industry at the moment. I have helped the Management Group with Objective One Fisheries grants in the last two years and was really pleased to see them get the award from SWREG and Cornwall County Council for this trip and the promotional work."

Clare continued, "The visit to Turin has increased the amount of international contacts the group has which will hopefully pay dividends in increasing the opportunities to export in the next few years. Securing PDO status would also be an enormous boost for the product, placing Fal Oysters alongside internationally well known brands such as Cornish Clotted Cream and Parma Ham."

Ben Wright, owner of the Duchy of Cornwall Oyster Farm, Helford said, "We already know that the product we're supplying is excellent but the oysters are a high value, low volume product and so we need to focus on a niche market. SWREG is helping us develop a specific focus for the sales and marketing to develop the reputation of Fal Oysters - at home and abroad."

The South West Rural Enterprise Gateway is delivered through the Business Link network and aims to help rural businesses access information, training and business development support, using funding sourced through the South West RDA. Specialised support is available to groups of fisheries and marine related businesses in the South West. For more information, contact Evonne Amblin on 0845 600 9966.

TACKLING THE THREAT OF INVASIVE NON-NATIVE SPECIES

Defra, along with the devolved administrations of Great Britain (the Welsh Assembly and Scottish Executive) has launched a consultation to help tackle invasive non-native species.

Invasive non-native species pose a very serious threat to our native plants and animals throughout Great Britain, and have been identified as the second biggest threat to biodiversity worldwide.

Barry Gardiner, Minister for Biodiversity, said: "Invasive non-native species not only have a detrimental effect on our native wildlife and habitats, but also our economy: agriculture, forestry and fisheries all suffer from their impacts. In fact it's estimated that invasive non-native species cost the British economy approximately £2billion per year.

"Once these species become established complete eradication is often impractical and unaffordable, leaving long-term control as the only alternative.

"Our three Administrations and a host of government agencies and non-government organisations have come together to develop this draft strategy for Great Britain. It offers a

co-ordinated and considered approach to coping with these "alien" species."

The Invasive Non-Native Species Framework Strategy proposes a way in which stakeholders can work together to guard against invasive non-native species through:

- Prevention: to reduce the risk of invasive non-native species being introduced;
- Early detection, surveillance and monitoring: ensuring effective mechanisms are developed so that invasive threats can be responded to quickly;
- Control and eradication: finding the best solution and identifying the right approach in the case of each species;
- Raising awareness: ensuring that the public is aware of invasive non-native issues;
- Legislative framework: ensuring that current and any future legislation can adequately guard against the negative impacts;
- Research: ensuring that there is up to date information on the threats posed by these species, and the best methods to tackle them.

The consultation will run until 23rd May 2007. A copy of the consultation can be found at: [www.nonnativespecies.org/07_Latest_Developments_\(Public_Consultations\).cfm](http://www.nonnativespecies.org/07_Latest_Developments_(Public_Consultations).cfm)

SCOTTISH CONSULTATION ON ALIEN SPECIES

The Scottish Executive are consulting on proposals to amend Schedule 9 and the use of an order made under Section 14A of the Wildlife and Countryside Act 1981.

Invasive non-native species are one of the greatest threats to global biodiversity. They also have large economic costs, can impact on the amenity of an area, and can adversely affect plant and animal (including human) health.

Section 14 of the Wildlife and Countryside Act 1981 (WCA) (as amended by the Nature Conservation Scotland Act 2004) is the principal legislation concerning non-native species. This legislation makes it an offence to release any animals that are not ordinarily resident in and are not regular visitors to Great Britain (or hybrids of those animals) into the wild; or to

release (or in the case of plants, allow to grow) any species of animal or plant listed on Schedule 9 of that Act.

In order to prevent the further undesirable release of animals into the wild it is important that Schedule 9 is kept updated with species that are already causing damage, or considered to be a potential threat, to the environment.

Some species are considered particularly high-risk, either because of the damage they are already inflicting on our environment, or due to the nature of their spread. Section 14A of the WCA provides a power to Scottish Ministers to list animal and plant species on an order which makes it an offence to sell, offer or expose for sale, or have in one's possession or transport for the purposes of sale, the specified species.

This new power was provided by amendments made by the Nature Conservation (Scotland) Act 2004, and there are currently no species listed under Section 14A of the WCA.

This consultation paper seeks comments on amendments to Schedule 9 and on proposals for species to be added to an order made under Section 14A of the Wildlife and Countryside Act 1981.

Further information

For more information on this consultation, including details on how we will handle your response, and the next steps in the process, please refer to the electronic consultation web pages.

<http://www.scotland.gov.uk/consultations>
Consultation Contacts Address, Biodiversity Policy Team - Invasive Species Consultation, Scottish Executive, Environment and Rural Affairs Department, 1H (North), Victoria Quay, Edinburgh, EH6 6QQ (Telephone 0131 244 6540; email invasivespecies@scotland.gsi.gov.uk)

FAO DATABASE ON ALIEN SPECIES INTRODUCTIONS

In the 1980s, with long-distance introductions of fish species into new habitats for fish farming becoming increasingly common, FAO began tracking these movements.

For a long while, FAO monitored only inland fish species -- around 1,300 in all. But as world appetite for fish continued to grow, both in terms of net demand as well as demand for greater diversity in fish products, more species became farmed, and FAO started collecting information on marine species and species other than fish.

The organization recently launched an expanded version of its database which includes introductions of all taxa being produced via aquaculture; it now contains over 5,000 records of introductions of several hundred species.

The expansion was largely funded with funds from FAO's regular working budget and the FishCode Project, but vital support also came from the Netherlands via the FAO-Netherlands Partnership Programme (FNPP).

The database is being made available on a CD-ROM which also includes a virtual library of reports and studies by FAO as well as the text of major international instruments relating to the transport and introduction of aquatic species.

For each species introduction listed, the database provides information on where and when the first introduction occurred, who introduced it and why they did so, and whether or not positive or negative impacts resulted. That information is supplemented by links to references for additional information. " Further information: George Kourous, Media Relations, FAO (email: george.kourous@fao.org).

CODE OF PRACTICE FOR SHELLFISH AQUACULTURE

The shellfish members of Seafood Shetland have approved a Code of Practice detailing standards and procedures for the industry to follow during its operation.

Introducing the Code, chief executive of Seafood Shetland, Ruth Henderson, said: "This is an important document which serves as a guide for shellfish growers. It sets out existing best practice and will be reviewed and updated

constantly to reflect developments within the industry and how it is regulated.

"The first of these changes will happen this year when the Works Licence will be replaced by land based planning regulations under the Town and Country Planning (Marine Fish Farming) (Scotland) Order 2007.

"Co-operation is a key aspect of this plan: shellfish farmers depend upon clean water and will endeavour to work with other users of the marine environment, public bodies and the wider communities to protect and sustain this resource, at the same time minimising visual impact on the landscape and maintaining clean, safe and orderly sites."

The Code has been prepared from existing best practice and industry regulations and addresses important issues such as the siting of farms, site access, navigational safety, stock handling, water quality, harvesting, transportation, depuration, equipment, staffing and respect for wildlife.

Seafood Shetland has met with RSPB and had continued consultation with Scottish Natural Heritage in the preparation of the plan to ensure that the industry is making every effort to protect birds, wildlife and habitats of conservation importance. Ruth Henderson continued: "We thank Scottish Natural Heritage for assistance and guidance in the preparation of this document."

For further information contact Ruth Henderson, Seafood Shetland (01595 693644, email sfpa@fishuk.net). A copy of the guide can be obtained at www.fishuk.net.

EUROPEAN COMMISSION WELCOMES COUNCIL ADOPTION OF NEW RULES ON THE HEALTH OF FARMED FISH AND SHELLFISH

Markos Kyprianou, Commissioner for Health and Consumer Protection, has welcomed the adoption of a new Directive on the health of farmed fish and shellfish and disease control in the aquaculture sector, at the Agriculture Council. The Directive aims to improve the health of aquaculture animals in the EU by upgrading the current legislation and introducing a series of new measures, including more emphasis on disease prevention at each point in the production chain. In setting down clear-cut and harmonised EU rules, the new legislation should also help to boost competitiveness in the EU aquaculture sector, which has a production value of some €2.6 billion a year, and facilitate increased trade in fishery products.

Markos Kyprianou, Commissioner for Health and Consumer Protection, said: "I am very pleased that Member States have given such strong backing to this Directive, which has also received input from the European Parliament and a wide spectrum of stakeholders. The new legislation will help to shape the future of Europe's aquaculture sector. It will also ensure that consumers can remain confident in the safety and wholesomeness of seafood farmed in the EU."

Greater disease prevention

The new Council Directive responds to the need to update current animal health legislation for farmed fish and shellfish, taking into account developments in the aquaculture sector, as well as

international experience and scientific knowledge. A major aim of the proposal is to provide for better disease prevention by applying stronger controls throughout the production chain. Pre-empting and preventing diseases, rather than just treating them when they occur, should reduce economic losses and minimise restrictions on trade. The Directive also seeks to ensure that disease-free fish farms are protected from the introduction of pathogens, and that no new diseases affecting aquaculture animals enter the EU.

More flexible approach

Greater flexibility in the application of EU rules on the health of aquaculture animals is provided through the Directive agreed today. While the new legislation sets firm required standards when it comes to the health of farmed fish and shellfish, there is no fixed approach laid down for achieving these standards. This allows for the possibility of local or regional approaches to be taken in preventing and containing diseases, while Member States will be responsible for ensuring proper implementation and controls. National control and eradication plans for aquatic diseases will have to be drawn up, as will contingency plans for possible disease outbreaks.

Financial assistance

The Directive adopted will enable financial contributions from the European Fisheries Fund to be made for the eradication of aquaculture disease. This funding will support Member States and aquaculture operators when they need

to implement compulsory disease eradication measures, which can range from culling stock to movement bans to long-term programmes to eliminate a less threatening disease.

For more information, see: http://ec.europa.eu/food/animal/liveanimals/aquaculture/index_en.htm

EU AQUACULTURE UPDATE

The Plenary meeting of the Advisory Committee on Fisheries and Maritime Affairs (ACFA) was held in Brussels in early December 2006.

Joe Borg, Member of the European Commission responsible for Fisheries and Maritime Affairs addressed the meeting on fisheries, markets, and aquaculture.

On aquaculture, he said "We are well advanced on the road to having Community rules for alien species in aquaculture. If not finalised this year we expect it to be approved during the German Presidency. Aquaculture products and seaweeds are also included in the new Community rules on organic production and labelling and while we expect this Council Regulation to be finalised before the end of the month (to apply from 2009), DG FISH will start work on detailed implementing rules for aquaculture products and seaweeds next year.

"In addition, our proposed directive on animal health requirements for aquaculture and prevention and control of certain diseases was adopted by the Council in October (*see previous Announcement item for more information on this*).

"But work does not stop here; 2007 will be an important year for aquaculture.

"First it will be the year when we will review the Community strategy on the sustainable development of aquaculture. We have to integrate new trends and recent developments, whether they concern offshore aquaculture or links with other sea-based activities.

"This brings me to the second important event for aquaculture in 2007, the elaboration of concrete proposals regarding an EU maritime policy. The aquaculture industry is treated as an equal partner to other maritime activities and it is crucial that the aquaculture industry submits a strong contribution to the Green Paper on the EU Maritime Policy.

"Finally 2007 will be the year when the European Fisheries Fund and the 7th Research Framework Programme will start. These two programmes are instrumental for the sustainable development of aquaculture and we must work together to make the best use of them."

SMILE LAUNCHED

The Agri-food and Biosciences Institute (AFBI) have announced the completion of a unique piece of work designed to contribute to the sustainable management of mariculture in Northern Ireland's sea loughs.

In 2004, the Department of Agriculture and Rural Development (DARD) commissioned the SMILE project (Sustainable Mariculture in Northern Irish Lough Ecosystems), which was carried out by a consortium led by AFBI, including Queens University of Belfast, the Institute of Marine Research, Portugal, the Plymouth Marine Laboratory and the Council for Scientific and Industrial Research in South Africa.

Mr Pat Toal CB, DARD Permanent Secretary said "On behalf of AFBI and our partners, I am delighted to be able to hand over this project to DARD. SMILE will provide DARD with the models to ensure the future growth and long term sustainability of the shellfish industry". Mr Toal, in his acceptance speech outlined the importance of this work in helping DARD address the sustainability of Northern Ireland's marine fish and shellfish resources and stated that "DARD has always recognised the importance of science to the sustainability of Northern Ireland's marine fish and shellfish resources. Fisheries science works best when scientists and the fishing and aquaculture

industries work closely together and DARD is pleased to note that the SMILE project has benefited hugely from assistance given by many of the shellfish growers. DARD will take into account the outcome of this work in considering the future development of mariculture in Northern Ireland”.

A hands-on session at the launch event gave those present an opportunity to examine and use the computer models developed during the project.

A NEW MAP OF UK SEAS

Surveying our seas is difficult. This means we know far less about the sea than we do about the land. Until now we have not had a comprehensive picture of its habitats, as existing maps are restricted to small, detailed areas that are few and far between. Now for the first time a more complete, broader picture has emerged following a two-year project to produce a new map of the sea that shows 44 large-scale ‘marine landscapes’. Marine landscapes reflect the equivalent of mountains, valleys and plains of the marine environment, together with major habitat types. The UKSeaMap project is a partnership of ten organisations including Government Departments, agencies, advisers and conservation charities.

David Connor, a marine specialist who led the work at the Joint Nature Conservation Committee, explains: “Through our understanding of the physical and hydrographic factors that determine what wildlife occurs where, such as seabed sediments and water depth, we have developed an approach to predict variation in seabed ecology using data that covers large areas. We brought together this well known data with new information such as that on light penetration, and how much the seabed is disturbed by waves. By combining these, the UKSeaMap project has for the first time provided an insight into the broad pattern of marine

habitats around the UK - a brand new map of our seas and the first of its kind in Europe.”

Dr Paul Gilliland, a marine specialist with Natural England and Chair of the project’s Steering Group, said: “We need to develop more sustainable management of the marine environment as a whole, not least in response to the growing use of the sea and the need to protect it. This requires us to understand its environmental features. Because we can’t readily survey them, UKSeaMap has taken a practical approach to providing such key information. The wide range of funding partners shows that the project’s results will have many applications, from environmental assessment to spatial and strategic planning. We believe this new map will be a useful tool to assist Government, regulators, marine industries and scientific researchers in the decisions they take and advice they give.”

PDF copies of the marine landscapes map and the full report as well as pictures to illustrate some examples of the habitats that occur in different marine landscapes are available from Natural England. Further details, including a web mapping application showing the outputs from the project, can be found at www.jncc.gov.uk/UKSeaMap.

LOBSTER STOCK CONSERVATION

The NAFC Marine Centre has recently published a report detailing two lobster conservation programmes that have been carried out in collaboration with the local industry.

The work involved marking the tail of female lobsters with a V shaped notch and then releasing them where they were caught. Once the lobsters have been marked it is illegal to land

them and they must be returned to the sea if caught again. The notch will take around four or five years to grow out and during this time each female will breed several times. In this way it is hoped that more juvenile lobsters will be produced each year.

During the first programme in 2001 a total of 1200 females were V-notched, with 365

included in the second programme in 2005/06. It is estimated that these females will produce in excess of 40 million eggs before the mark grows out and it will take around five to seven years for the offspring of the V-notched females to enter the fishery.

Fishermen's logbook data are vital in determining the success of this programme through reporting the capture of juvenile lobsters and V-notched females. It is hoped that through this reporting in logbooks, an increase in the numbers of juvenile lobsters and recruits to the fishery can be shown. This work has been carried out alongside lobster restocking programmes using juveniles reared in

the NAFC Marine Centre marine hatchery. NAFC would like to thank all of the fishermen who participated in the programme, which was also funded by Shetland Islands Council, Shetland Enterprise, Shetland Fishermen's Association and the Shetland Shellfish Management Organisation.

A summary of the work is available in Fisheries Development Note No.22 or a copy of the full report is available from the NAFC Marine Library, NAFC Marine Centre, Port Arthur, Scalloway, Shetland (Tel: +44 (0)1595 772000, Fax: +44 (0)1595 772001, E-mail: info@nafc.uhi.ac.uk, Web: www.nafc.ac.uk).

NEW EUROPEAN LABORATORY FOR FOOD CONTACT MATERIALS

European consumers want to know that the food they buy is safe and, where packaged, that the materials in that packaging keep it fresh and do not compromise the quality of the food inside. To this end the European Commission has inaugurated the Community Reference Laboratory (CRL) for Food Contact Materials. The CRL will be based at the European Commission's Joint Research Centre in Ispra, Italy.

Articles that come into contact with food, such as packaging, kitchen appliances, cutlery and crockery are made from a wide variety of materials, such as papers, plastics, metals and glass. There are of course a wide variety of types of food that are packed, processed and in some cases heated in these materials. The safety of the food therefore relies on adequate standards throughout the industrial chain, including producers of chemicals and materials, converters, packers and the food and catering industry. Advanced analytical techniques are necessary to research and control the potential transfer for substances from the packaging itself to the food inside. The CRL will enhance

work already underway in this field by providing common methods and reference data, as well as allowing for regular exchange of information and best practice.

EU legislation ensures that all materials that come into contact with food comply with standards so that safe food remains safe. The CRL will establish an equivalent level of laboratory practice across the EU. It will serve as a point of reference for issues relating to the enforcement of legislation on food contact materials, through a network of National Reference Laboratories and will develop methods, reference substances, training and so on to ensure the best possible implementation of EU legislation in this field.

The Joint Research Centre has more than ten years' experience of analysis of food contact materials. It has established a database with the chemical and physical characterisation of more than 400 substances used in the production of food contact material, as well as 350 methods for their analysis.

SCOTTISH SHELLFISH HELP PUT WAITROSE ON THE MAP

Scottish shellfish farmers are to benefit from a £½ million deal as Waitrose becomes the first supermarket in the UK to launch revolutionary new package for shellfish.

The Scottish Shellfish Marketing Group (SSMG) first introduced the new Modified Atmosphere Packaging (MAP) to the UK consumer market.

The MAP packaging delivers mussels in peak condition sealed in an atmosphere scientifically designed to exactly match that of the seashore where they were harvested.

SSMG MD Donny Gillies said: "As our mussels are supplied in the revolutionary MAP packaging, Waitrose consumers will now be able to enjoy mussels that remain fresher, moister and plumper for longer."

"The packaging is also a lot stronger, giving greater protection to the mussels themselves, as well as ensuring an additional three to four days product life."

The mussels in MAP packaging were launched in selected Waitrose stores on Monday 27th November 2006.

Jeremy Ryland Langley from Waitrose said: "Waitrose are committed to providing our consumers with the best quality, most responsibly sourced produce available. The new packaging adds another high quality product to the wide range from the Scottish Shellfish Marketing Group already in our stores. Our partnership with SSMG means we can offer our customers high quality, sustainably farmed, fresh shellfish continuously throughout the year".

The technology to replicate the seashore atmosphere was developed by Dutch firm PRINS & DINGEMANSE. SSMG has linked their scientific breakthrough with new packaging technology from Norwegian experts POLIMOON to provide UK customers with the world's first high-tech fresh mussel packaging. As well as delivering fresh mussels, SSMG will also be supplying fresh oysters using MAP packaging as well.

MARINE CONSERVATION SOCIETY (MCS) RECORDING SCHEME

The MCS in Scotland has launched an exciting new marine recording scheme for fish and shellfish farmers. Sightings of wildlife gathered by farm workers can now be recorded and put to good use in important conservation projects and sightings schemes.

"Fish and shellfish farm workers are in an ideal position to record marine life as they spend all day on or near the sea in the same sites and often record the wildlife they spot", says Dawn Purchase, MCS Mariculture Officer. "The MCS recording scheme allows that valuable information to be utilised for recording and monitoring purposes."

The bespoke scheme is designed to be quick and easy to use and includes a recording form for species of interest to MCS such as turtles, jellyfish and basking sharks, which are already the focus of long-running and successful MCS campaigns. Other species included on the forms are otters, seals, cetaceans and rare fish.

Information will also be passed by MCS to other organisations with an interest in some or all of these species.

Dawn Purchase says, "By including a number of species of interest within one easy to use recording form we are hoping to encourage farmers to gather and submit as much information as possible about the diverse and wonderful marine life we are lucky enough to have around Scotland's beautiful coastline."

Dr Jean-Luc Solandt, Biodiversity Officer at MCS who manages the Basking Shark Watch project said: "MCS Basking Shark Watch has recorded increasing numbers of shark sightings in Scottish waters in the last five years. This new scheme aimed at fish and shellfish farm workers will help us better gauge the actual number of sharks at any one time that occur along the West coast of Scotland, giving us a greater understanding of their conservation status."

To make identification easier MCS have included identification guides to many popular species likely to be spotted. Packs will be mailed to all marine fish and shellfish farms in Scotland free of charge, if you do not receive your pack

or wish to order further copies please contact: Dawn Purchase, Mariculture Officer, Marine Conservation Society, 3 Coates Place, Edinburgh, EH3 7AA (Tel: 0131 226 3113, email dawn.purchase@mcsuk.org).

IRISH AQUACULTURE REPORT

The Irish fish and shellfish farming industry has enjoyed a steady output of over €100 million per year for the past three years, according to the "Status of Aquaculture Report - 2005"

Production in 2005 reached 44,666 tonnes of shellfish and 15,384 tonnes of finfish.

The report is a joint collaboration between the three main state agencies involved in the development, monitoring and scientific support of the fish and shellfish farming industry in Ireland – An Bord Iascaigh Mhara (BIM), the Marine Institute and Taigdhé Mara Teo. The report also describes in detail the Marine Institute's 2005 monitoring results from biotoxins, fish health, residue testing, sea bottom surveys and sea lice inspections carried out in support of the industry, the consumer and the environment.

The report highlights the resilience of the fish farming sector over the years, in spite of below-cost selling by salmon producers in Chile and Norway, and other problems, Monitoring and food safety were key elements of the State assistance to the aquaculture industry last year.

BIM's annual employment survey on the fish farming industry, which is quoted in the report, shows that there were over 730 fulltime jobs, 540 part time jobs and 364 casual workers, creating a Full Time Job Equivalent of over 1,000 positions and a real impact in small communities around the coast.

During 2005 the shellfish farming sector experienced prolonged harvesting closures due to the protracted presence of toxic algal blooms such as *Karenia mikimotoi*, which also damaged bottom dwelling shellfish stocks. Nevertheless, overall shellfish production showed a 4% increase in volume, from 43,092 tonnes in 2004 to 44,666 tonnes in 2005. Market value also increased by almost 10% to €47.7 million.

Production volume was dominated by bottom mussels, which retained their 66% share of the market from 2004. The overall market value of dredged bottom mussels also increased by 7%, bringing it to represent 54% of the total shellfish market value. Rope-cultured mussels represented 20% of the market by volume, but suffered a decrease in price of 14%.

Pacific oyster production made up 13% of the total volume of shellfish produced in 2005 and 25% by value. The remaining shellfish species produced included; native oysters, clams, scallops and other shellfish which, when combined, composed a 1.5% volume and 7% value share of the market.

Copies of "Aquaculture Status Report 2005" - the third report since the series began in 2003 - are available from BIM and the Marine Institute.

For further information contact: Dr. John Joyce, Marine Institute (Tel: 087 2250871) or Ian Long, Communications Executive, Bord Iascaigh Mhara (Tel: +353 1 2144192 or Mobile: 087 4158354).

BONAMIA CONFIRMED IN LOUGH SWILLY OYSTERS

The Marine Institute in Ireland has informed the Minister of State at the Department of Communications, The Marine and Natural Resources, that it has received confirmation from the European Community Reference Laboratory for Diseases of Molluscs (CRL) in La Tremblade, France, that samples of wild oysters taken from an oyster bed in Lough Swilly have tested positive for the parasite *Bonamia ostreae*.

This microscopic parasite presents no threat to human health.

The Institute is working with the Department to ensure that all necessary action is taken to control the disease and prevent its spread.

The Department is forwarding information on the management of this outbreak to all aquaculture operators within the Lough.

NEWS FROM LANTRA

Historic agreement to deliver a better skilled, more competitive workforce for Scotland

The dawning of a new era for the Scottish environmental and land-based workforce was signalled last December with the launch of a Sector Skills Agreement (SSA) tailor-made for Scotland.

Brokered by Lantra, the Sector Skills Council for the environmental and land-based sector, the agreement has been created following 18 months of extensive consultation with thousands of employers in Scotland - from dairy farmers in Dumfriesshire to mussel farmers on the West Coast of Scotland.

Over 24,000 businesses from 17 different industries were consulted by Lantra, which has devised a 12-point collaborative action plan to improve business performance, develop the skills of the workforce and raise the quality of entrants to the sector.

Aquaculture is a major employer in Scotland with an estimated 2,200 persons directly employed. Through the SSA the industry now has its own action plan devised to tackle the particular issues and opportunities identified during consultation.

Doug McLeod, Oyster Farmer, and Chairman of the Association of Scottish Shellfish Growers and the Lantra Scottish Council said: "Industry welcomes the SSA as the vehicle for the implementation of competence-based training and qualifications throughout the

sector. A multi-skilled workforce is critically important for the long term sustainable development of our industries and the SSA will form a vital tool in the creation of such a skilled workforce."

Through this Agreement Lantra will negotiate funding mechanisms to deliver in accordance with the real skills and business needs of Scottish employers and sole traders. Employer and employer bodies involved in the development of the Agreement, such as the Association of Scottish Shellfish Growers, Scottish Salmon Producers' Organisation (SSPO), Panfish and Shetland Aquaculture, have also pledged to support the collaborative solutions and actions set out in the Sector Skills Agreement.

For more information about the SSA visit the Lantra website www.lantra.co.uk or contact the Lantra Scotland team on 01738 553311.

Employers and government work with Lantra to boost investment in skills

An agreement to tackle skills shortages in Wales was launched at the International Pavilion, BUILT Wells in February. This is set to support businesses and workers in the aquaculture industry.

Launching the Agreement, Minister for Environment, Planning and Countryside, Carwyn Jones called for investment in skills and for training to be a high business priority.



Carwyn Jones, Minister for Environment, Planning and Countryside (second from right) with employers and Lantra staff. Photo by Andrew Bufton

The Agreement has been developed for employers by employers, facilitated by Lantra, and is the culmination of 18 months of research which will help to ensure that businesses can get the right people, with the right skills at the right time to remain profitable, competitive, and sustainable.

The Welsh Assembly Government has highlighted the importance of aquaculture to the Welsh economy and has acknowledged the potential for economic growth and development of European markets through the development

of the Fisheries & Aquaculture Strategy. The Fisheries and Aquaculture Strategy Group is working with Lantra to support close links and contribution towards the development of policies and strategies.

For more information about the Sector Skills Agreement (SSA) visit the Lantra website www.lantra.co.uk or contact the Lantra Wales team on 01982 552646

See also <http://www.lantra.co.uk/Aquaculture/>



Chief Executive Officer, Marine and Fisheries Agency, 3-8 Whitehall Place, London, SW1A 2HH
Telephone: 02072708311 **Fax:** 02072708345 **Email:** nigel.a.gooding@mfa.gsi.gov.uk
 Website: www.mfa.gov.uk

To Marine and Fisheries Agency contacts and stakeholders

Date: 30 March 2007

Dear Sir/Madam

1. I am writing to inform you about the new responsibilities being undertaken by the Marine Fisheries Agency from 1 April 2007.

Change of name for the Agency

2. The Marine Fisheries Agency is changing its name to the Marine and Fisheries Agency (MFA) to reflect new marine environmental responsibilities that the Agency will be taking on from 1 April 2007. The new responsibilities are summarized below.

Transfer of licensing and consenting functions from Defra and Department for Communities and Local Government

3. The Agency will take on responsibility for the administration of statutory licences and consents for marine works together with marine pollution response, marine renewables and marine aggregates, previously the responsibility of the Marine Consents and Environment Unit (MCEU) within core-Defra and the marine aggregates team within the Department for Communities and Local Government. The teams, once transferred across, will be known as the Marine Environment Team and will be located in our headquarters, Whitehall Place. Current telephone and fax numbers will remain unchanged for all those currently in Whitehall Place. The marine aggregates team will have new telephone numbers which will be notified to their particular customers and stakeholders separately when they move over later in the month.
4. The main aim of this merger is to bring together within the MFA all Government's delivery functions covering the control of coastal and marine developments, including coast defences, wind farms, wave and tidal power, disposal of marine dredgings at sea, contingency planning for oil spills and other marine pollution, and marine sand and gravel extraction.

Monitoring, control and enforcement of new Offshore Marine Conservation Regulations (OMRs)

5. It is intended that the MFA will take on responsibility for the monitoring and enforcement of the new Offshore Marine Conservation (Natural Habitats, &c.) Regulations which are due to come into force later this year. These new regulations extend the protection of important marine species and habitats under the Birds and Habitats Directives beyond UK territorial waters. They will extend the

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protection given to marine species, wild birds and habitats through tougher laws and improved protection of the marine environment. They will also enable the designation and protection of areas that host certain important habitats and species in the offshore marine area. Once designated these sites will be known as:

- Special Areas of Conservation (SACs) for the protection of certain habitats and species, and
 - Special Protection Areas (SPAs) for the protection of certain wild bird species.
6. These regulations will apply equally to all sea users in the offshore area and will prohibit the deliberate capture and killing of European Protected Species, including dolphins, turtles and sturgeon, and the deliberate disturbance of those species and their habitats.

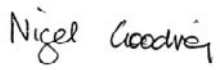
Wildlife licences

7. The MFA will also be responsible for the administration and issuing of wildlife licences, which will grant special permission for activities in the offshore marine area that would otherwise be an offence under the new regulations when they come into force. Activities that may be affected by these provisions include scientific study, research and conservation work on European protected marine species and wildlife sensitive developments.
8. When licences are applied for, industries will be required to provide supporting information. Applicants are advised to contact the UK Government's scientific adviser on marine nature conservation issues, the Joint Nature Conservation Committee (JNCC), for guidance and advice about the effect of these new provisions. More information on the JNCC can be found on their website, www.jncc.gov.uk.

Further information

9. We are currently in the process of revising our "Guide to the Marine and Fisheries Agency" leaflet, which describes the work of the Agency including the new responsibilities described in this letter. Copies of this will be available from your local MFA office shortly. Any questions relating to the forthcoming OMRs should be directed to the Defra Marine Biodiversity Team (Zone 1/05, Temple Quay House, 2 The Square, Temple Quay Bristol BS1 6EB. Email: marinebiodiversity@defra.gsi.gov.uk).
10. Finally, I look forward to meeting as many of the Agency's new stakeholders as possible in the coming weeks and months.

Yours faithfully



NIGEL GOODING



Shellfish report published by Seafish

SEAFISH has published the first in-depth analysis of the English shellfish industry.

The report, 'Towards a National Development Strategy for Shellfish in England', highlights the major contribution the shellfish industry makes to our economy. The report presents the main findings from the work programme that forms part of the National Development Strategy for the Shellfish Industry in England.

The work programme was commissioned by the Defra Inshore Fisheries Working Group and Seafish, and was supported by the Financial Instrument for Fisheries Guidance (FIFG).

The Executive Report describes the results for six 'tasks' that were assigned to the consultant, Dr R C A Bannister, a renowned expert on the management of the capture shellfisheries and their stocks. A CD-rom containing the full report is packaged within the Executive Report.

Peter Hunt, Director of the Shellfish Association of Great Britain who contributed to the work said: "This is an incredibly important document

as the first, definitive, in-depth analysis of the shellfish industry. It provides details of the nature of the industry; what different species can be found, and where, around our coast; and what constraints and opportunities exist within the industry. It encompasses all facets of the subject including production, employment and rural development."

Sue Utting of Seafish, who co-ordinated the project said: "This report was commissioned to provide an up-to-date picture of the shellfish industry in England. It is an extremely comprehensive review of the shellfish capture and cultivation sectors, drawing together production data from Defra and Sea Fisheries Committees, and highlights the very important role that shellfish plays in the English and UK economies.

"Many of the recommendations made in this report, will be explored further in the forthcoming 'National Development Strategy for the Shellfish Industry in England'. These include the need for reliable data on shellfish stocks; effective management of these stocks; and the sustainable development of the industry."



SHELLFISH ASSOCIATION OF GREAT BRITAIN (SAGB)

Norovirus Breakthrough Announced at New Zealand Shellfish Safety Conference

Ever since noroviruses, as they are now known, were recognised as causing viral gastro-enteritis transmitted by shellfish, salads and by person-to person contact, back in the 1980's, full understanding of the way they cause illness has been hampered by an inability to culture them. This has meant that it was impossible to be sure whether the methods used to detect them, such as PCR to replicate and record their RNA, were in fact measuring viable virus particles. This in turn made it very difficult to relate recorded PCR results to risk of illness.

In March this year, during the 6th International Conference on Molluscan Shellfish Safety, in Blenheim, New Zealand, it was announced that an American team had succeeded in culturing noroviruses for the first time in tissue culture. A teleconference was held with members of the research team as they were not present at the conference. The news was literally 'hot off the press' as it had just been published in the March issue of the research journal *Emerging Infectious Diseases*.

Although the work is at an early stage, the huge importance of norovirus to society, with frequent outbreaks (not related to shellfish consumption) on cruise liners, schools, hospitals and care homes means that there is great impetus to progress this. The technique may not be used as a direct monitoring tool, but it will provide the vital link in relating existing PCR methods to risk of infection. It will also be able to determine whether water treatment methods, such as UV, are effective at inactivating the viruses.

SAGB has been pressing for norovirus evidence to be used as a driver for further improvements to sewage treatment systems and to storm overflows, rather than just an additional standard for shellfish to meet. This view was stressed during discussion at the conference. The announcement on noroviruses should be a turning point and a stimulus for fresh thinking on the issue.

Neural networks

Malcolm Green of New Zealand's National Institute of Water and Atmospheric Research (NIWA) presented another new idea that could have great application in improving shellfish safety. This was on the use of Neural Network software to predict pollution at shellfish sites, using simple inputs such as rainfall a few days earlier, turbidity in streams, wind speed and direction. Instead of using complex and costly computer models, the neural network 'learns' the relationship at the site in question as additional data is fed in. It has already been shown to be useful in predicting the conditions which produce exceedances of *E.coli* thresholds (rather than predicting individual results) and so could form a basis for HACCP management of shellfish harvesting, avoiding risky conditions.

Sanitary surveys

The implementation of sanitary surveys in Europe was described by Ron Lee from Cefas and Lorna Murray of FSA Scotland. She said that harvesters needed to be involved in the surveys and to have ownership of them.

Toxin testing

Much of the conference was devoted to toxin testing methods and controls, with much discussion of the need to move away from mouse bioassay tests (MBA). New Zealand had led the way in changing to chemical testing for DSP, using LC-MS, but had been forced by EU requirements to revert to MBA as the reference method. In the UK, Cefas has been able to greatly reduce the number of mouse tests for PSP, by pre-screening with HPLC, only forwarding samples found positive by this for confirmatory MBA tests. Myriam Algoet of Cefas gave a report on this progress. Ngaire Dennison described how the Home Office, who oversee the MBA application in the UK, have worked to bring about these improvements. She stressed the need for collaboration and good communication between regulators, laboratories and industry to resolve issues.

Paul McNabb of the Cawthron Institute in New Zealand described how they have developed an LC-MS method for a further group of toxins, the brevetoxins, to further reduce reliance on

mouse testing. This is now regularly used to monitor harvesting of New Zealand shellfish. He stressed the benefits of chemical testing, including greater sensitivity and the ability to follow the development of toxic blooms before they have reached closure levels, allowing a degree of prediction and better management of harvesting.

This conference presented a view of considerable progress in both virus and toxin management, opening new directions for the future. The discussion of the shortcomings of

the MBA test did highlight the reality that there is much resistance to change from developing nations within the WTO who are not equipped to perform the high-tech LC-MS methods. They may view a change to chemical testing as creating a non-tariff trade barrier, but the overall feeling was one of real progress.

Further information

The Shellfish Association of Great Britain,
Fishmonger's Hall, London Bridge, London, EC4R
9EL (Tel. 020 7283 8305) (Fax. 020 7929 1389)
(email: SAGB@shellfish.org.uk)

ASSOCIATION OF SCOTTISH SHELLFISH GROWERS (ASSG)

Science and policy

Shellfish specialists from the UK and Europe (Belgium, France, Ireland, Spain), as well as from the USA, Canada and Chile, gathered in Oban in the last week of October 2006 for the latest in the series of the ASSG's annual 'International Conference', to deliver presentations and exchange views on their special areas of expertise and interest under the over-arching theme of "The interaction between science and policy-making and regulation". This subject, although it may initially appear somewhat arcane and only 'adjacent' to the majority of growers' interests, is actually pretty central when one considers any potential for a long-term profitable future for our sector.

If policy is not driven by appropriate science, what does promote positive policy decisions? What guides regulators if there is an absence of relevant research? Do research priorities reflect industry priorities? Do the three communities work together, supporting industry (as well as protecting the consumer) or are there barriers and conflicts?

These were the issues, and I believe that we witnessed an excellent set of position papers, with speakers defending their individual 'community' and identifying difficulties at the interface between their work area and the others. And because it was an industry Conference, all the issues had to be discussed and argued in the context of our sectoral activities (water quality, product quality, end product testing, alternative methods – speed and cost as well as analytical efficacy).

Our old 'favourites' of biotoxin testing (methods - especially the fate of the mouse bioassay - management regimes, end product standards, etc), and bacterial and viral sampling (Harvesting Area Classification, on-going monitoring, Risk Assessment & Management, integrated catchment alert systems, testing methods, etc), were all well aired and debated. Alternative approaches to those of the UK, from the US, Canada, Spain and Chile, were of great interest to the audience.

Issues relating to environmental protection, seed mussel concerns and threats from and potential regulation of alien species were also on the Agenda on Day Two, rounding off a stimulating and interesting Conference.

Planning

Meanwhile, other issues continue to occupy the ASSG – including the looming implementation of the transfer of 'planning control' from The Crown Estate to Local Authorities. The current main concern appears to be that there will be a minimal differences between terrestrial and marine planning regimes, with the implication that the equivalent of 'land banks' will be allowed at sea, and thus there will be no pressure for the surrender of unused sites (of which there appear to be a significant number, many with shellfish development rights). Under the current proposals, all current farming sites will be granted automatic and permanent planning permission by 'Scottish Ministers', following a 'review' of the environmental assessment conditions – a 'review' panel for finfish farms, and an auditing (against the requirements of The Habitats Directive) for shellfish sites. There is a continued background murmuring, from a variety of quarters, about the current derogation of shellfish farms from EIA requirements, so don't be surprised if molluscan applications are required to carry out such assessments at some time in the future. I don't believe that this should cause significant constraint on future developments in the majority of cases – after all, we are the environmentally benign sector of aquaculture!

Native oyster workshop

Partly as a result of the detection of *Bonamia* amongst native oysters in Loch Sunart, the ASSG organised a Workshop on the status and possible future development of *Ostrea edulis* in Scotland. The event, supported by SNH and The Crown Estate, was generally viewed as a success by participants, who included representatives from the Strathclyde Police, Argyll & Bute Council, The Crown Estate, SNH, SFIA, FRS, Cefas and SEERAD as well as growers. A 'meeting report' has been drafted and is available to any interested parties either from myself or (eventually) via the website (www.assg.co.uk).

Water quality

Other on-going concerns, although with no major developments to report at this time, include continuing discussions relating to water quality, tracking methods for pollution, changes to 'guidance' over shellfish cultivation applications (SEPA appears to have an objective to restrict development to 'pre-designated areas', possibly designated shellfish growing waters).

The new regime for Harvesting Area Classification, and the draft classification schedule for 2007, have re-ignited the discussion over water quality in west coast waters, particularly as studies appear to indicate that the main source of *E. coli* contamination is diffuse pollution from hillside runoff. If this is confirmed, then my long standing view that *E. coli* is the wrong indicator for rural coastal waters will gain even greater strength – and lend backing to our efforts to adapt the classification process for such rural areas, using a direct viral measurement methodology, but certainly a method that is more appropriate than simple *E. coli*.

Nevertheless, I have to say, that the FSAS appear to be adopting a flexible approach to the detail of the new procedure, so if ASSG members have valid concerns, they should write to their sampling officer at the appropriate local authority and copy it to Lorna Murray at FSAS in Aberdeen. The inclusion of industry sample results has now been formalised (a process which has both benefits and drawbacks, but I believe it represents a step forward).

Biotoxins

These (and related issues of microbiological and biotoxin assessment) will be discussed in great depth and great extent at the meeting of the 'International Conference on Molluscan Shellfish Safety' (ICMSS) in New Zealand in March 2007, I believe this is the most significant regular gathering (every second year), of shellfish regulators, scientists and industry representatives. This is a forum where real concerns, and practical issues, can be presented to the regulators and scientists whose efforts result directly in the legislative constraints that rule our industry. It's a long way to travel, but is one of the most important fora for industry to have representation.

Other issues of current importance include the stately progress of the process of designating a Coastal & Marine National Park, with all the concerns that such a designation would create, ranging from additional complexities for planning consents, to additional stress on the infrastructure (namely sewerage systems and the roads, already congested). And the overall issue of 'marine spatial planning', neatly described by the SFF as 'a solution looking for a problem'!

KEYZONES Project

Carrying Capacity issues, which relate to both individual farms and how much stock they can efficiently hold, and planning considerations concerning how much shellfish development is reasonable for a given loch, continue to occupy ASSG time and effort. We are a partner in the CRAFT Project, 'KEYZONES', and are promoting further research via the Scottish Aquaculture Research Forum (SARF). I believe that these models have much to offer our sector, and will move to a higher plane the assessment of the contribution of shellfish culture to the sustainability of the eco-system, and therefore the ability of the shellfish cultivation industry to expand in an agreed and environmentally acceptable form.

Solway

Finally, the 'Aquaculture Strategy for the Solway Firth' is out for consultation; and although there are some aspects of the report that I would query, overall the document represents, in my view, a pretty good stab at a development strategy for a specific area - different from the 'framework plans' that Highland Council have prepared for Loch systems, but rational, reasoned, comprehensive and based on logic not subjective unsubstantiated concerns. The document illustrates the economic and social benefits resulting from the development of shellfish cultivation in the Solway, and how shellfish aquaculture can be developed without significantly affecting other legitimate interests (avian conservation, environmental priorities, tourism, etc).

Further information

Association of Scottish Shellfish Growers,
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Tel/Fax : 01471-844-324;
Mobile : 07831-383-826;
email: DouglasMcLeod@aol.com

THE FOOD STANDARDS AGENCY'S RADIOLOGICAL MONITORING PROGRAMME: NATURALLY-OCCURRING RADIONUCLIDES IN SHELLFISH, 2000-2005

Dr Selwyn Runacres

Radiological Protection and Irradiation Branch, Emergency Planning, Radiation and Incidents Division, Food Standards Agency

Introduction

The Food Standards Agency conducts annual monitoring programmes to determine the concentrations of radionuclides in a variety of foods, including seafood such as molluscs, crustacea, and fish. The main purpose of these programmes is to ensure that authorised discharges of radioactive waste do not result in unacceptable doses to consumers through their diet. This article looks at some of the trends in concentration levels for naturally-occurring radionuclides LEAD-210, POLONIUM-210 AND POTASSIUM-40 also detected by the programme for the years 2000-2005.

The radionuclides analysed as part of the monitoring programme can be split up into three basic categories, namely naturally-occurring, technologically enhanced naturally-occurring and artificially produced radionuclides. Naturally occurring radionuclides fall into three categories: primordial radionuclides, secondary radionuclides and cosmogenic radionuclides. Primordial radionuclides have existed in their current form since before the earth was formed and are still present because of their long half-lives (billions of years). The half life is the time taken for half of the element to have changed, by radioactive decay, to another. Hence the primordial have a long enough half life to have not yet completely decayed. Secondary radionuclides are radiogenic isotopes derived from the decay of primordial radionuclides. They have shorter half-lives than primordial radionuclides. Cosmogenic isotopes, such as carbon-14 (^{14}C), are present because they are continually being formed in the atmosphere due to cosmic rays. Despite their "short" half-lives, they are found in the environment because their supply is always being replenished. This article provides trend data of three nuclides of the first two categories over the last 5 years.

Lead and Polonium

As part of its monitoring programme the Food Standards Agency analyses shellfish for lead-

^{210}Pb . ^{210}Pb is part of the uranium-238 (^{238}U) decay chain commonly called the "radium series", and is a predecessor (after two decays) of polonium-210 (^{210}Po). Uranium is a primordial radionuclide. Figure 1 shows that certain species of shellfish contain higher concentrations of ^{210}Pb & ^{210}Po . Nevertheless even the highest results found are well within safety levels. It is not surprising to find that filter feeders such as mussel and cockles retain higher levels of these radionuclides. The winkles are not filter feeders but herbivorous grazers and so for them the higher levels may be from the consumption of sediments while eating seaweeds.

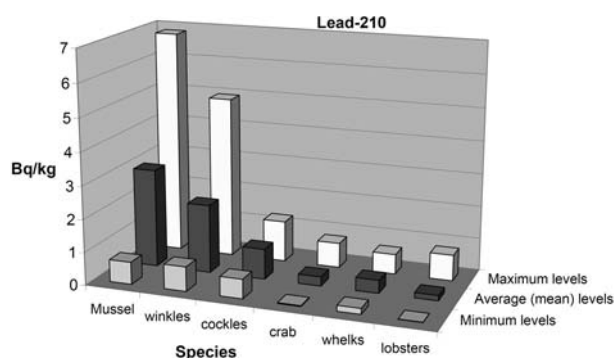


Figure 1a: ^{210}Pb concentrations in UK shellfish 2000-2005

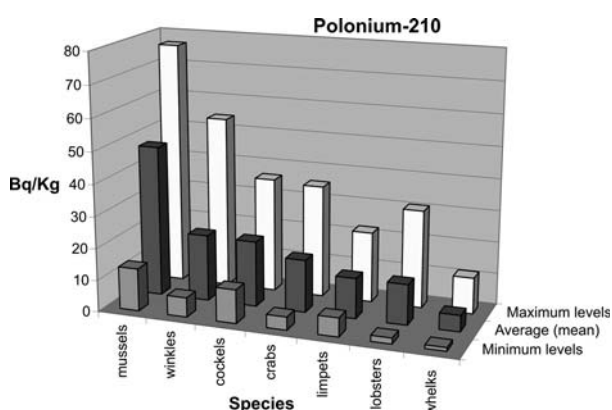


Figure 1b: ^{210}Po concentrations in UK shellfish 2000-2005

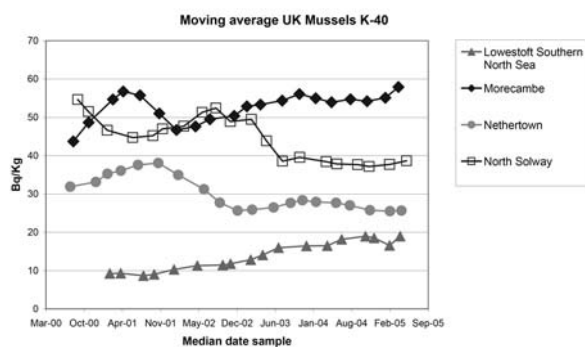


Figure 2: ^{40}K levels in mussels 2000-2005

Potassium

Potassium 40 (^{40}K) is one of the most common naturally occurring radionuclides found in food. In healthy animals and people, ^{40}K represents the largest source of radioactivity. The highest concentrations in food are found in Brazil nuts (in some cases up to approximately 5,600 Bq/kg). The levels found in shellfish are considerably less. Figure 2 shows the levels of ^{40}K in mussels from four locations in the UK. It has been drawn using a rolling four-quarter average of the results obtained in order to smooth out seasonal variations, and to give an overall picture of changes in levels. The four locations have reasonably defined ranges of ^{40}K concentrations that are area specific.

In considering the underlying raw data for Morecambe Bay and Lowestoft Southern North Sea (Figure 3), it is interesting to note the unusually high result from Lowestoft Southern North Sea for second quarter 2005. There are several possible reasons for this; the result may come from an outlier or may be due to the relaying or transportation of mussels from another area. The generally higher levels found in Morecambe Bay may be due to specific local geochemical/ environmental sources.

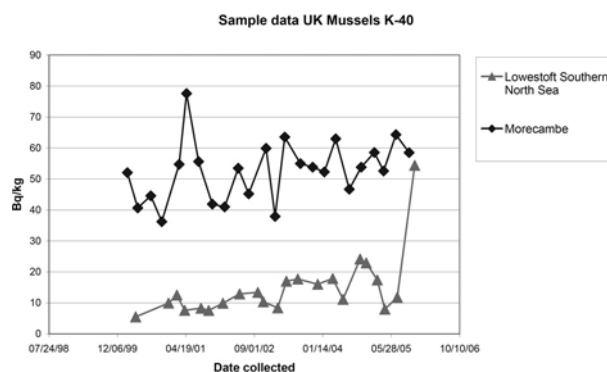


Figure 3: Temporal variation of ^{40}K concentrations in mussels

Summary

The results from the monitoring, together with assessments of the doses received by consumers, are reported annually in the Radioactivity in Food and the Environment (RIFE) reports. The reports show that members of the public exposure to artificially-produced and technologically enhanced naturally-occurring radionuclides via the food chain remained below the EU annual dose limit of 1 millisievert. Doses from naturally-occurring radionuclides are not subject to the EU dose limit but it is worth noting that, if they were then the doses from consumption of fish and shellfish would still be less than 1 mSv.

Further information

Further information on the levels of Radioactivity in Food and the Environment (RIFE report) can be found at <http://www.food.gov.uk/science/surveillance/radiosurv/>

For further information about non-radioactive levels of lead and other heavy metals in shellfish, see "food survey information sheet number 79/05 October 2005" <http://www.food.gov.uk/science/surveillance/fsis2005/fsis7905>

If you have further questions please email radiological.surveillance@foodstandards.gsi.gov.uk

BIOTOXIN MONITORING PROGRAMME FOR ENGLAND AND WALES: 1ST APRIL 2005 TO 31ST MAY 2006

Ben Stubbs, Steve Milligan, Steve Morris, Wendy Higman and Myriam Algoet, Cefas

Introduction

At certain times of the year naturally occurring marine algae can give rise to sudden and unpredictable blooms, which may not necessarily be visible or noticeable. Algae in these blooms may produce potent biotoxins, which can accumulate in filter feeding bivalve molluscs and in certain circumstances in other shellfish such as the grazing gastropods. Consumption of contaminated shellfish can pose a serious health risk. In the European Union (EU) (including the UK), there are currently three major shellfish biotoxin groups, which may be detected in shellfish, and are subject to statutory testing to protect human health. These are Paralytic Shellfish Poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP) and Amnesic Shellfish Poisoning (ASP) toxins.

Because of the health risks to consumers of contaminated shellfish, legal controls are placed on the production and marketing of fishery products worldwide. These require that each EU Member State conducts Official Control checks for the presence of marine biotoxins in shellfish production and relaying areas and for the presence of toxin producing phytoplankton in all active production and relaying areas. Should any shellfish be found to contain levels of biotoxins above the limits prescribed in the legislation, action is taken to close the production or relaying area and prevent harvesting or sale of these products.

In England and Wales, the central Competent Authority is the Food Standards Agency (FSA) which delegates local enforcement and sampling activities to local Food Authorities (LAs). The co-ordination of the English and Welsh biotoxin programme and testing of all flesh and water samples are conducted by Cefas. This article summarises the results of the English and Welsh Official Control biotoxin monitoring programme for the period 1st April 2005 to 31st May 2006.

The programme was divided, as in previous years, into two elements, the flesh monitoring element, where samples of shellfish from designated shellfish harvesting and relaying areas were tested for ASP, PSP and DSP toxins,

and the water monitoring element, where water samples are collected from sites within selected harvesting areas and analysed for the presence of potentially harmful phytoplankton species which may be responsible for the accumulation of the above toxins in shellfish flesh.

Shellfish collection

The programme required the monthly collection of flesh samples by LAs, except in areas with a history of shellfish biotoxins or toxic phytoplankton, where samples were requested on a more frequent basis (weekly or fortnightly), dependant on the level of risk. Where toxins above the limits prescribed in the legislation were detected, the affected sites continued to be tested, until two consecutive negative or below maximum permitted level results were obtained, allowing the subsequent lifting of any harvesting restrictions applied on the sites.

During the reported period, 43 LAs contributed to the sampling of shellfish from 116 inshore locations representing 64 active classified production or relaying areas. In total, 1143 shellfish samples [consisting of mussels (*Mytilus* spp.) (563 samples), native oysters (*Ostrea edulis*) (284), common cockles (*Cerastoderma edule*) (162), Pacific oysters (*Crassostrea gigas*) (108), surf clams (*Spisula solida*) (7) and hard clams (*Mercenaria mercenaria*) (16)] were submitted to the laboratory for ASP, DSP and/or PSP testing. The samples reached Cefas between 1 and 72 hours post-collection, with 93% of the samples reaching the laboratory within 24 hours of collection.

Water collection

A total of 737 water samples were collected from 61 classified production or relaying areas around the coast of England and Wales. Monitoring of harmful phytoplankton at Blyth, Northumberland, an offshore site included in previous monitoring programmes continued during the reported period.

The period April-May 2005 corresponded to the end of the rolling water monitoring programme encompassing a total of 18 monitoring points, as agreed in previous years with the FSA.

June 2005 saw the introduction of a revised programme designed to improve the coverage (both temporally and geographically) and the quality of the water monitoring element of the biotoxin surveillance programme. The revised programme was rolled out to 42 local authorities who monitored 90 sites representing 57 production or relaying areas during the year and the frequency of sampling was increased to fortnightly during April to September or weekly in the event of cell concentrations breaching pre-defined action levels (see table), as agreed with the FSA. The notion of water 'trigger' levels was introduced and implemented from October 2005 (see table). This was designed to provide more frequent information from harvesting areas where the concentration of potentially toxic algae may be increasing. The trigger levels were therefore set at lower cell concentrations than the action levels (which remained in force, at the same cell densities as previous years). A breach of water trigger levels in an area instigated requests for weekly water sampling. A breach of water action levels continued to instigate requests for weekly flesh and water sampling from an area.

Phytoplankton trigger and action levels used for the instigation of further water or water and flesh collections.

Algal group	Toxin	Trigger levels(cells/litre)	Action levels(cells/litre)
Alexandrium spp.	PSP	Presence (40 cells/L)	Presence (40 cells/L)
Dinophysis spp. / Prorocentrum lima	DSP	Presence (40 cells/L)	100
Pseudo-nitzschia spp.	ASP	50,000	150,000

Shellfish analysis

On arrival at the laboratory, all samples were assigned a specific laboratory number and assessed for their suitability for analysis. Shellfish which failed to respond to a percussion test and/or did not exhibit organoleptic characteristics associated with freshness were excluded from testing and reported as unsuitable for analysis. Less than 1% of the samples were rejected as unsuitable for analysis. A total of 5.2% of flesh samples were also found to yield insufficient material for at least one of the required tests to be carried out.

All samples were analysed in accordance with the prescribed methods and in compliance with Cefas standard operating procedures (SOPs) and with the SOPs of the UK National Reference Laboratory for Marine Biotoxins (UK NRL).

Water analysis

On arrival at the laboratory, all samples were assigned a specific laboratory number and sample details were recorded from the enclosed label. The preserved water samples were prepared for analysis by allowing them a minimum of twelve hours to settle out in 25mL settling (Utermöhl) chambers. This was an increase from the two hours settling period used prior to 1st June 2005, to comply with the recommendations of the UK NRL.

After a few hours, the samples were assessed for the quantity of algal cells or debris present on the base of each chamber. If necessary, (where cell or debris concentrations were high) the sample was re-settled in either a 10mL or 5mL chamber to enable enumeration of potentially toxic phytoplankton species.

After a minimum 12 hour settling period, phytoplankton species were identified and counted in each of the samples collected.

Only one water sample was found unsuitable for analysis and therefore rejected, due to high sediment content.

An agreed number of water samples, all showing *Pseudo-nitzschia* spp concentrations exceeding 50,000 cells per litre were further analysed by transmission electron microscopy for speciation of the algal group.

Results of the April 2005 to May 2006 flesh and water sampling programme for biotoxin monitoring

Diarrhetic Shellfish Poisoning toxins

A total of 1023 tests for DSP toxins were carried out.

DSP positive assays were recorded in only four samples (0.4% of all tested samples).

All four samples found DSP positive gave "atypical" responses. The terminology "atypical" relates to the fast acting responses in the DSP

assay, which have been observed by monitoring laboratories on some samples, in particular cockles and to a much lesser extent mussels. The affected samples comprised of mussels (2) from Plymouth: East of Ajax, cockles (1) from The Wash: Zone 4, and hard clams (1) from Newtown: Clamerkin Creek. The affected sites were subject to temporary harvesting restrictions. Whilst "atypical" results have been recorded in both mussel and cockle species in the past, this year saw the first occurrence of atypical DSP in a clam species.

Dinophysis spp. occurred in 23 samples from 11 production areas, in particular the Camel, Fal and Fowey and 7 samples from Blyth. The action level (set at 100 cells/L) was breached on 7 occasions in the reported period in samples from three areas (Blyth: Offshore and Silloth: Silloth and Fal: Turnaware Pontoon).

Prorocentrum lima were found infrequently, only occurring in three samples from The Wash: Zone 2 and Portland: Fleet Oyster Farm. The only sample which breached the action level (set at 100 cells/L) was collected from Fleet Oyster Farm in August 2005.

No correlation could be established between presence of *Dinophysis* spp. or *Prorocentrum lima* in water and presence of DSP toxins in shellfish flesh.

Paralytic Shellfish Poisoning toxins

A total of 1085 tests for PSP toxins were carried out.

PSP toxins were detected in four samples, Fowey: Pont Pill (mussels)(3) and Holy Island: Ross Links (mussels)(1). Two samples (Fowey: Pont Pill, 04/07/2005 and 11/07/2005) were found to contain PSP toxins at levels above the statutory maximum permitted level of 80µg PSP toxins/100g shellfish flesh. The affected site was subject to temporary harvesting restrictions.

Alexandrium spp. were recorded in 80 samples from 17 production areas and 6 samples from Blyth, with peak concentrations of 1.8 million cells/L. As in recent years, *Alexandrium* spp. were found regularly in samples from the Fal: Turnaware Pontoon, where they occurred from early June to late September 2005, and at Portland: Weymouth Inner Harbour (June

to October 2005), where they reached a peak concentration of over 100,000 cells/L during July 2005. *Alexandrium* spp. were also regularly detected in samples from Poole: Round Island, Salcombe: Geese Quarries, Milford Haven: Coedcanlas Spit and Blyth: Offshore.

No correlation was established between presence of *Alexandrium* spp. in water and presence of detectable levels of PSP toxins in shellfish flesh.

Amnesic Shellfish Poisoning toxins

A total of 1004 tests for ASP were carried out.

ASP toxins were detected in nine samples collected from two classified production areas: Milford Haven [Lawrenny Quay (mussels)(2), Roscrowther/Kilpaison (cockles)(2) and Metal Box (cockles)(2)] and Taw/Torridge [Cool Stone (mussels)(2) and Appledore Lifeboat Slipway (mussels)(1)]. All of these results were recorded during a four week period between 25th May and 21st June 2005 and toxin levels did not exceed 9.04mg domoic/epi-domoic acid per g shellfish flesh, i.e. remained below the statutory maximum permitted level (MPL) of 20mg/g. The detection of ASP toxins at Milford Haven at this time was associated with the presence of a known domoic acid producing *Pseudo-nitzschia* species, *P. australis*, at concentrations below 55,000 cells/L. This was also the first recorded observation of this species in Welsh and English coastal waters.

Pseudo-nitzschia spp. were found in 277 samples collected from the 38 areas. Cell concentrations breached action levels (set at 150,00 cells/L) on three occasions (Burry Inlet: Machynys – 15/05/05 ; Dee: Salisbury Bank – 15/05/05 ; Portland: Weymouth Inner Harbour – 18/05/05), with peak concentrations 309,600 cells/L. No correlation could be established between such high counts of *Pseudo-nitzschia* sp. with the presence of ASP toxins in the flesh of shellfish from the same areas. Cell concentrations also breached the agreed trigger level (set at 50,000 cells/L) on eight occasions. The affected areas were the Burry Inlet: Machynys, Conwy: Morfa, Fowey: Wisemans, Milford Haven: Metal Box and Beaulieu: Needs Ore.

A total of five *Pseudo-nitzschia* species: *P. australis*, *P. delicatissima*, *P. multiseriata*, *P.*

fraudulenta and *P. pungens*. were speciated in English and Welsh coastal waters. Only *P. australis* and *P. multiseriata* have been directly linked to toxicity in UK shellfish. As some *Pseudo-nitzschia* species have not been associated with toxicity in shellfish this may explain the high cell concentration of this genus in some samples but lack of any ASP in associated shellfish.

The implementation (in October 2005) of trigger levels for *Dinophysis* spp. and *Prorocentrum lima* (40 cells/L) and *Pseudo-nitzschia* spp. (50,000 cells/L) led to nine requests for additional water samples. Only seven of these samples were provided. No link could be established between the presence of cells above trigger levels with the commencement of an algal bloom. However ASP toxicity was detected (Milford Haven, see above) at half the maximum permitted limit for this toxin and this episode

coincided with the presence of *P. australis* at a concentration below the 150,000 cells/L action level. It is recommended that trigger levels continue to be implemented to allow their continued assessment.

Acknowledgements

The English and Welsh biotoxin monitoring programme is funded by the Food Standards Agency. We would like to thank the monitoring staff at Cefas and all the sampling authorities that have collected the shellfish and water samples during the past year, particularly the authorities who have collected additional material for research on our behalf. The success of the biotoxin monitoring programme relies upon the co-operation between the competent authority, local food authorities and testing laboratories, the Food Authorities and their agents have been unfailingly helpful often at considerable cost in terms of both staff time and expense.

THE UK BONAMIA & MARTEILIA SAMPLING PROGRAMME 2006

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Cefas Weymouth Laboratory

Introduction

The two most serious diseases of native oysters (*Ostrea edulis*) in Europe are Marteiliosis and Bonamiasis. In 2002 the UK achieved Approved Zone status in respect of these two diseases (Commission Decision 2002/300/EC). Approved Zone status recognises that it has been demonstrated, by regular and targeted sampling and testing, that the oysters in the specified areas are free from the causative organisms of these diseases. For *Marteilia refringens*, the UK is completely free of this disease and the whole coastline is approved.

Until early 2006, for *Bonamia ostreae* the whole coastline, except for three restricted areas in England and Wales and one in Northern Ireland, where the disease is present, was approved. The three areas in England and Wales were (1) from the Lizard to Start Point; (2) from Portland Bill to Selsey Bill and (3) from Shoeburyness to Felixstowe. In Northern Ireland the restricted area is Lough Foyle, where *Bonamia* was first detected in 2005.

Examination of samples collected in late March 2006 from Burton Beach in the River Cleddau confirmed that the *Bonamia ostreae* parasite

had spread to this new area. This is the first appearance of this disease in Wales. Further sampling has shown that the disease is present, at a low level of prevalence, throughout the fisheries in the estuary and river system. Controls have been put in place and the whole of the River Cleddau, Milford Haven and the adjacent coast from Skomer Island to St. Govan's Head is now also a restricted area. *Bonamia* was also detected for the first time in Scotland in 2006. The area affected here is Loch Sunart, where routine sampling and testing in late April confirmed the presence of the disease organism in native oysters at a farm site. The farm affected was cleared of the diseased stock and as the disease has apparently not spread any further the Fisheries Research Services are investigating the possibility of eradication, hopefully leading to restoration of Approved Zone status.

Approved zone status enables the UK to operate import controls aimed at preventing the introduction of these diseases from elsewhere in the EU, where they are known to occur, or where no sampling and testing is carried out. Movements within the UK are also controlled according to the health status of these areas. Anyone wishing to deposit or relay any molluscan

shellfish taken from the above mentioned restricted areas must apply for permission to the appropriate Fish Health Inspectorate (Cefas Weymouth Laboratory, for England and Wales; Fisheries Research Services at the Marine Laboratory, Aberdeen, for Scotland; DARDNI, Belfast, for Northern Ireland). Addresses are at the back of this issue of Shellfish News.

Sampling results for England and Wales in 2006

For *Bonamia*, Table 1 gives a summary of the results for all sites from which samples of native oysters were taken in autumn 2006. The usual sample size at each site was 30 oysters. Eight sites in the unrestricted areas (i.e. those free from *Bonamia* and *Marteilia*) were also sampled in spring 2006. No cases of *Bonamia* were detected in these samples.

All samples were also examined for *Marteilia*. This was not detected in any samples.

Table 1: Summary of results of native oyster sampling in England and Wales for *Bonamia* (2002-2006)

Year	Restricted Area 1 The Lizard to Start Point		Restricted Area 2 Portland Bill to Selsey Bill		Restricted Area 3 Shoeburyness to Landguard Point		Restricted Area 4 Milford Haven	
	Sites	% infected (range)	Sites	% infected (range)	Sites	% infected (range)	Sites	% infected (range)
2002	11	0-10	23	0-29	12	0-46	1	0
2003	11	0-25	23	0-33	15	0-62	1	0
2004	6	0-7	24	0-30	20	0-50	1	0
2005	4	0	23	0-30	17	0-37	1	0
2006	7	0-10	17	0-20	12	6-53	4	0-10

In Table 1 the results for 2006 are compared with those for the previous 4 years. The mean level of *Bonamia* infection in farms in 2006 was slightly higher than in the previous year. The mean level of infection in fisheries was the highest recorded in 14 years of sampling. The average for all sampled farm sites was 18.49% of oysters infected, compared with 15.39% the previous year and a ten-year average of 16.4%. Farms in the restricted areas on the south coast had slightly lower levels of infection than the average for previous years but the levels of infection at the east coast farms was the highest for three years.

The average for all the fishery sites sampled was 7.28%, compared with 4.46% the previous year

and a ten-year average of 4.47%. It must be remembered that not all sites are sampled each year and in 2006 some targeted sampling was carried out, at the request of the industry, on some east coast fishery sites that obtained results of very high levels of infection, boosting the average figure. This area has seen good natural recruitment in recent years and it may be that these increased levels of infection are a response to increasing densities of oysters on the ground. We did not, for the first time, get any negative 30-oyster samples from the east coast restricted area in 2006.

Sampling results for Scotland in 2006

Bonamia ostreae was detected for the first time in flat oysters collected in Loch Sunart, as described above. Testing confirmed the absence of *Bonamia* at all other sites tested and *Marteilia* in samples taken from all nine farm sites holding native oysters in Scotland. Two tests (spring and autumn) were carried out.

Sampling results for Northern Ireland in 2006

Samples were collected in spring and autumn. The autumn sample from Lough Foyle confirmed a low level of prevalence of *Bonamia* (one oyster positive in a sample of 30). All samples tested negative for *Marteilia*, maintaining Approved Zone status for this disease.

Further information

Shellfish farmers should note that if they have a mortality problem with their stock then they are legally obliged to report it to the appropriate Fish Health Inspectorate (Weymouth, Aberdeen or Belfast) for investigation. The Inspectorate will then identify the causes and where appropriate take any action to limit the spread of disease and minimise economic losses to the industry.

RESEARCH NEWS

1. Reuse of water in scallop hatcheries

In a commercial scallop hatchery spat production depends on a culture system that ensures high survival and good growth. Reuse of water with algae may increase the food exploitation and hence reduce the costs.

Post-larvae of great scallop were studied in a commercial hatchery using a partial open and continuous feeding tank system. Three different water recirculation rates (67, 83 and 92%) were tried out in two experiments with post-larvae originating from three spawning groups of ages between 43 and 57 days post-spawn.

Generally no significant differences in survival, growth or chemical content were found between the three recirculation rates, while few differences were found between and within groups. Large variation in survival was found between and within groups (1-81%). The daily growth ranged from 15 - 62 μm shell-height. The scallop post-larvae could well be reared at all three recirculation rates studied as an increase from 67 to 92% did not seem to affect the post-larval performance seriously. The algal supply, however, had to be compensated by an increasing number of cells (> 10 cells per μl) when increasing the recirculation rate.

Christophersen, G. (gyda.christophersen@bio.uib.no), Torkildsen, L., van der Meeren, T. (2006). Effect of increased water recirculation rate on algal supply and post-larval performance of scallop (*Pecten maximus*) reared in a partial open and continuous feeding system. *Aquacultural Engineering*, 35: 271-282.

2. Abalone diets

The effect of different diets on growth in the cultured South African abalone was investigated. Fresh kelp blades (seaweed control), Abfeed (formulated feed control), kelp + Abfeed, dried kelp pellets, dried kelp blades, dried kelp stipes, fresh kelp with an epiphyte, a mixed seaweed diet and a rotational diet (abalone were fed 1 of the 9 treatments for the first week and then kelp for the next 3 weeks) were all tested.

Results show that abalone grow well on all fresh seaweed combinations, but grow best on a mixed diet. The likely reason for the success of the mixed diet is that the red and green seaweed was farm grown, with increased protein content.

Dried kelp in any form produced poor growth. Abalone fed on the mixed diet grew at 0.066 mm per day shell length and 0.074 g per day body weight; this corresponds to 24.09 mm shell length and 27.01 g body weight increase per annum. Abalone fed on dried kelp grew at only 0.029 mm per day shell length and of 0.021 g per day body weight. Abalone grown on Abfeed grew at 0.049 mm per day shell length and 0.046 g per day body weight which corresponds to 17.88 mm and 16.79 g increase per annum; this is better than the dried seaweed feeds, but poorer than the fresh seaweed combinations. This study shows that seaweed diets, particularly if the diets include seaweeds grown in animal aquaculture effluent, are good substitutes for the formulated feed generally used today.

Naidoo, K., Maneveldt, G. (gmaneveldt@uwc.ac.za), Ruck, K., Bolton, J.J. (2006). A comparison of various seaweed-based diets and formulated feed on growth rate of abalone in a land-based aquaculture system. *Journal of Applied Phycology*, 18: 437-443.

3. Norovirus inactivation

Murine norovirus (strain MNV-1), a propagable norovirus, was evaluated for susceptibility to high-pressure processing. At room temperature (20°C) the virus was inactivated over a pressure range of 350 to 450 MPa, with 5 minutes treatment. Inactivation was enhanced when pressure was applied at an initial temperature of 5°C. The inactivation of MNV-1 directly within oyster tissues was also demonstrated; a 5-min, 400-MPa treatment at 5°C was sufficient. This work is the first demonstration that norovirus can be inactivated by high pressure and suggests good prospects for inactivation of non-propagable human norovirus strains in foods.

Kingsley, D.H. (dkingsle@desu.edu), Hollinian, D.R., Calci, K.R., Chen, H.Q., Flick, G.J. (2006). Inactivation of a norovirus by high-pressure processing. *Applied and Environmental Microbiology*, 73: 581-585.

4. Taste tests of high-pressure treated oysters

Australian oyster consumers evaluated the sensory quality of diploid and triploid Pacific oysters subjected to high-pressure (HP) treatment, with and without salt.

Triploid and diploid oysters received comparable ratings despite having dissimilar condition

indices at the time of testing.

The HP treatment did not adversely affect the sensory quality of Pacific oysters because the test products received similar ratings of sensory quality to the control (unprocessed) products. Moreover, oysters subject to HP received higher ratings for liking of appearance and were judged to have lower levels of perceived saltiness compared with the control.

Nell, J.A. (john.nell@dpi.nsw.gov.au), O'Riordan, P.J., Ogburn, D.M. (2006). Consumer evaluation of diploid and triploid Pacific oysters subjected to high-pressure treatment. *Journal of Shellfish Research*, 25: 1101-1104.

5. Genetics of native oysters

The European oyster has been the subject of human-mediated translocation and aquaculture in Europe for centuries and may have diluted or masked natural population genetic structure. Samples of oysters from 10 sites in Scotland and The Netherlands, Brittany and Norway were collected and genotyped at up to six microsatellite loci. Numbers of alleles and heterozygosity per locus were high in all populations and were consistent with previous microsatellite studies. There is no evidence that extensive traditional oyster aquaculture has led to loss of allelic diversity.

Overall, population differentiation was estimated to be higher than previous studies and could be resolved into four main genetic groups (1) Norway, (2) The Netherlands and Brittany, (3) Scotland apart from (4) Skye. The genetic distinctness of Norway oysters agrees with previous findings. The distinctiveness of the Skye population could be partly due to an artefact of small sample sizes and partly due to the founder effect of importation of Brittany oysters in the 1950s. Further studies are required to ascertain whether the Skye population may be deserving of special conservation status. The results suggest that human aquaculture activities over recent centuries have probably diluted any original local genetic differentiation within Scotland, but that potentially important genetic differentiation still exists at the wider scale across Europe.

Beaumont, A. (a.r.beaumont@bangor.ac.uk), Garcia, M.T., Honig, S., Low, P. (2006). Genetics of Scottish populations of the native oyster, *Ostrea edulis*: gene flow, human intervention and conservation. *Aquatic Living Resources*, 19: 389-402.

6. Genetic selection in Pacific oysters 1

An experiment was conducted with Pacific oysters to determine if the relative rankings of average family performance (individual weight, survival and yield) remain stable across a wide range of growing environments. Twenty-four full-sib oyster families were each planted both inter-tidally and sub-tidally in two bays in Washington state. Each family was represented by up to 12 replicate grow out bags (stocked with 60 spat each) or 12 replicate lantern nets compartments (stocked with 40 spat each).

Family, environment, and family x environment interactions all significantly affected average individual weight, survival, and yield at harvest. Family, environment, and family x environment interaction, accounted for 5%, 80%, and 2% of the total phenotypic variation in average individual weight, respectively, 36%, 16%, and 7% of the total phenotypic variation in survival, respectively, and 14%, 62%, and 5% of the total phenotypic variation in yield, respectively.

High-yielding families in one environment tended to be high yielding in other environments. Results of this study suggest that the effect of genetic and environment interactions on average individual weight, survival, and yield, while significant, are not large enough to prevent selection in a limited number of well-chosen environments from resulting in favourable correlated gains in other environments.

Evans, S. (ford.evans@oregonstate.edu), Langdon, C. (2006). Effects of genotype x environment interactions on the selection of broadly adapted Pacific oysters (*Crassostrea gigas*). *Aquaculture*, 261: 522-534.

7. Genetic selection in Pacific oysters 2

Three experiments were performed to examine the heritability of body weight among adult Pacific oysters and to determine if selection on individual body weight could result in changes in offspring survival and yield.

In Experiment 1 both parents and offspring were evaluated in an "upriver" environment. In Experiment 2 parents were evaluated in a "downriver" environment, while offspring were evaluated in an "upriver" environment. Experiment 3 contrasted average body weight, survival, and yield of offspring (evaluated

upriver) derived from three large sires and three small sires mated to the same five females that were chosen at random (all parents evaluated downriver).

Heritability estimates for adult body weight at harvest ranged from 0.313 in Experiment 1 to 0.003 in Experiment 2. In Experiment 3, average body weight did not differ between offspring derived from large sires and offspring derived from small sires.

Significant negative co-heritability estimates were observed between adult body weight and offspring survival in both Experiment 1 and Experiment 2. Significant negative co-heritability estimates between adult body weight and offspring yield were observed in Experiment 2 but not in Experiment 1. In Experiment 3, offspring derived from large sires had significantly lower survival and yield than offspring derived from small sires. These results show adult oyster body weight to be heritable but also subject to site-specific adaptation such that selection in the downriver environment was ineffective at changing average body weight in the upriver environment. Adult oyster body weight may be a poor indirect measure of oyster yield potential, and that selection solely for increased body weight could lead to a decrease in offspring yield.

Evans, S. (ford.evans@oregonstate.edu), Langdon, C. (2006). Direct and indirect responses to selection on individual body weight in the Pacific oyster (*Crassostrea gigas*). *Aquaculture*, 261: 546-555.

8. Summer mortality in Pacific oysters

The multidisciplinary project "MOREST" aims to improve our understanding of causes of summer mortality in *Crassostrea gigas* juveniles in France and to reduce its impact on oyster production. As part of the MOREST project, 43 full-sib families nested within 17 half-sib families were produced, planted out and tested in 3 sites during summer 2001 to assess to what extent genetic variability exists for this trait. Results indicated that selective breeding in a single site should be an efficient means of improving survival in oysters less than one year old along the French Atlantic and Channel coastlines with only very limited effects on growth. As yield mostly depends on survival and growth, this approach should significantly improve harvestable yield.

Degrernont, L., Ernande, B., Bedier, E., Boudry, P. (pierre.boudry@ifremer.fr) (2007). Summer mortality of hatchery-produced Pacific oyster spat (*Crassostrea gigas*). I. Estimation of genetic parameters for survival and growth. *Aquaculture*, 262: pp 41-53.

9. Juvenile oyster ration and subsequent performance

An experiment was performed to determine if dietary restriction in the nursery significantly affects the performance of Pacific oysters after two years in the field. Five out-bred full-sib families and three inbred full-sib families were created in August 2000, and reared under each of three feeding levels during juvenile development in the nursery. In June 2001, 40 individuals from each family-nursery treatment combination were stocked into net tiers and suspended in Yaquina Bay, Oregon, USA.

Although the effect of nursery feeding environment was detected even after two growing seasons in the field, the lack of a genotype x nursery environment interaction suggests differences in nursery feeding regime should not significantly alter relative field performance of out-bred oyster families. Significant rank changes were seen among inbred families; however, relative field performance should not be affected under all but the most stressful juvenile growing conditions.

Evans, S. (ford.evans@oregonstate.edu), Langdon, C. (2006). Effect of dietary restriction during juvenile development on adult performance of Pacific oysters (*Crassostrea gigas*). *Aquaculture*, 259: 124-137.

10. Pacific oyster growth in North Wales

Two sites in North Wales were compared for growth, survival, immunocompetence and gonad development of Pacific oysters. Juveniles were purchased as a cohort and placed in bags on trestles at the Menai Strait (MS, two heights on the shore) and the Inland Sea (IS) in the summer of 2003. Performance was examined as a function of several environmental parameters.

Both sites produced variations in growth, as assessed by dry weight indices and condition index, which were found to be lower at IS, where the animals were permanently immersed, than at MS, where they were emerged for at least 1 hour per tide (at the low shore height) and 4 h per tide (at the high shore height)

during spring tides. Condition index was also significantly higher at MS high shore than at MS low shore. Mortality was low at all sites, though an increase at IS at the end of the trial led to a significantly greater final percentage mortality of 15.6%. Gonad development was limited, particularly at IS where most animals remained undifferentiated. Gonad development was significantly higher at MS high shore than at MS low shore. At IS the temperature and chlorophyll a levels were higher than MS, however the phytoplankton communities were significantly different, with a bloom of *Prorocentrum micans* dominating at the Inland Sea for much of the experimental period. Differences in the hydrodynamics, as well as phytoplankton community appeared to be the only parameters that might cause a lower growth rate in the Inland Sea. The possibilities of *P. micans* having a sub-lethal effect on Pacific oysters are discussed.

King, J.W. (j.w.king@bangor.ac.uk), Malham, S.K., Skov, M.W., Cotter, E., Latchford, J.W., Culloty, S.C., Beaumont, A.R. (2006). Growth of *Crassostrea gigas* spat and juveniles under differing environmental conditions at two sites in Wales. *Aquatic Living Resources*, 19: 289-297.

11. Natural recruitment in Pacific oysters in France

The Pacific oyster, well known throughout the world because of its ability to adapt to a wide range of environmental conditions, was introduced for cultivation into France on a massive scale in the 1970s. With global warming, the reproductive population, confined at the beginning to the south of the French Atlantic coast, became established at more northern latitudes, and wild oysters began to colonize coastal areas such as our study site, Bourgneuf Bay, an oyster-farming area.

In the northern part of this bay, more than 70% of the total Pacific oyster biomass was composed of wild oysters (i.e. not bred by oystermen). The analysis of the spatial distribution of wild oysters indicated that 75% of the stock consisted of wild oysters in natural beds (rocky areas) and on low retaining walls of former fisheries. Wild oysters also colonized oyster-farming structures at a lower biomass (21% of the stock composed of wild oysters), but locally they could reach densities of up to 55 kg per square metre, i.e. 2.5 times the mean biomass of cultivated oysters. The economic and

ecological consequences of this colonization are discussed. Wild oysters seems to be the principal trophic competitor of cultivated oysters in Bourgneuf Bay. This may partly explain the decrease in growth of cultivated oysters observed in this bay during the last decade. Moreover, the trophic and spatial competition exerted by wild oysters may also affect the native biota and, in particular, the honeycomb worm *Sabellaria alveolata*. The results obtained in this study have led oyster farmers and regional authorities to modify oyster-farming practices and to destroy wild oyster stocks in concession areas.

Cognie, B. (Bruno.Cognie@univ-nantes.fr), Haure, J., Barille, L. (2006). Spatial distribution in a temperate coastal ecosystem of the wild stock of the farmed oyster *Crassostrea gigas* (Thunberg). *Aquaculture*, 259: 249-259.

12. Oyster Herpes virus in USA

Seed losses of Pacific oysters in Europe have been associated with an ostreid herpesvirus-1 (OsHV-1), and in 2002, a similar OsHV was detected in Tomales Bay, California, USA. In May 2003, 5 stocks of seed Pacific oysters were planted at 2 sites (Inner Bay and Outer Bay) in Tomales Bay and monitored for mortality, presence/prevalence of OsHV and growth. Temperature and salinity data were collected every half an hour at each site.

OsHV was detected at both the Inner and Outer Bay sites on the same sample date. Mean temperature predicted OsHV presence. OsHV presence predicted mortality. High levels of mortality occurred 2 wk (Inner Bay site) and 4 wk (Outer Bay site) after OsHV detection. Temperature maximums and overall temperature exposure were greater at the Inner Bay site and may explain why mortality affected these oysters sooner than oysters planted at the Outer Bay site. Differences in cumulative mortality were significant among stocks, but not between sites. OsHV prevalence was similar among stocks and between sites. Stocks with smaller oysters had higher mortality rates than those with larger oysters; growth rate did not correlate with mortalities.

Taken together, these data suggest that the OsHV may cause or act in synergy with temperature to kill Pacific oyster seed in Tomales Bay, but further investigation of OsHV etiology in seed oysters is needed.

Burge, C.A., Griffin, F.J., Friedman, C.S. (carolynf@u.washington.edu) (2006). Mortality and herpesvirus infections of the Pacific oyster *Crassostrea gigas* in Tomales Bay, California, USA. *Diseases of Aquatic Organisms*, 72: 31-43.

13. Bonamia - search for an intermediate host

The parasite *Bonamia ostreae* can be transmitted directly from infected to uninfected native oysters. Though direct transmission of the parasite can occur between oysters it is unclear if this represents the complete life cycle of the parasite, and the involvement of a carrier/reservoir cannot be ruled out. A survey of benthic macro-invertebrate and zooplankton survey was carried out in the North Channel, Cork Harbour, Ireland, an area where *B. ostreae* is endemic and the parasite has been present since the 1980s. This was compared to several European surveys of benthic macro-invertebrate and zooplankton species found in other *B. ostreae* endemic areas. The objective was to identify any species that were common to these sites and could act as possible carrier/reservoir hosts for the pathogen. Species that were found to be common in two or more sites were included in two comparison tables. These species will be targeted in future studies investigating the possible role of macro-invertebrates and zooplankton in the complete life cycle of *B. ostreae*.

Lynch, S.A. (s.lynch@ucc.ie), Armitage, D.V., Wylde, S., Mulcahy, M.F., Culloty, S.C. (2006). Inventory of benthic macroinvertebrates and zooplankton in several European *Bonamia ostreae*-endemic areas and their possible role in the life cycle of this parasite. *Marine Biology*, 149: 1477-1487.

14. Detecting Brown Ring Disease

The bacterium *Vibrio tapetis* is the aetiological agent of Brown Ring Disease (BRD), which affects the Manila clam. Two PCR assays for detection of *V. tapetis* were applied to a sample of 52 Manila clams, and evaluated in comparison with the more traditional *V. tapetis* detection method of microbiological isolation and characterization, as well as the traditional BRD diagnostic technique of shell valve analysis. The pathogen was detected in 15.4% of the sample using the PCR assay of Rodriguez et al., in 50% of the sample using the PCR assay of Paillard et al. and in 36.5% of the sample by microbiological methods. Shell valve analysis was the least sensitive technique, detecting

BRD in 7.7% of the sample. It was nevertheless an essential diagnostic tool because it was the only technique that identified the disease, rather than the aetiological agent. None of the four techniques was sufficient alone for effective BRD diagnosis; rather various combinations of two techniques were the minimum required. The combination of shell valve analysis with the assay of Paillard et al. proved to be the most sensitive and rapid method. Shell valve analysis was the most time-efficient and cost-effective technique, whereas microbiological characterization was the most time-consuming, and PCR detection, using either set of primers, the most expensive. These results may need to be considered in light of diagnosis and management of BRD.

Drummond, L.C. (l.drummond@ucc.ie), O'Reilly, P., Mulcahy, M.F., Culloty, S.C. (2006). Comparison of techniques for diagnosis of Brown Ring Disease and detection of *Vibrio tapetis* in the Manila clam, *Venerupis (Ruditapes) philippinarum*. *Journal of Shellfish Research*, 25: 1043-1049.

15. Tolerance of mussels to tidal exposure

The distribution of the blue mussel spans a steep gradient of environmental stress between inter-tidal and sub-tidal habitats. A 7 wk experiment of reciprocal transplant of mussels between the upper inter-tidal and sub-tidal portion of their natural depth distribution was carried out and then their tolerance to either aerial exposure or submerged hypoxia assayed in the laboratory.

Inter-tidal mussels transplanted to sub-tidal and back to the inter-tidal had a tolerance to aerial exposure 50 % higher than sub-tidal mussels that remained in the sub-tidal. That difference can be explained by changes in mussel physiology induced by ambient conditions, since the tolerance of mussels transplanted between the inter-tidal and sub-tidal became similar to mussels occurring naturally in each habitat. In laboratory tests, the tolerance of mussels to submergence in hypoxic water and environmental stress exacerbated by anthropogenic factors that experimental mussels had not encountered in the field followed a pattern qualitatively similar to the aerial exposure assay: inter-tidal mussels had higher survivorship in hypoxic water than those from the sub-tidal, and an elevated tolerance was induced by transplanting sub-tidal individuals to the inter-tidal. These results suggest that

the response of mussels to a change in environmental conditions could vary between the centre and edge of their depth distribution as a function of stress previously encountered.

Altieri, A.H. (altieri@neu.edu) (2006). Inducible variation in hypoxia tolerance across the intertidal-subtidal distribution of the blue mussel *Mytilus edulis*. *Marine Ecology-Progress Series*, 325: 295-300.

16. Mussel shell thickness and strength

The shell thickness and strength of the mussel were investigated across the season on the Exe estuary, SW England.

Collection and measurements of mussels across the season showed that the average ventral thickness of their shells increased from the end of September to mid-November and stayed constant till early December, and then significantly decreased and reached a minimum during mid-December. The initial increase is thought to be due to the selective predation of thin-shelled mussels by oystercatchers, but there is no evidence of any processes selectively removing the thick-shelled mussels. The subsequent decrease in average thickness must therefore be due to individual mussels becoming thinner. Furthermore, when mussels were smashed using an artificial oystercatcher bill, results indicated that even with the effect of ventral thickness taken into account, the strength was approximately constant until mid-January then increased and became strongest during mid-March. We suggest that the shell thinning is due to reduced estuarine salinity and temperature, with the increases in thickness at the beginning of winter and in strength at the end of winter due to selective predation by oystercatchers.

Nagarajan, R. (r.nagarajan@ex.ac.uk), Lea, S.E.G., Goss-Custard, J.D. (2006). Seasonal variations in mussel, *Mytilus edulis* L. shell thickness and strength and their ecological implications. *Journal of Experimental Marine Biology and Ecology*, 339: 241-250.

17. Tidal transport of mussel larvae

Larval transport is a key process in the recruitment of many marine species. It is strongly influenced by ocean currents, but the influence of behavioural traits of larvae (e.g. vertical migration) is poorly understood. In the absence of field data, predictions of population connectivity are often based on hydrodynamic models and assume that larvae behave as passive particles.

Variations in the vertical distribution of early and late stage larvae of *Mytilus* spp. were investigated in a field study in the Irish Sea. Larvae were homogeneously distributed throughout the water column during flood tide, whereas larvae were more densely aggregated in middle and bottom waters during ebb tide. Highest densities were greatest near the bottom during low flow conditions. Larval size had no effect on the patterns of vertical distribution of larvae in the water column. The relative lack of larvae in the water column during ebb tides compared to flood tides could lead to significant net transport in the direction of flood tides. If this is a widespread phenomenon, models based on the assumption that larvae behave as passive particles are unlikely to predict dispersal distances correctly.

Knights, A.M. (t.knights@ucc.ie), Crowe, T.P., Burnell, G. (2006). Mechanisms of larval transport: vertical distribution of bivalve larvae varies with tidal conditions. *Marine Ecology-Progress Series*, 326: 167-174.

18. Mussel hybrids

In Ireland, mussels on exposed rocky shores constitute an interbreeding mixture of two forms of mussels, the blue mussel, *Mytilus edulis*, and the Mediterranean mussel, *M. galloprovincialis*. Results from an Irish study in the 1980s, using partially diagnostic allozyme markers, indicated that mussels higher up the shore were more *galloprovincialis*-like than those lower down. In this study we set out to test two hypotheses: (a) recruits arriving on the shore are composed of genetically distinct cohorts that settle preferentially at different levels on the shore, and maintain genetic distinctiveness into adulthood; (b) recruits are genetically homogeneous, but once settled they diverge genetically over time, due to within-habitat site specific-selection.

Results did not support the preferential settlement hypothesis, i.e., the genetic composition of primary settlers was similar between tidal heights and shores. Neither was there evidence of post settlement selective mortality, as adults were genetically similar to settling spat. In spat and adults the frequency of the *M. galloprovincialis* allele was high, due to high frequencies of *M. galloprovincialis* (> 37%) and hybrid (> 33%) genotypes, and correspondingly low frequencies of the *M. edulis* genotype (< 11%). Adult mussels from a nearby sheltered estuarine site,

while significantly different to exposed shore mussels, still had low frequencies of the *M. edulis* genotype (< 17%), indicating no apparent advantage for the genotype in this environment. There are indications that the genetic composition of mussels may be changing on the Atlantic coasts of Ireland.

Coghlan, B., Gosling, E. (elizabeth.gosling@gmit.ie) (2007). Genetic structure of hybrid mussel populations in the west of Ireland: two hypotheses revisited. *Marine Biology*, 150: 841-852.

19. Age and growth of mussels

The aim of this study was to elucidate the impact of age and temperature on the metabolism controlling maximal size and longevity in the blue mussel *Mytilus edulis* L. from geographically separated populations of Northern European seas.

Mussels from the Barents Sea attain similar maximal sizes as animals from the warmer North Sea. Young animals (<5 y) grow faster in the North Sea, however, inshore Barents Sea mussels grow rapidly even at an advanced age. The slowest growth rates were found in a population exposed to strong wave action in the Barents Sea. Respiration rates followed the same age dependent pattern in mussels from all studied populations with low respiration rates in the youngest specimens followed by a rapid increase and then a gradual decline to nearly constant values in the oldest animals.

Sukhotin, A.A. (aasukhot@email.uncc.edu), Abele, D., Portner, H.O. (2006). Ageing and metabolism of *Mytilus edulis*: Populations from various climate regimes. *Journal of Shellfish Research*, 25: 893-899.

20. Mussels and birds

Increased abundances of a number of seabird species have been found in areas of mussel long-line aquaculture (compared to control sites) in a recent study at Bantry Bay, southwest Ireland. The aim of this study was to investigate whether this form of mussel aquaculture also affects the activity budgets and foraging behaviour of these seabirds. Scan-sampling was used to compare seabird activity budgets between three areas of mussel long-line aquaculture and three control sites. Foraging activities of Great-Northern Divers, an Annex 1 species under the European Union's Birds Directive, were also compared between sites using focal sampling.

The behaviour of gulls, Cormorants, Shags and Great-Northern Divers (but not auks) differed significantly between areas of mussel aquaculture and control sites. Gulls, cormorants and shags heavily utilized mussel suspension buoys as safe perching platforms for preening activities. Gulls also fed extensively on epifauna attached to the buoys. Great-Northern Divers spent more time snorkelling (head submerged in search of food) in mussel sites than in the control sites, however dive duration and visible foraging success rates did not differ significantly between sites. Overall, the environmental impact of mussel suspension culture appears to be positive or neutral on marine bird species occurring at this study site.

Roycroft, D. (d.Roycroft@ucc.ie), Kelly, T.C., Lewis, L.J. (2007). Behavioural interactions of seabirds with suspended mussel longlines. *Aquaculture International*, 15: 25-36.

21. Mussel parasites

In 2 field experiments in 2 habitats and at 2 tidal heights (low and mid inter-tidal), controlled infection of blue mussels serving as second intermediate hosts for larval stages (metacercariae) of the trematode *Renicola roscovita* resulted in significant lower growth of parasitized compared to non-parasitized individuals. However, tidal height had a stronger effect on mussel growth than parasitism, without any interaction between the 2 factors. The negative effect of *R. roscovita* metacercarial infections on mussel growth is thought to result from direct tissue disruptions, interference of metacercariae (located in palps and visceral mass) with food intake ability, and growth of metacercarial cysts within the host. Mussel growth was negatively correlated with the number of metacercariae, but this relation was significant only at the mid and not at the low inter-tidal sites. This may indicate that parasites act as background stressors that affect their hosts depending on additional environmental stress such as (e.g.) food shortage, desiccation and heat, which all increase with the increasing aerial exposure. The results of this study show that trematode infections can be an important determinant of bivalve growth, with potential economic implications for mussel cultivation.

Thieltges, D.W. (dthieltges@awi-bremerhaven.de) (2006). Effect of infection by the metacercarial trematode *Renicola roscovita* on growth in intertidal blue mussel *Mytilus edulis*. *Marine Ecology-Progress Series*, 319: 129-134.

22. Depuration of DSP toxins

Depuration or elimination of diarrhetic shellfish toxins (DST) was followed for 73 days in 1 and 2-year-old mussels. The age groups also differed in size, providing a broad approach to studying the effect of the differences in physiology accompanying the differences in size. Content of DST was analysed both on groups and individual mussels. Environmental variables were measured to evaluate their effect on depuration.

We found no significant differences in elimination rate of DST between 1 and 2-year-old mussels under natural conditions. This suggests that size and age do not affect the elimination rate of the DST. Natural variations in food levels and temperature were also found not to affect the elimination rate of DST. The digestive gland weights in the 1-year-old mussels increased four times while the DST content per individual decreased eight times. This demonstrated that dilution of toxins due to tissue growth could have an important contribution to declines in toxin concentrations. The mechanism of DST elimination is still unknown. If this process involves metabolism of the toxins, one could expect the rates of elimination to follow overall metabolic rates. However, the results from the present study suggest that large differences in growth rates, which also include difference in feeding and metabolic rates, do not affect the elimination rate of DST. Our results support the assumption that the depuration rates cannot be accelerated, even in artificial systems, as a cost-effective way to solve the problem of mussel toxicity.

Duinker, A. (duinker@nifes.no), Bergslien, M., Strand, O., Olseng, C.D., Svardal, A. (2007). The effect of size and age on depuration rates of diarrhetic shellfish toxins (DST) in mussels (*Mytilus edulis* L.). *Harmful Algae*, 6: 288-300.

23. Depuration of Domoic acid in scallops

The depuration kinetics of domoic acid from the king scallop was studied over 154 days.

The scallops, which had accumulated the toxins during a *Pseudo-nitzschia australis* outbreak, were obtained from a natural bed and hung from a mussel raft in two locations (front and centre) and at three depths (2, 6 and 10 m). The whole body depurated the toxin very slowly. This was driven mostly by the digestive gland, which accounted for about 95% of the total

toxin burden from the start of the experiment. Suspending the scallops from a raft increased the depuration rate of the whole body and digestive gland by 30% and of the edible tissues by 15%. Depuration rate of domoic acid seem to be related to temperature and salinity. Food amount does not seem to have any effect.

Blanco, J., Acosta, C.P., Marino, C., Muniz, S., Martin, H., Morono, A., Correa, J., Arevalo, F., Salgado, C. (2006). Depuration of domoic acid from different body compartments of the king scallop *Pecten maximus* grown in raft culture and natural bed. *Aquatic Living Resources*, 19: 257-265.

24. ASP blooms in Scotland

A phytoplankton monitoring programme was established for almost 3 yr at a coastal station in western Scottish waters to study the diversity and seasonal variation of *Pseudo-nitzschia* species in relation to physical and chemical parameters of the water column. Annually repeatable seasonal patterns of abundance of two groups of *Pseudo-nitzschia* were evident. In spring non-toxic *P. delicatissima* were dominant, while the *seriata*-group occurred mainly during the summer months. Summer to autumn blooms of both groups were composed of several species, including toxic *P. australis* and *P. seriata* and potentially toxic *P. pseudo-delicatissima*. Redundancy analysis indicated that 31% of the variance in *Pseudo-nitzschia* spp. abundance could be explained by the measured environmental variables. The repeatable annual nature of the blooms suggests that deterministic forecasting of the timing of future toxic *Pseudo-nitzschia* spp. events may be an achievable goal.

Fehling, J. (jf510@york.ac.uk), Davidson, K., Bolch, C., Tett, P. (2006). Seasonality of *Pseudo-nitzschia* spp. (Bacillariophyceae) in western Scottish waters. *Marine Ecology-Progress Series*, 323: 91-105.

25. ASP in Scallops - Ireland

Amnesic shellfish poisoning (ASP) has proved problematic in Irish king scallop fisheries, necessitating restrictions on the sale of fresh scallops (in-shell), which achieve a higher market price than frozen processed product. An investigation of variability in domoic acid (DA) concentration in king scallop from 69 sampling sites within a limited area off the southeast coast of Ireland was performed. Variation in DA concentration was examined in the whole area, within smaller sub-areas, with size, age, and water depth.

Mean DA concentrations in whole scallop ranged from 6.5 to 154.3 $\mu\text{g g}^{-1}$, with an overall mean of 40.6 $\mu\text{g g}^{-1}$. The concentration in gonad exceeded 20 $\mu\text{g g}^{-1}$ in 17 sites and in adductor muscle in 3 sites. Significant differences in DA concentration were detected between scallops from different sampling stations. Highest DA concentrations were recorded in inshore, shallow sites and lowest DA concentrations in deeper offshore waters. Significant positive correlations between DA concentration in hepatopancreas and scallop size were exhibited at inshore sites but not at offshore sites. High inter-animal and spatial variability in toxin concentration demonstrated the importance of a reliable sampling protocol for the management of ASP outbreaks to ensure public safety and to avoid unnecessary fishery closures.

Bogan, Y.M., Bender, K., Hervas, A., Kennedy, D.J., Slater, J.W. (john.slater@lyit.ie), Hess, P. (2007). Spatial variability of domoic acid concentration in king scallops *Pecten maximus* off the southeast coast of Ireland. *Harmful Algae*, 6: 1-14

26. ASP in Scallops – Isle of Man

Approximately 59% of the total value of all fish and shellfish landed in the Isle of Man comprises of king scallop, hence the economy of the Manx marine sector is particularly susceptible to impacts from Amnesic shellfish poisoning (ASP). Scallops from fishing grounds around the Isle of Man were sampled in October 2003, June 2004 and October 2004 to determine levels of inter-animal and spatial variability in DA concentration and factors that might influence toxin concentration such as scallop size and water depth.

Mean DA concentrations in hepatopancreas ranged from 296.3 $\mu\text{g g}^{-1}$ to below the detection limit, in gonad from 27.8 $\mu\text{g g}^{-1}$ to below the limit of detection and in adductor muscle from 7.3 $\mu\text{g g}^{-1}$ to below the limit of detection. High levels of inter-animal variability of DA concentration in hepatopancreas were recorded. Scallops from fishing grounds on the east of the Isle of Man were significantly less contaminated than those from the west and southwest. A significant positive correlation between DA concentration and shell length was recorded in some sites, but there was no relationship with water depth. The high inter-animal, spatial and seasonal

variability in toxin concentration highlighted the importance of understanding field variability for the development of reliable sampling and management protocols.

Bogan, Y.M., Kennedy, D.J., Harkin, A.L. Gillespie, J., Vause, B.J., Beukers-Stewart, B.D., Hess, P., Slater, J.W. (john.slater@lyit.ie) (2007). Variation in domoic acid concentration in king scallop (*Pecten maximus*) from fishing grounds around the Isle of Man. *Harmful Algae*, 6: 81-92.

27. Biotoxins and scallop cultivation

The impact of toxic outbreaks of *Gymnodinium catenatum*, producer of Paralytic shellfish poisoning toxins (PSP toxins) and *Pseudonitzschia* spp., producer of Amnesic shellfish poisoning toxins (ASP toxins), was studied throughout the culture cycle of the king scallop (length from 40 to 100 mm) from December 2001 to April 2003.

Several mortality events took place during the period studied, but none of them coincided either with an ASP or PSP outbreak or with long exposure of the scallops to these toxins. Post-spawning stress seemed to be the main factor responsible for mortality. No appreciable effect of ASP or PSP toxins on growth or reproductive state of the cultured scallops was found.

Blanco, J. (jblanco@cimacoron.org), Cano, J., Marino, M.D.C., Campos, M.J. (2006). Effect of phytoplankton containing paralytic shellfish and amnesic shellfish toxins on the culture of the king scallop *Pecten maximus* in Malaga (SE Spain). *Aquatic Living Resources*, 19: 267-273.

28. Effect of herbicides on oysters

Diuron is a substituted urea herbicide used for agricultural and non-agricultural weed control. Its widespread use and relatively slow breakdown led us to analyze its influence on aneuploidy level (lowered chromosome number in a percentage of somatic cells) and haemocyte parameters (to indicate stress) in Pacific oysters.

Significantly higher aneuploidy level was observed in diuron-treated oysters compared with the control. Furthermore, the observed impact on aneuploidy persisted to the next generation as offspring exhibited significantly higher aneuploidy levels when their parents had been exposed to diuron. Significant increases in haemocyte parameters of the adults were also observed after 4 weeks of diuron exposure.

Bouilly, K., Bonnard, M., Gagnaire, B., Renault, T., Lapegue, S. (slapegue@ifremer.fr) (2007). Impact of diuron on aneuploidy and hemocyte parameters in Pacific oyster, *Crassostrea gigas*. *Archives of Environmental Contamination and Toxicology*, 52: 58-63.

29. Oil spill toxicity

An evaluation of the toxicity of seawater and sand sampled from an area of the Galician coast (NW Iberian Peninsula), highly impacted by the Prestige fuel-oil spill, was attempted by using marine invertebrate embryogenesis bioassays with bivalves and sea urchins.

Sand elutriates were non toxic for embryos despite visual presence of small tar balls. In contrast, seawater from the most impacted site was highly toxic during the first days after the spill, with complete inhibition of embryogenesis even after 4-fold dilution. In a lower degree toxicity persisted for two months in light-exposed coastal water. These findings stress the impact of the less conspicuous and frequently overlooked water-accommodated fraction, rather than the more visible oil slick, to water column organisms.

Beiras, R. (rbeiras@uvigo.es), Saco-Alvarez, L. (2006). Toxicity of seawater and sand affected by the Prestige fuel-oil spill using bivalve and sea urchin embryogenesis bioassays. *Water Air and Soil Pollution*, 177: 457-466.

30. Effect of TBT on clams

In a waterborne exposure test, veliger Manila clam larvae (D-larvae stage: 24 h after fertilization) were exposed to TBT at measured concentrations of <0.01 (control), 0.055, 0.130, 0.340, and 0.600 µg/l for 13 d. The percentage of normal veliger larvae decreased significantly in all TBT treatment groups compared with that in the control group. In a maternal exposure test, 100 clams were exposed to TBT at measured concentrations of <0.01 (control), 0.061, and 0.310 µg/l at 20-22 °C for 3 weeks, and the percentage of normal veliger larvae assessed for 13 d. No maternal effects on veliger larvae from TBT were observed in TBT treatment groups as compared with the control group. These results demonstrate that waterborne TBT affects Manila clam veliger larvae, and indicates that TBT may have reduced Manila clam populations by preventing the development and survival of veliger larvae.

Inoue, S., Oshima, Y. (yoshima@agr.kyushu-u.ac.jp), Usuki, H., Hamaguchi, M., Hanamura, Y., Kai, N., Shimasaki, Y.,

Honjo, T. (2007). Effect of tributyltin on veliger larvae of the Manila clam, *Ruditapes philippinarum*. *Chemosphere*, 66: 1353-1357.

31. Effects of pearl mussels on salmon

Experimental infection of pearl mussel glochidia on the performance of Atlantic salmon hosts has been examined.

Infection intensity declined significantly 15 weeks after infection, to means of 50 and 112 per fish in two trial tanks and, by 6 months numbers were <1 per fish. This loss was attributed to fungal treatments with a combination of malachite green, which was still the authorised treatment during the study in 2001, and formalin. The weight of infected fish was significantly lower than controls at 15 weeks but this was not significant after 1 year. The condition factor of infected and naive fish was not significantly different and a stress indicator suggested no significant difference with controls either.

Fish that had been previously infected with glochidia were re-infected in their second year and comparison made with infection of naive fish to determine whether glochidial infection elicits an immune response. Although there was no significant difference in glochidial numbers in both groups at around 9,000 glochidia per host 3 weeks after infection, numbers of glochidia in naive fish did not change to 15 weeks after challenge, whereas there was a significant reduction in previously infected fish to 116 per fish. Various treatments were used to provoke closure of the glochidial valves. It is concluded that infection of salmon with glochidia levels in the current study had no significant effect on salmon performance, condition and stress.

Treasurer, J.W. (jim.treasurer@vikingfish.com), Hastie, L.C., Hunter, D., Duncan, F., Treasurer, C.M. (2006). Effects of (*Margaritifera margaritifera*) glochidial infection on performance of tank-reared Atlantic salmon (*Salmo salar*). *Aquaculture*, 256: 74-79.

32. Scallop spat collection

Over five million king scallop spat were collected in the North Water of Mulroy Bay in County Donegal, Ireland in the summer of 1979. This large natural settlement, by far the greatest number obtained at the time in any European trial, led to research investigations in 1980 and 1981 to support the development of this site as a scallop spat collection centre. A combination of gonad

monitoring, plankton sampling, spat settlement and spat collection trials were used to develop a technique for predicting the date of the scallop spatfall to maximize the yield of scallop spat.

A technique for forecasting the date of peak spatfall was developed, involving installation of spat collectors when the mean shell length of scallop larvae was 180 µm and 50% of the larval cohort exceeded this size. Unlike other sites studied, peak spat collection occurred at 4 m beneath the water surface. Since its development, this technique for prediction of the date of the peak collection has been used commercially. The development and application of this forecasting technique has assisted in the collection of millions of scallop spat for on-growing trials by the scallop culture industry.

Slater, J. (john.slater@lyit.ie) (2006). Development and application of techniques for prediction of the scallop *Pecten maximus* (L.) spatfall. *Journal of Shellfish Research*, 25: 795-806

33. Slipper limpets – good or bad?

The suspension feeding gastropod *Crepidula fornicata* was accidentally introduced with American oysters to Europe and was soon after claimed to be an 'oyster pest' although no evidence was provided in justification. Recently, small-scale experiments with *C. fornicata* and the Pacific oyster failed to prove competition. However, *C. fornicata* is impeding native mussels but at the same time provides protection against starfish predation. It also may serve as a sink for infectious trematode parasites and hence be beneficial for bivalves. Another positive effect of *C. fornicata*, especially in France, where it is superabundant, may be that it causes a shift of phytoplankton blooms from toxic flagellates to diatoms. Positive effects of invaders might thus occur with the same frequency as negative ones, and the general prejudice that introduced species exert a negative effect may be wrong. We argue that considering both negative as well as positive effects of an introduced species is needed to eventually enable us to evaluate the overall effect of an invasion.

Thieltges, D.W. (dthieltges@awi-bremerhaven.de), Strasser, M., Reise, K. (2006). How bad are invaders in coastal waters? The case of the American slipper limpet *Crepidula fornicata* in Western Europe. *Biological Invasions*, 8: 1673-1680.

34. Survival of trawled *Nephrops*

For economic and logistical reasons, an increased proportion of the landings from trawl caught *Nephrops norvegicus* is being used in the live export trade. This paper reports a series of trials that investigate the impact of capture method and trawl duration on the levels of stress, damage and mortality of *N. norvegicus*.

The stress of *N. norvegicus* captured during trials in spring and autumn by means of short trawl (1 h duration), long trawl (5 h duration) and creeling was assessed using a range of physiological measures, the immunological status and physical assessments (mortality, damage indices).

N. norvegicus caught by creeling were generally less stressed than their trawled counterparts. Increased duration of trawl did not significantly alter physiological parameters, while time of landing did have a significant effect as individuals landed in the morning exhibited some higher stress indices. Irrespective of the season in which trawling occurred, individuals captured by short trawls in the morning suffered lowest mortalities. Damage assessment data revealed that a greater proportion of individuals was categorised as heavily damaged following longer trawls conducted in spring.

Ridgway, I.D. (osx405@bangor.ac.uk), Taylor, A.C., Atkinson, R.J.A., Chang, E.S., Neil, D.M. (2006). Impact of capture method and trawl duration on the health status of the Norway lobster, *Nephrops norvegicus*. *Journal of Experimental Marine Biology and Ecology*, 339: 135-147.

35. Effect of cooking on microbiological contamination of mussels

Quantitative real-time reverse transcription and cell culture were used to determine the effect of heat treatments on norovirus and hepatitis A virus (HAV) in the New Zealand Greenshell mussel. Since it is common practice to cook mussels until the shells open, internal temperatures and opening times of mussels on boiling and steaming were determined at regular time intervals.

Our results show that when New Zealand Greenshell mussels open on heating, their internal temperature may not reach the parameters required for virus inactivation. Immersion for a minimum of 3 min in boiling

water rather than steaming is recommended to reduce the risk of viral food borne illness from contaminated shellfish.

Hewitt, J., Greening, G.E. (gail.greening@esr.cri.nz) (2006). Effect of heat treatment on hepatitis a virus and norovirus in New Zealand Greenshell mussels (*Perna canaliculus*) by quantitative real-time reverse transcription PCR and cell culture. *Journal Of Food Protection*, 69: 2217-2223.

Shellfish in the Press



New jobs for coastal Scotland

THERE are expectations that 141 new jobs will be created as a result of £3.7m of funding to improve and modernise fisheries and aquaculture businesses in Scotland's coastal communities, according to the Scottish Executive.

More than 453 full-time existing jobs will also be safeguarded in the companies supported by the funding.

Eighty-two projects will benefit from FIFG grants. It

is anticipated that the awards will trigger more than £13.4m in private investment across the sector.

The money will be used to make the sectors more sustainable and profitable by improving product quality and maximising the value of production. This investment will help to improve port infrastructure, upgrade processing plants and improve catch handling on vessels, the executive says.

Fishing News, 6 October 2006

Potting survey off Yorkshire coast

Recent years have seen increases in the numbers of velvet crabs along the east coast of England as well as the development of a small fishery, particularly off the Yorkshire and north Norfolk coasts. However, little is known about the distribution of the crabs and the nature of the fishery.

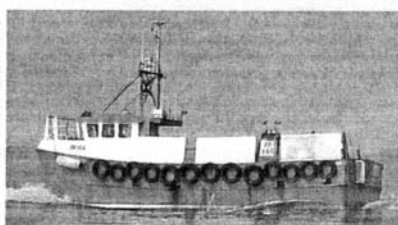
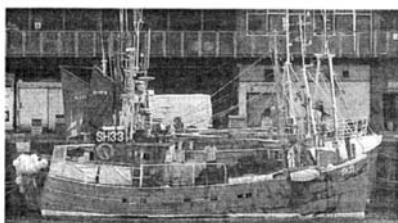
In many areas, velvet crabs have seemingly replaced either brown crabs or lobsters as the dominant species in the catch. The ecological relationships between velvet crabs and the other crustaceans are currently poorly described or understood.

Detailed information is required to understand the spatial distribution of velvet crabs in relation to the other commercially exploited crustaceans. Important information on the distribution and magnitude of velvet crab catches should emerge from the introduction in January 2006 of obligatory catch and effort returns from under-10m vessels under the shellfish licensing scheme.

This year, Bridlington fishermen collaborated with CEFAS scientists to initiate the first Fisheries Science Partnership (FSP) survey that utilised chartered commercial potting vessels deploying standard par-lour pots.

CEFAS staff accompanied the *Hollie J* (skippers Chris

Traves or Pete Sanderson) and *Magdalene Ann* (skippers Gary Hodgeson or Jason Smales) from 14 to 28 June



The *Magdalene Ann* SH 33 (top) and *Hollie J* FR 166 (above) both participated in the first FSP potting survey in June 2006.

2006 to carry out a potting survey between Flamborough Head and north of Spurn Point. An area around the

survey, whereas brown crab catches tended to be biggest

Estimated numbers of commercial sized velvet crab per fleet



Rough's gas field was also surveyed, taking advantage of the pre-survey positions of both vessels' gear.

Although the velvet crab was the main species of interest, catches of lobster and brown crab were also recorded. Velvet crabs were numerically more abundant in catches made in the northern and central parts of the survey area (see graphic top right), but analysis of size composition revealed that the southern portion, off Withernsea, would be commercially more important.

Reasonable catches of lobsters were also taken towards this southern part of the survey, whereas brown crab catches tended to be biggest

farther offshore, around the Rough's gas field.

Analysis of catches by pot suggests possible behavioural interactions among velvet crabs, brown crabs and lobsters of commercial size. For instance, in some areas lobsters and brown crab of commercial size were more likely to be taken in pots where few velvet crabs were captured.

In other areas, discarded or unsorted crabs were more likely to be taken in pots in which there were more than just a few velvet crabs. This last observation could demonstrate the patchiness of the distributions of both velvet crab and brown crab on favourable ground within certain areas.

This FSP survey has continued the established tradition of generating successful collaboration between fishermen and CEFAS. In this case, data on variations in and distributions of catches of velvet crab in the target area, as well as size compositions of other components of the catch, was provided. The data will be submitted to ICES in due course.

The owners, skippers and crew of the two vessels, as well as other/all CEFAS staff involved in the work, are warmly thanked for their contribution.

Full reports of all FSP surveys are available on the CEFAS website at www.cefasc.co.uk/fsp.

Fishing News, 20 October 2006

Licensing begins for shellfish gangmasters

FROM Monday 2 October 2006 gangmasters and others who use labour to gather shellfish can apply for a licence. They have six months before it becomes mandatory, the Gangmasters Licensing Authority (GLA) has announced.

The revised GLA standards incorporate specific health and safety obligations for anybody using workers to gather shellfish. This builds on the safeguards already in place to protect workers from exploitation in the agriculture and food processing and packaging sectors.

The GLA, set up to safeguard the welfare and interests of workers whilst ensuring labour providers operate within the law, will inspect all applicants against the revised standards and make checks with other government departments and enforcement agencies before a licensing decision is made.

Mike Wilson chief executive of the GLA said: "We accept that it will take some time for the new standards to be understood in this sector. We intend to use the next six months working with those affected to help them meet the standards, but if anybody continues to operate without a licence after 6 April 2007 we will not hesitate to prosecute."

The GLA website is at www.gla.gov.uk

Fishing News, 6 October 2006

Study of North East lobster stocks

A STUDY of lobster stocks is to be carried out on the coast of north east England to investigate their long-term viability.

The North Eastern SFC is carrying out the study, which will start early next year in the Humber estuary and Yorkshire coast area, where there is a big shellfish fleet, much of it based at Bridlington, now the country's biggest shellfish port.

The aim of the study is to assess the management options for the stock, and it will involve a comprehensive biological assessment of inshore and offshore lobster stocks and populations.

A full-time assistant will be appointed for 18 months to manage the fieldwork and data analysis. The project is funded by Scottish and Southern Energy, the new Langed North Sea gas pipeline, DEFRA and the European Fisheries Fund.

Fishing News, 27 October 2006

Sustainable shellfish on agenda at NI workshop

By Lynn Browne

DELEGATES from across the UK and Ireland travelled to Portaferry, Northern Ireland for the C-Mar Aquaculture Workshop on September 14 and 15. The main themes of this year's workshop were Sustainable Shellfish Aquaculture; Crustacean Aquaculture and Fisheries and Seaweed Aquaculture and Industrial Applications.

Exciting

Adele Cromie from C-Mar gave the first presentation of the shellfish session with an exciting and informative review of the SHARE (Sustainable Harvesting of Ensis) project. SHARE is an Interreg IIIB-funded project aimed at contributing towards the development of sustainable harvesting strategies for razor clams in the European Atlantic Area. The development of hatchery and intermediate culture technology for *Ensis siliqua* and *Ensis arcuatus*

represents a major component of the project and Adele described recent successes in the C-Mar hatchery where *Ensis siliqua* have been cultured from fertilised eggs up to shell lengths of 2 cm. Dr Edward Fahy of the Irish Marine Institute gave a fascinating insight into the effects of fishing (by fluidised dredging) on a razor clam bed at Gormanston, Co. Meath. He described the changes in species composition observed over an 8-year study period and his research highlighted the need for management of this resource in the Irish Sea.

The benefits of successful management of valuable shellfish resources were the feature of a presentation by Dr Andy Brand (Port Erin Marine Laboratory). Dr Brand's work on the use of closed areas for sustainable scallop fisheries in the Isle of Man dramatically illustrated the benefits of closing areas to fishing. He de-



Ensis Siliqua

scribed how the density and biomass of scallops increased in the closed areas and how evidence now suggests that the area acts as a spawning refuge, supplying larvae and juvenile scallops to surrounding fished areas. Dr Gavin Burnell presented work by his group in the Aquaculture Development Centre, University College Cork on culture of the purple sea urchin (*Paracentrotus*

lividus) in the UP System (patent pending). The land-based, modular system can be used to ongrow urchins to market size, maximising growth rates and gonad development in cultured animals. The group are also working on development of a seaweed-based compound diet, suitable for use in the UP system.

Interesting

Dr Paulo Prodöhl (Queen's University Belfast), chair of the crustacean session, gave an interesting presentation on microsatellite DNA profiling in the European lobster. Dr Prodöhl described how his team have been working with local fishermen analysing lobster V-notches and samples of fertilised eggs to monitor the V-notching scheme and its impact on local lobster stocks. The use of probiotics in homarid lobster culture was presented by Carly Daniels of the National Lobster Hatchery

in Padstow, Cornwall. Carly demonstrated how the use of these substances may have the potential to increase larval and juvenile survival during hatchery production.

The final talk in the crustacean session was given by Lynsey Patterson of Queen's University Belfast on stress responses to decapodising in the edible crab. Lynsey presented interesting data which showed that stress levels in crabs are increased significantly with removal of claws and this may have a negative impact on survival of the animals when they are returned to the sea by fishermen.

The annual seaweed session was well attended and post-graduate students from Queen's University Belfast presented results from ongoing research on seaweed aquaculture and on the use of seaweeds as biomonitors and as bioremediators of sewage effluent. Speakers from Canada and Ireland gave fascinating insights on the seaweed business from an industry perspective.

Fish Update, October 2006

Shetland investment for cod and mussels

SHETLAND Islands Council have backed almost £1 million (US\$1.88 million) in investment into the islands' aquaculture industry, helping to create a new era of growing cod and processing mussels.

The SIC's executive committee approved a £750,000 (\$1.4 million) stake in the cod hatchery run by Nufish Ltd, in Sandwick, to be purchased by public investment agency Shetland Development Trust (SDT).

The committee also supported a council grant of almost £100,000 (\$188,000) into mussel firm Demlane Ltd, which is promising to create 24 jobs and safeguard a further nine as part of a large development plan.

The Nufish investment follows a £300,000 (\$565,000) loan SDT made to the hatchery's parent company Johnson Seafarms in May to fit out a processing factory in Scalloway.

Johnson Seafarms, which is a world leader in growing organic cod, won a Soil Association award recently and was judged supreme winner of the Scottish Food and Drink Awards earlier this year. It is already

supplying major supermarket chains across the country, including Tesco and Sainsbury's.

SIC economic spokesman Drew Ratter said the trust's new stake, which must still be approved by the full council, represents 8% of the total value of the company, estimated at around £9.5 million (\$18.8 million).

"The rest of the money has been inward investment developing this industry and providing employment in Shetland," Ratter said. Nufish employs 14 people in Sandwick who supply Johnsons with 600,000 codlings a year to grow in sites all around the isles.

"This is a new industry for Shetland so there are risks involved in developing it, but having observed the progress made by the company so far we think this is the kind of risk we ought to take on."

Demlane was set up in 1995 by Jim and Joy Tait, but last summer it was sold to Isle of Shuna plc, based near Oban with offices in London, which had extensive background in mussel farming.

Fish Farming International, October 2006

Trials for new spider crab pot underway



Spider crab exercise is well under way in South-west England

A SEAFISH project to investigate the potential of using large pots and entrances to target spider crabs is now underway in the south-west of England.

Spider crabs are principally caught in the south-west by large mesh tangle nets and this new project assesses the potential of using crab pots instead. If successful, these pots could also bring conservation benefits by reducing the bycatch of unwanted species.

These pots are larger than the traditional lobster pots used by the region's fishermen, featuring a 40 inch base and a cone-shaped entrance diameter of 4 inches, compared with the 0-12 inch diameter bucket-shaped entrance used for brown (edible) crab and lobster.

These pots were originally constructed for fishing trials for deepwater red crab, which were carried out off the west coast of Scotland last year and are based on a design used in the Canadian snow crab fishery. As a number of these redundant pots were readily available, it was recognised that they provided the perfect opportunity for low-cost trials in a different fishery.

The trials commenced in April and have so far produced some promising, although mixed, results. Different bait-

ing methods and painting the entrances differing colours helped to show different levels of success in attracting and retaining the crabs. However, all trials to date have alleviated the by-catch and entanglement problems associated with the use of tangle nets.

The trials are continuing, with interim results of the projects now available.

For more information on the project contact Gus Caslake on 01736 362625, 07876035738 or email r_caslake@seafish.co.uk

If successful, these pots could also bring conservation benefits by reducing the bycatch of unwanted species

Fish Update, October 2006

Farming almost equals caught

NEARLY half the fish consumed as food worldwide are raised on fish farms rather than caught in the wild, says a new report from FAO.

The *State of World Aquaculture 2006* was presented to delegates from more than 50 countries attending the biennial meeting of the FAO Sub-Committee on Aquaculture in New Delhi.

While in 1980 just 9% of the fish consumed by human beings came from aquaculture, today 43% does, the report shows.

But levels of captures of fish in the wild have remained roughly stable since the mid-1980s, hovering around 90-95 million tonnes annually. There is little chance of any significant increases in catches beyond these levels, FAO says.

"Catches in the wild are still high, but they have levelled

off, probably for good," explains Rohana Subasinghe of FAO's Fisheries Department and Secretary of the Sub-Committee on Aquaculture.

This levelling off, coupled with a growing world population and increasing per capita demand for fish, spells trouble.

FAO's report estimates that an additional 40 million tonnes of aquatic food will be required by 2030 – just to maintain current levels of consumption.

"Aquaculture could cover the gap between supply and demand, but there are also many forces which could pull production in the opposite direction, making it difficult for the industry to grow substantially enough to meet demand in the decades to come," the report notes.

Aquaculture has been experiencing a boom since the mid-

1980s, sustaining a growth rate of around 8% per year. Today it continues to expand in almost all world regions, with the notable exception of sub-Saharan Africa.

But FAO is concerned that momentum could taper off if governments and development agencies don't adjust their policies to respond to emerging challenges that threaten to dampen the sector's future growth.

One serious bottleneck, says FAO, is the lack of investment capital for producers in the developing world. Another is a shortage of land and freshwater for use in aquaculture. Rising energy costs also pose a problem, and environmental impacts and questions of product safety continue to require attention.

The agency's report also points to doubts regarding future supplies of fishmeal and

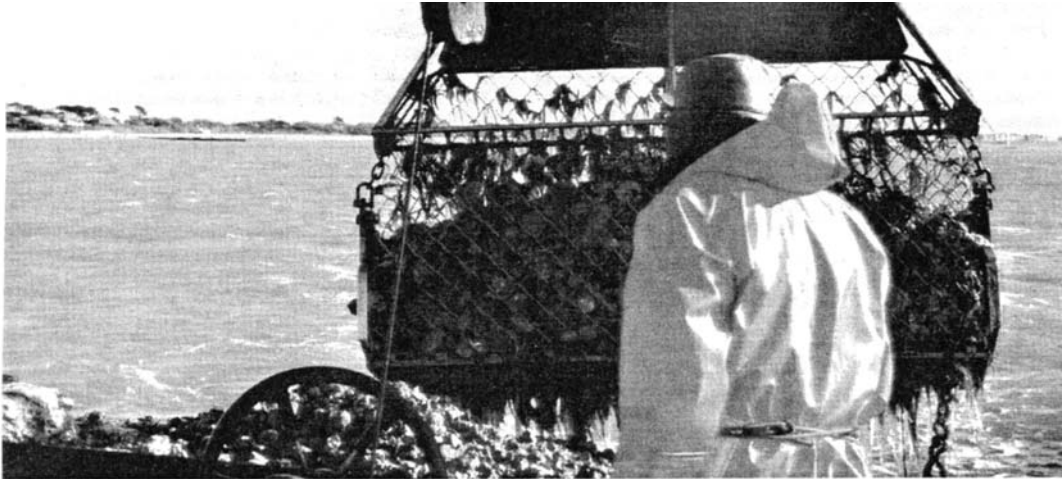
oil, used to feed carnivorous cultured species, such as salmon, grouper and seabream.

Since 1985, world production of fishmeal and fish oil has stabilised at 6 to 7 million tonnes and one million tonnes, respectively.

While the vast bulk of fishmeal is used for livestock feed, chiefly by the poultry sector, aquaculture now accounts for 35% of the world's fishmeal supply. So as aquaculture's fishmeal needs grow, competition with terrestrial livestock for a limited resource will intensify, with ramifications for both price and availability.

Key to resolving the dilemma will be continued progress in improving the efficiency of feed formulations – reducing the amount of fishmeal they contain – and coming up with adequate vegetable-based additives.

Fish Farming International, October 2006



Fifty boats fish Solent oysters

THE SOLENT oyster fishery, near Southampton, saw the new season get off to an excellent start after over 50 boats paid for licences last week, writes **Eric Edwards**.

The vessels which are licensed to work the regulated fishery, managed by the Southern Sea Fisheries Committee, began dredging for native oysters at 0800 on Wednesday 1 November.

The best catches of oysters were taken at the eastern end of the fishery and a fleet of vessels concentrated around the Portsmouth Spit area while another flotilla dredged off Lee-on-Solent and a few boats fished the public beds in Southampton Water and Portsmouth and Langstone Harbours.

Regular spatfalls east of Southampton water have boosted the stocks and many boats fishing this area

caught about a tonne of native oysters daily during the first few days of the new season, although catch rates will fall as the season progresses. Prices paid by local buyers are believed to average £1200 a tonne.

Fewer boats have purchased licences costing £450 each this season as stocks in the western Solent and in Langstone Harbour are low. This natural stock relies on good spatfalls for recruitment and these have been consistently better in the east than the western part of the fishery.

The SSFC's 42ft fishery patrol vessel *Southern Trident* monitored the first few days of the fishery and fishery officers did numerous boardings, using the RIB, checking for undersized oysters and ensuring every boat dredging is licensed.

The first part of the season will end on

22 December and the fishery will reopen on 26 February until 16 March 2007.

The Solent oyster fishery exploits one of the largest and most productive natural stocks of native oysters left in Europe. It covers over 100 square miles and includes regulated and several order areas and public beds.

Despite some 30 years' of regular exploitation, strict management by the SSFC and annual stock surveys by CEFAS scientists have sustained most of the fishery.

Solent oysters are sold for relaying and fattening at home and abroad. This sustained oyster fishery will produce a catch worth well over £1m and provide a decent livelihood for a few months for several hundred south coast fishermen who trawl or work pots during the rest of the year.

Fishing News, 10 November 2006

£8m facelift for Conwy

IT MAY be many years since anyone could describe Conwy as a thriving fishing port but it's far from down and out, writes **Stephen Lockwood**.

The old town quay is just nearing the end of an £8m EU-funded facelift that includes a one tonne hoist part funded by a fishing harbours improvement grant for general boat use as well as the local industry.

Martin Parry, a local crab-potter and director of the Conwy Mussel Company, said: "It has been a good summer and the mussel season has got off to a good start. There were not as many brown crab about as in most summers but the lobster fishing was very good. There were also plenty of smaller lobsters which bodes well for next year or the year after.

"Our traditional mussel markets continue to give us good support and we are supplying a new merchant in the Home Counties, which is very promising," said Mr Parry.

But not everyone is happy with the quay improvements and the crane. Second-homers who now own quayside cottages have complained the crane is an "industrial eyesore that will deter tourists".

"They forget the quay is a working area," Martin Parry said. "It will prove a great help landing mussels and for heavy work like bringing an engine



Fishing News, 24 November 2006

Secret life of lobsters

The private lives of lobsters may be hidden from most fishermen, but research in the UK and Canada reveals how those supposedly aggressive creatures will at certain times of their life become placid and gentle. Males even become subordinate to females at mating time, writes **Phil Lockley**. From the moment lobsters are shed from the eggs carried under a female's abdomen, they enter the world of plankton and the chances of those larvae reaching adulthood is

"as low as 0.005%," claims leading shellfish scientist Dr Eric Edwards.

When a mature female sheds her shell to grow, the male becomes protective and gentle towards an animal he would rather eat just a few weeks before or after.

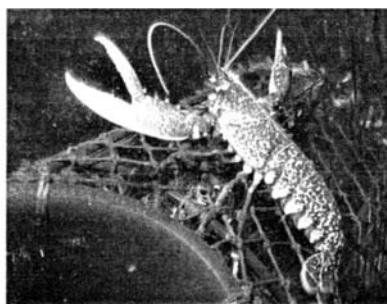
Courtship may take days but copulation takes just eight seconds. After a gestation period of nine to 12 months, more than 10,000 fertilized eggs normally hatch over a period of five nights that normally coincide with a full

moon.

Attraction to such light (also afterwards when they are attracted to daylight) is the biggest downfall of the early stages of a lobster's life! Having risen to the top three metres of water, where plankton food is most abundant, the lobster larvae are the prey of basking sharks, herring, mackerel, sprat and other pelagic species that feed on plankton.

The larvae go through a series of four moults and depending on weather conditions and the state of the tides they could be hundreds of miles away from the point of release.

At the post larval stage the juveniles will undergo a large change and begin looking like lobsters, measuring 5mm or so. Having dropped to the seabed to seek shelter, the young lobsters eat plankton to grow quickly before leaving cover to seek food.



Left: A lobster will moult over 20 times during the first five years of its life and each time it will gain about 15% of body weight and 50% of volume.

new body from the now fragile old shell and occasionally the lobster dies attempting this.

Also, body parts that are rigid like teeth inside the stomach that grind food must also be shed, so the lobster must rip out the lining of its throat, stomach and its anus before being completely free of the old shell; it is another time of high risk where many lobsters may die.

Once the animal is free of the old shell its body functions go into over-drive, stretching out the new shell. Once able to stand the lobster eats as much of the old shell as soon as possible and what it doesn't eat it burrows into the sand!

The word lobster is derived, say many, from the Old English word *loppestre* and experts reckon it is linked to the Latin word for locust, *locusta*.

To grow, the hard outer skeleton of a lobster must at times be shed. During the first five years of a lobster's life it will moult over 20 times and each time it will gain about 15% of body weight and 50% of volume. Once at the legal minimum landing size (MLS), the lobster is still an adolescent and moults about twice each year.

It then progresses to once per year until being relatively

old, when it may moult even less. Finding out the exact age of a lobster is very difficult, as each time it discards the old shell, any clues to its past are lost.

When ready to shed its old shell the lobster pumps liquid into its body, forcing the old shell to split lengthways at the top of its carapace.

After 20 minutes and aided by a self-made lubricant the animal must begin drawing its

Fishing News, 24 November 2006

French connection for oyster company

By Martin Syvret

SECURITY of access to market is a prerequisite for any business, so when one of the main ferry operators from the Channel Islands to France withdrew all sailings in the run up to Christmas last year, The Jersey Oyster Company decided to take things into their own hands to help ensure the continued viability of their business.

Jersey Oysters is Britain's biggest Pacific

oyster producer for the table market, producing about 500-600 tonnes annually as well as around 50 tonnes of bouchot mussels for the local market. Their proximity to mainland Europe gives them the ideal base from which to send their high quality oysters to a French market that is beyond the capability of the French themselves to fully supply. The traditional peak in oyster consumption by the French is over the Christmas and New Year period when half of their annual Pacific oyster production is consumed.

Consumption

When you consider that French production is 130,000 tonnes per annum then this puts the Christmas and New Year consumption of oysters in France at around 60,000 tonnes over the one to two weeks! As such, it was a major problem, for Jersey Oysters and other Jersey producers when at short notice in the run up to Christmas 2005, Emeraude Ferries withdrew their freight service between Jersey and France. It was at this point that Company Directors Chris Le Masurier and Steve Luce became convinced that if they were to continue to target the French market then they would need control of how their produce was transported.

An opportunity presented itself this year when

the old States of Jersey launch became available to buy. The launch, a 44 foot Nelson craft, was built in the Isle of Wight where it was used to take laundry to and from cruise ships docked in Southampton Harbour. It was purchased by the States of Jersey in 1983, where it continued in service up until 2004, carrying out a range of duties as their general harbour work vessel. The Duchess of Normandy as it was known, had the capacity to handle the regular shipments of shellfish to France that Jersey Oysters needed to make, and so in July, Jersey Oysters bought the launch and renamed her with the French title the 'Duchesse de Normandie'. Powered by twin six cylinder Perkins Sabre M265Ti engines the launch now makes the two hour journey between Jersey and Granville in Normandy on a weekly basis, carrying up to 4.5 tonnes of oysters at a time. The purchase of the Duchesse has allowed Jersey Oysters to continue to service the mid-week deliveries to their packer in France from where the oysters go to retailers, including the French Casino supermarket chain. Jersey Oysters are keen to maximise the potential of their position relative to France and are actively promoting their brand of high quality oysters on the French market.



Tractor and trailer with launch

Fish Up!date, November 2006

Getting to grips with scallops

ONE of Britain's most popular shellfish, the scallop, has been the target of a comprehensive processing training project, based in Scotland.

The project, funded by the Food Standards Agency (Scotland) and organised by Seafish, provides processors with a suite of training materials, developed in collaboration with the scallop industry, scientific experts and shellfish associations.

The packs are made up of an in-company training pack, a DVD and a scallop-specific version of



Martin Pyke and Lee Cooper of Seafish explain the process of shucking

Seafish's Introduction to Hazard Analysis Critical Control Points (HACCP) in the seafood industry training course. Processors also have the opportunity to benefit from associated visits from their local Group Training Association and access to free HACCP training for staff.

Sally Moore of the Fish Industry Training Association says scallop processors appreciate the opportunity to use the free training materials.

Learn

"Even the larger, more established companies can learn something new and important from participation," she said.

Training Development Team Leader at Seafish, Lee Cooper, says the training has been rolled-out to the majority of Scottish scallop processors.

"By the end of the project, we expect to have contacted 100% of the scallop processors in Scotland, visited 80% of those that shuck scallops, and have delivered 14 HACCP courses."

At recent workshops delivered by Seafish and FITA, information on marine biotoxins, practical methods of processing safer scallops and progress with the project were presented to FSA officers working in the fish industry.

Scallop processors outside of Scotland can also obtain a free copy of the training materials, by contacting Lee Cooper at Seafish. Email: training@seafish.co.uk or telephone 01482 327837.

**Fish Farmer,
November/ December 2006**

Science and regulation hot topics at shellfish conference

An international mix of leading shellfish-growers, government policy-makers and microbiologists aired their differing views at the ASSG conference.

THE relationship between science and regulation in the shellfish sector came under the spotlight at the Association of Scottish Shellfish Growers' annual international conference.

Held in Oban on October 26 and 27, the conference was attended by around 110 delegates and featured speakers from the UK, Europe, South Africa, Chile, the USA and Canada.

Aim

Opening the conference, ASSG chairman Doug McLeod said the aim of the two-day event was to debate and contribute to improvement in relationships between scientific researchers, policy-makers and regulators, in the context of the shellfish sector.

"There is no doubt that Europe lags behind the US, in investment in R&D," he said. "In addition, much basic research is carried out in universities in both continents, yet in an international league table compiled by the University of Shanghai, 25 of the top thirty places were occupied by American universities (of the other five, four were in the UK and one was in Switzerland).

"This is true across the spectrum of subjects, including aquaculture. So we must ensure that our limited research resources – e.g. in FP7 – are used in the most effective, problem solving manner.

Problems

"I think that industry knows what it wants – science that will address our real problems in a comprehensive and pragmatic fashion; policy that will be rational, and support good practice and economic development; regulation that will be effective and appropriate in impact reflecting credible risk assessment and risk management parameters."

During the course of two days, presentations focused on issues including biotoxins, microbiology, hygiene and food safety, shellfish resource management and transfer of alien species.



Pictured back, from left to right: Jacques Fuchs, Sebastien Chantreau, Roberto Flores Aguilar, Klaus Schallie, Gavin Burnell, Bill Dore, Monique Pommepuy, Liz Turrell, Doug McLeod. Front: Ron Lee, Doug McKenzie, Ngairé Dennison, Dorothy Leonard, Lorna Murray, Manuel Franco Leis.

**Fish Farmer,
November/ December 2006**

Consultation on Conwy mussels

A CONSULTATION meeting for renewal of the Conwy Mussel Regulating order was well attended by local fishermen last Monday week, reports **Stephen Lockwood**.

The 60-year-old order expires in 2008 and North Western & North Wales senior fishery officer Greta Hughes is preparing the draft application for renewal.

The existing regulating order limits fishing to hand picking or the use of a hand-rake from an un-powered boat working in not less than 1m of water.

Among proposals for modifying the order is the idea of allowing the use of small dredges. Also discussed was applying for a hybrid fishery order which might allow for an extension of the fishery area to include an order across Conwy Bay adjoining the regulated fishery area.

Fishing News, 8 December 2006

M&S £1K helps Cornish lobsters

MARKS & SPENCER has come to the rescue of the National Lobster Hatchery in Padstow through a donation of £12,000.

It will enable the hatchery to continue producing thousands of juvenile lobsters and develop its groundbreaking research into lobster culture.

The donation will go towards the salary of the hatchery's senior technician and reflects M&S's ongoing support of sustainable fishing practices.

Since opening at the start of the millennia the hatchery has released over 38,000 juvenile lobsters into the waters around Cornwall.

Dominic Boothroyd, general manager of the hatchery said: "The generous donation from Marks & Spencer will make a huge difference to us."

Andrew Mallison, fish specialist, Marks & Spencer said "We've been impressed by their work for many years and we know its making a real difference.

"If it wasn't for the hatchery, local lobster fishermen wouldn't have enough stock to catch, visitors to Padstow would not get an insight into fishery conservation and our future generations might not get the chance to enjoy the tasty delights of real Cornish lobster."

M&S was recently named by Greenpeace as, the best retailer in the UK for sustainable seafood sourcing for the second year running.

Fishing News, 15 December 2006

Shellfish doesn't raise cholesterol

FOR two decades there has been debate on whether those seeking to reduce their cholesterol levels should stay clear of shellfish but finally the question has been settled once and for all.

Following a wave of studies and lobbying from industry, official advice to avoid dishes like prawns and mussels has been reversed on the government's NHS Direct website.

Before last week the website – used by millions of Britons – included seafood among a list of items that were causes of high cholesterol, but it now emphasises that what is important is low fat foods and not any cholesterol they naturally contain.

SAGB director Dr Clive Askew said: "You are now witnessing the death throes of the myth, the idea of shellfish being a cholesterol risk."

Professor Bill Lands in the USA said the way the public has been misled over the question of cholesterol in the diet is a tragedy of scientific miscommunication.

"There never was any evidence that cholesterol

in shellfish was in any way a risk to your heart. Indeed in countries like Japan, where people eat lots of shellfish, cholesterol is not an indicator of heart disease risk," he said.

Canada had rejected the idea in 1988 and in French speaking countries the idea is ridiculed.

They have never strayed from the idea that shellfish is good for you.

Although some shellfish contain cholesterol they are low in saturated fat and leading nutritionists say it is clear that the low-fat, low-calorie qualities of shellfish, including prawns, are more important and generally beneficial to healthy eating.

Prof Lands says maintaining an adequate omega-3 level in the diet is the surest way of avoiding heart disease and also helps avoid other inflammatory diseases.

For the majority who need to reduce their cholesterol, shellfish is simply not a problem and for most with high cholesterol they would be better off by including shellfish in their diet than by excluding it.

Fishing News, 15 December 2006

South Wales V-notch success

LOBSTER V-notching in South Wales has been a great success, says the South Wales SFC.

In 2005, after a delayed start due to the large cockle fishery, some 5431 lobsters were released.

Then, in 2006, concerted efforts by SWSFC fishery officers working closely with local fishermen and merchants led to a further 22,168 V-notched lobsters, making a total of 27,599 lobsters being returned to the sea which would otherwise have found their way to market.

SWSFC director, Phil Coates, said: "To have exceeded our target release numbers a year early is a tremendous achievement and a testament to the efforts of

fishery officers and fishermen alike.

"The industry has wholeheartedly endorsed the scheme and pulled together to make available large numbers of lobsters.

"This has helped keep the costs down to a bare minimum and allowed more lobsters to be released in the summer when prices are lowest, thus providing maximum value for money. In fact, the advanced release of next year's lobsters will add an extra spawning and further boost to spawning stock."

SWSFC now aims to try to buy more lobsters in 2007.

Some extra scientific work is also being undertaken, and paid for and returned lobsters are being banded and/or tagged. The blue or

white claw bands (according to area of release) allow fishermen to identify V-notched lobsters more easily and their general movements to be tracked.

One thousand lobsters will also have an individually numbered orange streamer tag attached to their underside. This will allow the movements of individual animals to be tracked as they are recaptured and reported.

Dr Andy Woolmer, biologist for SWSFC, said that although it was still early days, it appeared that a number of animals had moved south to be caught by North Devon fishermen, perhaps augmenting the lobsters within the established 'no take zone' at Lundy Marine Nature Reserve. The SWSFC

website will periodically record these findings.

In April 2005 the SWSFC was granted £336,816 – 75% from EU FIFG and 25% from the Welsh Assembly Government (WAG) – to finance the V-notching scheme in 2005, 2006 and 2007. But Phil Coates warned that this aid could be put at risk if the WAG absorbs the Welsh SFCs, as it has proposed.

This could mean that either the capacity to do such work would disappear, or the WAG would not be able to apply for grants in currently matched funds.

"We are seeking reassurances from the minister that such important work will be allowed to continue," he said.

Fishing News, 15 December 2006

Marine Institute hosts international shellfish safety workshop

■ Focus on monitoring of naturally occurring biotoxins

INTERNATIONAL experts joined with their Irish colleagues at the invitation of the Marine Institute in Galway to attend a two-day workshop aimed at monitoring naturally occurring "biotoxins" in Irish shellfish.

Experts from the US, Japan, Canada, Norway and Italy joined representatives from the Marine Institute, the Department of Communication, Marine and Natural Resources (DCMNR), Bord Iascaigh Mhara (BIM), the Food Safety Authority Ireland (FSAI) and the Irish shellfish industry itself. Together they focused on the problem of Azaspiracids - a group of compounds produced by naturally occurring plankton which was discovered in Ireland in 1995, following human illness from shellfish consumption.

A three-year NDP funded project, which has just been completed by the Marine Institute, in collaboration with the Conway Institute, UCD, and international collaborators, has carried out vital research to un-

derstand the problems caused by this group of compounds.

As a result of this project, Ireland has been able to implement strict quality control procedures for the harvest of shellfish from Irish waters.

These procedures have in-

creased international confidence in shellfish produced in Ireland, contributing to the growth of the shellfish industry over the last few years.

The workshop took place from October 31 to November 1.



Photo by David Bannigan - AquaSport

Strict quality control procedures are in place

Fish Update, December 2006

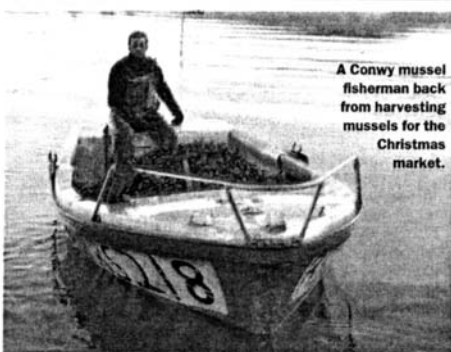
Health OK boosts sales of shellfish

SALES of prawns and other shellfish were reported to be brisk over the Christmas and New Year celebrations as consumers sought a change from poultry and moved to a healthy seafood diet, writes **Eric Edwards**.

At Billingsgate market in London and at the major supermarkets, sales of both coldwater and warmwater prawns rose significantly after publicity in the national press that the Government Health Authority now includes prawns as part of a healthy diet.

This U-turn follows protracted negotiations between the Shellfish Association (SAGB), the Department of Health, and Heart UK, which cracked the myth that the cholesterol in prawns and other shellfish should be avoided by people trying to reduce their blood cholesterol levels.

Shellfish like prawns, oysters and mussels, which are low in saturated fats and contain essential Omega-3 oils and minerals like iodine, zinc and selenium, are now recommended by NHS Direct and others as part of a healthy



A Conwy mussel fisherman back from harvesting mussels for the Christmas market.

diet.

Writing in a recent SAGB Newsletter, the association's assistant director Dr Clive Askew states that the seafood industry has a major challenge to re-educate the medical profession and the general public with the fact that people with high cholesterol levels can still enjoy prawns and other shellfish as part of a healthy diet.

Demand for oysters in 2006 has also been the strongest for many years. Better sales are also linked to

the trend towards eating more seafood as part of a healthy diet and improved confidence in eating and handling bivalve shellfish.

Pacific oysters provide most of the supplies, which come from farms in Scotland, Essex, Cornwall and Poole Harbour. During the year, Billingsgate sold over a million oysters and most supermarket counters now sell live Pacific oysters at around 50p each.

One of south east England's main oyster suppliers - the Maldon Oyster and Seafood

Company - graded and packed about 100,000 Pacific oysters for sale at Billingsgate and top restaurants in London during the 10 days around Christmas and the New Year.

Director David Coward-Talbot told *Fishing News* that their oyster sales were up on last year and his staff of six had a job keeping up with the extra demand.

Scottish rope grown mussels dominated the fish counters at the supermarkets. Traditional mussel fishermen

like those at Conwy, North Wales, also reported good sales over the holiday period.

Youngs Seafood reported that the UK seafood industry has shown consistent growth, including a 5% rise in value in the past year and it was recorded as being worth a staggering £1.94bn in 2006.

British retailer Waitrose reported that for the first time in a decade, fish and shellfish is outselling chicken at its stores and has shown a 20% increase in sales.

Fishing News, 12 January 2007

MSC clarifies its certification standards

THE MARINE Stewardship Council (MSC) is seeking public comment to clarify the 23 criteria that form the backbone of its environmental standard for sustainable fishing.

It is publishing 23 'draft intent statements' – short, technical paragraphs that seek to help everyone involved in MSC fishery assessments to have clear expectations and a

common understanding of what sustainable fishing looks like in practice.

The draft intent statements were developed in 2006 through consultation workshops around the world and are available online at the MSC's website: www.msc.org

Once finalised, the intent statements are expected to:

■ Improve the clarity of the MSC's environmental standard.

■ Help fisheries interests understand what certification bodies will be looking for during the assessment process.

■ Facilitate the participation of stakeholders during the assessment process.

■ Improve clarity for certification bodies during the preparation phase of assess-

ment.

■ Help expert assessment teams score fisheries consistently, whatever the fishery's size, type or location.

"The statements will improve the transparency and consistency of fishery assessments against the MSC's environmental standard," says Rich Lincoln, the MSC's International Policy Director.

Fishing News, 26 January 2007



Fal oysters promotion

THE TRURO Oyster Fishery Management Group is hoping to increase exports to the Continent of sustainably caught and high-quality Fal Oysters. This follows a recent visit to Italy for Slow Food's biennial conference, 'Terra Madre', which draws over 6500 participants from all over the world.

The Slow Food organisation was founded in 1989 to counteract fast food and protect the diversity of food, tradition and culture.

In 2003, the oyster fishermen formed a group with local buyers and the River Fal oyster fishery regulator, Carrick District Council. The group manages the

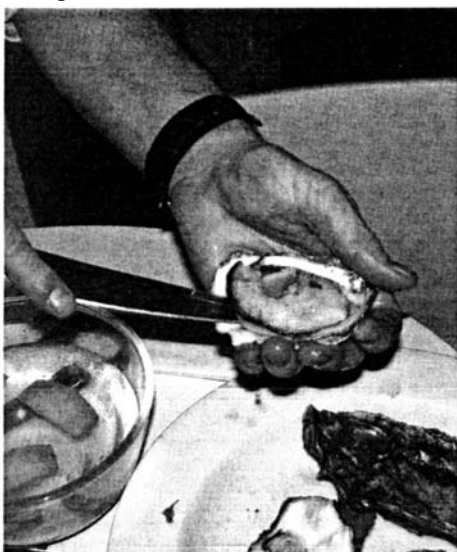
fishery and has recently accessed support and funds from the South West Rural Enterprise Gateway (SWREG) project and support from Cornwall County Council to help them market the product to wider audiences.

Evonne Amblin, Business Link project officer for SWREG Fisheries, said the work the group was doing was important for the Fal oyster fishery's future.

She said: "At one point there were around 80 boats fishing on the Fal estuary, then in the 1980s disease caused stocks to plummet. The fishery is slowly recovering and currently there are about a dozen fishermen as supplies gradually increase."

Fishing News, 26 January 2007

Oyster farmers flat out to meet Christmas demand



CHRISTMAS brought an oyster bonanza to Scotland's shellfish farmers, who faced the biggest demand for oysters ever.

Sales of oysters normally run at around five tonnes a month. But during the week before Christmas, the Scottish Shellfish Marketing Group (SSMG) farmers received orders for nearly 10 tonnes of oysters to be shucked and slurped at Christmas parties throughout the UK and, surprisingly, Switzerland.

Scottish oysters have one major advantage over their overseas competition – they

are always in season. The Pacific Oyster spat is grown in waters along the West Coast of Scotland.

Donny Gillies, SSMG Managing Director said: "Oyster farming at Christmas is like a military operation. Unlike turkeys which can be prepared weeks in advance and kept chilled, Scottish oysters have to be extremely fresh – and everyone wants to eat them on December 25th!"

"As the water in Scotland that the oysters are grown in is always cool, the oysters grow at a slower rate, ensuring a better quality product."

"Oyster farming at Christmas is like a military operation"

Fish Update, January 2007

Coping with summer mortalities

THERE is no doubting the fact that producing good quality Pacific oysters is hard work. So when you spend all year turning, shaking, grading, making bags and racks, freezing, sweating and dealing with many other trials and tribulations just to throw 30% of your stock away, the thoughts of becoming a monk or aquaculture journalist often enter your head.

I have been producing Gigas for 20 years and until the last four years, have been selling 80-90% of spat purchased as 70g plus oysters; this was until summer mortalities struck. It is a problem that is easy to recognise, but hard to diagnose and soul destroying to live with.

CEFAS were very helpful, testing stressed and dying oysters, monitoring water temperature and passing on information from IFREMER and BIM. Spawning, oxygen shortages, water temperature, lack of food, disease and stress from man handling and densities are all obvious culprits.

Spawning didn't seem to be a problem as they were milky but had not spawned; in fact the meats looked very fit. Oxygen supply and water temperatures would be linked as the water's ability to hold oxygen declines as it warms up. Problems seemed to start as the daily average reached 17 degrees.

Food supplies are difficult to monitor, but the condition of the shellfish surely showed a plentiful supply; if the feed dropped off why did the oysters not reabsorb some of their condition to survive? Even on neap tides there is a strong current flowing through the bags, which I would have thought provided plenty of water for oxygen and food demands.

Testing showed no disease problems. I am the only producer here and have only used spat from one hatchery. This estuary is also very remote from other oyster producing waters. I tried not touching an area of racks after May 30; these suffered the same mortalities as the rest, so handling did not seem to be a major problem, especially when very hot weather was avoided.

Do genetics play a part? In land based livestock farming this can be the case with some problems, but I believe this is not proven in oyster farming.

Intensive agriculture has usually paid better than extensive, and having run a fairly intensive dairy farm. I took the lessons learned there into aquaculture. Making the best use of rack space, foreshore and bags seemed to be the obvious course of action, so I piled as many oysters as seemed sensible on to each rack and this seemingly worked well while total numbers were moderate. As numbers quadrupled, problems started and I couldn't turn to drugs, feed and fertiliser suppliers, or alter the environment artificially to solve them as I did on the farm. Extensive cows may not have made as much money as intensive, but they are generally easy care and healthier, so I have kept the number of shells the same, but have had to double my rack space by opening a new site in another area.

I hope I am not tempting fate, but this year has seen a drastic decline in mortalities. The man at the end of the road who puts candle wax in the dead shells and sells them for £3 each to holiday makers as souvenirs is looking very thin, thankfully. Growth rates are very good on this river, so it is my belief that fast growing, larger, milky oysters coming up against a sudden drop in oxygen and maybe nutrients in an overcrowded situation, could not cope. This may just be a year without mortalities or, possibly, the drastic husbandry changes may have worked; only time will tell.

Please email me with your comments or experiences: timmarsh58@hotmail.com

**Fish Update, January 2007
Grower Focus - Tim Marshall**

A better way to gather mussel seeds

A DUTCH mussel company and a Netherlands research institute are working on a project to gather mussel seeds in a more efficient manner by use of mussel seed collection installations (MSCI).

In 2003, Koninklijke Prins & Dingemanse from Yerseke started research in cooperation with research institute TNO in the Malzwin near Den Helder into the biological, technical and commercial feasibility of MSCIs.

The purpose of this is to catch seed mussels in a responsible manner in order to partly compensate for shortages of seed mussels.

Initially, the research used six installations, but next season the MSCI will be expanded in accordance with the project plan to 60 installations. A subsidy has been granted for this project plan by the Netherlands Ministry of Agriculture, Nature and Food Quality.

The customary method of stocking up the mussel-breeding sections is the fishing of natural seed mussels on seed mussel beds.

These seed mussels, which are in fact small mussels 1cm in size, are then laid on sections belonging to the mussel farmers so that they can grow further.

This method has been used for more than 100 years. However, there are years in which nature provides too few or no seed mussels. With the help of the new innovative method of obtaining seed mussels, a fixed supplement to the (sector-wide) need for mussel seed can be provided for.

The seed mussel collection installations consist of nets on floats which are set out in the Malzwin. Mussel larvae, which are swimming alongside the nets, attach themselves to the

nets and grow into seed mussels. This mussel seed is then retrieved from the nets and planted in the breeding sections.

A new ship will also be deployed as part of the expansion of the project. This ship is unique for the Netherlands and is a multifunctional aquaculture ship which will be specially adapted in order to be able to carry out the various MSCI activities.

Among other things it will be fitted with spuds with which the ship can anchor itself, a patented harvesting machine, a special propulsion and several cranes. Because the MSCI company is located in the north, a home port will be sought for the ship in this region.

In the 1980s the Netherlands was in second place as mussel-breeding land in Europe with an average landing of 100,000,000kg. It is now in 8th place with an average landing of 50,000,000 kg and is the only country with a declining production. Other countries show an annual increase.

The MSCI company supplies as yet only a few percent of the 60,000,000 kilograms of seed mussels needed annually. As a result of further improvements in the collection and harvesting system and optimisation of the mussel-breeding sections it is expected that this percentage will increase further.

In the future, a Dutch mussel breeding and trading industry will be created with this, together with the traditional mussel fishing, with which the Netherlands will regain its high position in the sector and employment in Zeeland and the Northern provinces will be positively influenced.
■ info@prinsdingemanse.com

Fish Farming International, January 2007

Sandia research focus on harmful algal blooms

US-BASED Sandia National Laboratories researchers Todd Lane and Victoria VanderNoot have been awarded a research grant to develop a technology that can successfully detect deadly toxins from harmful algal blooms (HABs).

The funding is provided by the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), a partnership of the National Oceanic and Atmospheric Administration (NOAA) and the University of New Hampshire.

Lane and VanderNoot, a molecular biologist and an analytical chemist, respectively, are both in the Biosystems Research department at Sandia's Livermore, California, site.

In addressing the HAB problem, they will employ laser-induced fluorescence and other separation methods inherent in Sandia's μ ChemLab ('Micro' ChemLab) technology.

Along with a small team of Sandia colleagues and external collaborators, they have commenced with the research, which could lead to longer-term funding after the initial 'proof of principle' work has been completed.

Harmful algal blooms are widely acknowledged to be a severe coastal resource management issue, adversely impacting virtually every coastal region.

Current methods for detecting the poisonous toxins characteristic of the blooms are cumbersome, require either expensive reagents or animal testing, or are unable to quantify toxins — critical information for managing shellfish beds. The technologies under development at



Sandia researchers Todd Lane (left) and Victoria VanderNoot are leading an effort funded by NOAA and the University of New Hampshire to detect deadly toxins from HABs

Sandia would eliminate these problems.

"Today's standard detection methods, frankly, are too slow and labour-intensive," says Lane. "By the time the process is complete, it's too late: the shellfish beds are already toxic."

The ability to quickly sample organisms low on the food chain, Lane says, can provide an early warning system to help protect communities from exposure to toxins.

Most species of algae are not harmful and actually serve as the energy producers at the depths of the food web. The dense patches (or blooms) that sometimes accumulate near the surface of the water, however, can produce potent neurotoxins that are then transferred through the food chain, accumulating in zooplankton and shellfish, eventually harming or even killing marine mammals and

humans that consume tainted shellfish.

Sandia's research will focus on enhancing the early-warning capability of detection and is expected to lay the groundwork for the development of a reliable, cost-effective prototype to simultaneously analyse multiple HAB toxins in phytoplankton and/or shellfish in the field.

Lane and his colleagues will aim to optimise the micro-separations process for a sub-set of relevant toxins, and establish the laboratory-based protocols for sample preparation.

The long-term goal, should the initial phase of the Sandia research go as planned, is to develop small, lightweight devices that could be fielded by oceanographers and marine biologists as part of their regular monitoring systems.

In addition to Sandia's Lane and VanderNoot, collaborators include Donald M. Anderson, a senior scientist and director of the Coastal Ocean Institute, Woods Hole Oceanographic Institute; and Gregg Langlois, marine biologist at the California Department of Health Services.

The technologies developed under this effort will be equally well suited to detecting algal toxins in freshwater sources and complements other ongoing Sandia research.

Sandia is a multi-programme laboratory operated by Sandia Corporation, a Lockheed Martin company, for the U.S. Department of Energy's National Nuclear Security Administration. Sandia has major R&D responsibilities in national security, energy and environmental technologies, and economic competitiveness.

■ www.sandia.gov/water

Fish Farming International, January 2007

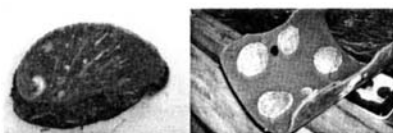
Abalone development - moving at a snail's pace?

By Martin Syvret

THE abalone or ormer is a high value marine snail that has long attracted interest from aquaculturists. Despite the promise it holds for fisheries diversification and wealth creation for the rural economy, progress has been slow. However, the South West Abalone Growers Association (SWAGA) has been working hard to identify the key environmental, technical, regulatory and legislative issues limiting the development of this new species to UK aquaculture.

Progress so far

Following successful sea trials with Cornwall Sea Fisheries, initial work, funded by FIFG helped identify the base requirements for establishing abalone culture in the UK. Since then SWAGA has led the development of hatchery and on-growing techniques in the UK, has organised both UK and Cross-Chan-



nel workshops and has provided a single point of contact when dealing with the various regulatory agencies. More recently, help with development costs has been received through the Rural Enterprise Gateway scheme, operated by Business Link for Devon and Cornwall, which will help this work to continue.

Seed availability vs. disease risks

Seed supply is still a key limiting factor to the growth of this industry. Ormer seed is being successfully produced by the Brittany hatchery France Haliotis. Unfortunately differences in Approved Zone status means that currently this seed cannot be imported, although proposed changes in the regulations may allow this in the future. Seed is available through Irish hatcheries. However, in July 2006 the presence of Withering Syndrome, a disease that has devastated abalone stocks in California, was confirmed in four Irish abalone farms. It therefore seems strange that this disease has recently been delisted by the OIE, meaning that there are no longer any official controls on movements of abalone, other than those for *Bonamia* and *Marteilia*. These restrictions will also be lifted by Directive 2006/88 when it comes into force in August 2008. Delisting is only normally carried out where there is either no "significant" threat through a disease or it is already "widespread". The former cannot be true and if the latter is then this has serious consequences for the wild European abalone.

Irish industry representatives have described this as more of an EU regulatory issue than a serious clinical issue, as no mortalities have occurred. However, this disease has a +18°C temperature-trigger to start and then requires 15°C seawater to develop; conditions unlikely to occur in Ireland. This does mean that there is a very real risk that the Irish hatcheries may end up 'exporting' this disease to other parts of Europe where these environmental conditions do exist. There is some evidence that this has already occurred, with Spanish researchers confirming the presence of both WS and a new protozoan parasite in juveniles imported into Spain from Ireland. These imported abalone eventually suffered 100% mortality. In consequence, a UK-based disease free hatchery is still a prime aim of the co-op.

Planned research

Support is now being sought through FIFG to help with several new key areas of research. These include: a Biotope assessment in order to demonstrate that there will be no harmful impacts on the existing marine ecosystem through proposed cage culture trials; an investigation into sustainable harvesting of seaweed; and a cage design study to provide practical guidance on a low-cost alternative to on-shore recirculation systems. Other work includes a mass-balance investigation to quantify the environmental impact of rearing abalone in a tank system and a shellfish classification investigation in order to guide discussions with the FSA about appropriate public health protection measures.

Whilst there is still much work to be done, the potential rewards for both the SW and also a wider UK industry means that these challenges are well worth pursuing. For further information contact Andy FitzGerald, Chairman of SWAGA, on af018b7274@blueyonder.co.uk



Sexing ormers during a broodstock collection off Guernsey in 2005

Fish Update, January 2007

Mussel ladder system gives good results

By Christina Reid

EIDER ducks have caused serious problems at Loch Striven Mussel Farm recently, but owner Jim McLachlan is confident that a newly completed, 900m long and 100m wide, protection net will resolve the issue.

The farm, based near Dunoon, is in the process of going through its first harvest since it was converted from 16 lines using conventional growing methods to 30 lines using a continuous ladder system.

The mussel ladder system was developed in 1999 by Mr McLachlan's company, Xplora Products Ltd and was trialled at Loch Striven by former farm owner David Scott. According to Mr McLachlan, who bought the farm in 2002, the mussel ladder is easier to install and easier to harvest than conventional ropes.

"If you have a good site you get more mussels per linear metre," he told *FISHupdate*. "It's a two man operation. Ten lines, that's 75km of ladder, were installed this year by two men."

The farm originally produced 50 tonnes of mussels a year and was taken up to 300 tonnes by the new owner. He aims to produce around 4-500 tonnes per year in the future.

"We are currently harvesting five tonnes per week for the UK bulk market and six tonnes a week of mussels in 20kg bags for the French market," he continued. "Both these operations take place onboard the harvest raft. Harvest will be ongoing for the next three to four months if anyone is interested in seeing how the equipment works."

Mr McLachlan said previous trials have shown that the mussel ladder system can grow up to three times more mussels per linear metre than the conventional system.

It is currently being used in six farms in Scotland and an order for 100kms was received last year for a farm in Southern Norway.

An engineer and toolmaker by trade, Mr McLachlan became involved in the aquaculture industry after working as a commercial diver.



The farm was converted to 30 lines using a continuous ladder system

Fish Update, January 2007

New netting product designed for shellfish

MARINE equipment supplier Ocean Nets Ltd has developed a new growing system for farmed mussels that previously have been grown on suspended ropes with pegs from a floating headline. The new product is called SHELLNET.

Manager Charlie Hunter says: "Over the last few years several novel ideas have been tried by mussel farmers to improve on labour, yield and cost efficiency, with varying levels of success. The most successful was the use of old trawl netting, cut up into strips and hung from the surface headline instead of rope droppers, but the supply of old netting is a limited resource with varying quality and size and requires a lot of time to prepare. The next step was to progress to new netting. This was initially offered from suppliers from redundant stocks

"Over the last few years several novel ideas have been tried by mussel farmers"

of trawl netting cut to size, ready for the farmer to add a top rope and weight before deploying on site".

He adds: "After supplying standard netting to the market we saw that more could be done to improve the profit margin for farmers and to make life easier. We started to develop SHELLNET, a new product to fit the specific requirements of our customers exactly."

Fish Update, January 2007

Revolutionary new mussel float yields exceptional results

RECENT trials of a new mussel float undertaken along the exposed West Coast of Ireland make for exciting reading with yield increases of 30% reported. This represents one of the most promising developments in aquaculture in recent years. Irish-based firm JFC Manufacturing Ltd have designed a float that can withstand the pressures of high waves and will sit steadily on the water when loaded with a full crop of mussels. This addresses a major and often very costly problem with the old barrel system when barrels would often buckle in stormy conditions under the pressure of heavy mature crops, thus putting the complete crop in danger of being lost. The JFC Subaqua float has a patented stabilising ring around the side of it to stop it from bobbling up and down in the water. This will stop the mussel holding lines from brushing up and down and prevents the crop from falling back into the sea.

Breakthrough Commenting on the results, John Concannon, Managing Director of JFC said: "We have made a major breakthrough in the fish farming industry with a quality designed product which will solve many problems for producers. The stabilising ring will ensure better buoyancy

and less chance of the mussel getting traumatised whilst growing. To facilitate fast growth, mussels need to be in a relaxed state and the tests that have been undertaken on our floats show a production tonnage increase of up to 30%."

These trials have taken place in Clew Bay in Co. Mayo (Danny McNulty), in Co. Donegal (Hugh Wilhare and John McClusky) and in Bantry Bay (Ger Hanley of Bantry Bay Mussels) in Co. Cork. Trials are also being undertaken in the Shetland Islands, Scotland by Willie MacLean. International interest in JFC mussel floats is also gathering momentum with the company winning an order to supply a new mussel farm in Bulgaria. The company also plans to exhibit at a number of international events in the coming year including AquaNor 2007, to be held in Trondheim, Norway. In addition, the company produces a range of navigation buoys accompanied with solar-powered lights for marking fish farms, dangerous rocks and other navigational hazards.

Further information can be obtained by contacting Colin Concannon or Michael Haverty via telephone on +353 (0)93 60056 or via email at info@jfc.ie

Fish Farmer, January/February 2007

Irish aquaculture nets a steady €100 million a year

THE Irish fish and shellfish farming industry has enjoyed a steady output of over €100 million per year for the past three years, according to the "Status of Aquaculture Report - 2005" launched recently in Oranmore, Co. Galway.

Production in 2005 reached 44,666 tonnes of shellfish and 15,384 tonnes of finfish, including salmon, trout and Arctic charr. Other developments in recent years have been the development of the organic salmon market, producing high quality fish to strict organic guidelines which command a premium price.

Collaboration

The report is a joint collaboration between the three main state agencies involved in the development, monitoring and scientific support of the fish and shellfish farming industry in Ireland - An Bord Iascaigh Mhara (BIM), the Marine Institute and Taighe Mara Teo. The report also describes in detail the Marine Institute's 2005 monitoring results from biotoxins, fish health, residue testing, sea bottom surveys and sea lice inspections car-



44 tonnes of shellfish was produced

ried out in support of the industry, the consumer and the environment.

The report highlights the resilience of the fish farming sector over the years, in spite of below-cost selling by salmon producers in Chile and Norway, and other problems. Monitoring and food safety were key elements of the State assistance to the aquaculture industry last year.

BIM's annual employment survey on the fish farming industry, which is quoted in the report, shows that there were over 730 full time jobs, 540 part time jobs and 364 casual workers, creating a Full Time Job Equivalent of over 1,000 positions and a real impact in small communities around the coast.

Regarding the development of new species, the first trial of marine fish farming for a species other than salmon and trout took place in 2005 in Galway, when juvenile cod that had been cultured from eggs to 100 grams weight at the Martin Ryan Institute Carna laboratory hatchery were successfully transferred to sea in February at a former salmon farm in Beirtragbui Bay, Connemara. In spite of an algal bloom in June, the remaining fish survived the warm summer waters and continued to feed and grow well.

A second batch of smaller cod were transferred to sea in a more sheltered site in the same bay in October and November 2005.

2007 will be important year for aquaculture, says Borg

NEW trends and recent developments in fish farming, such as offshore aquaculture or links with other sea-based activities, must be incorporated into the European Community's strategy on the sustainable development of aquaculture, Fisheries Commissioner Joe Borg has said.

Speaking at the Plenary meeting of the Advisory Committee on Fisheries and Maritime Affairs (ACFA) held in Brussels, Dr Borg said these issues will be addressed when the strategy comes up for review in 2007.

Discussing recent developments in the industry, he said: "On aquaculture, we are well advanced on the road to having community rules for alien species in aquaculture. This was one of the items highlighted in the 2002 communication on sustainable development of aquaculture and is currently under discussion at working party level in the council.

If not finalised this year, we expect it to be approved during the German Presidency.

Aquaculture products and seaweeds are also included in the new community rules on organic production and labelling, and we expect this Council Regulation to be finalised before the end of the month (to apply from 2009). DG FISH will start work on detailed implementing rules for aquaculture products and seaweeds."

Fish Farmer, January/February 2007

Fish Update, January 2007

Prawn farming insight for Cefas scientist

DR Grant Stentiford, a fisheries pathologist from the UK's Centre for Environment, Fisheries and Aquaculture Science (Cefas), has recently returned from a seven-week Winston Churchill Travelling Fellowship to Chile, Ecuador and Arizona, with the aim of studying aquaculture and disease issues in farmed prawns.

Commenting, Dr Stentiford said: "Many of the prawns produced in these regions (and similar production areas in Asia) end up in restaurants and supermarkets in Europe and the USA. Prawn farming is a rapidly expanding global industry in developing nations, but with such expansion has come problems.

Susceptible

"Intensively farmed prawns are more susceptible to disease, with crop losses leading to reductions in exports and consequent economic instability in countries that rely on these crops. Furthermore, prawn farming has been associated with habitat loss (especially mangroves) in some regions."

In addition to visiting a number of farming regions, Dr Stentiford discussed production and export issues with a range of academic and government institutes, particularly with regards to the long-term sustainability of this important industry.

Fish Farmer, January/February 2007

Faster French oyster testing – and Teign work praised

AN EU-funded project has shown that the French system for identifying the bacterial count in oysters is five times faster than the system used in the UK, reports Phil Lockley.

The three-year Cycleau Project, based on the oyster beds in the River Teign, south Devon, compared UK and French methods of monitoring shellfish quality from the five designated shellfish beds on the Teign, and measured the time taken to receive back the results, which are important in managing

shellfish quality and protecting public health.

The two methods produced comparable results but it took more than five times longer for the UK results to be given to the relevant authorities and the shellfishermen.

The time "drag" takes to identify the quality of the region's oyster cultivation industry will now be

addressed to bring the UK system in line with the French.

The Teign Estuary Partnership (TEP) recently gave a presentation on the project to a national audience hosted by the Shellfish Association of Great Britain (SAGB) in London. The audience included representatives from the Food Standards Agency, the Environment Agency and CEFAS.

The findings were well received by the SAGB and the shellfish industry, which has expressed concerns in the past about the length of time it takes to get results from UK laboratories.

The SAGB's Dr Clive Askew praised the work of the Cycleau Project for having "progressed thinking by both the shellfish

industry and, importantly, the UK regulators towards accepting French impedance-based methods for enumerating bacteria in shellfish".

Sarah Clark of the TEP said: "The original project idea came from listening to the concerns of the Teign shellfishermen. We have been able to demonstrate that our local concerns can really get noticed by national bodies and that the science we have been undertaking for the last three years may well change national policies."

Fishing News, 9 February 2007

Iceland explores mussel farming potential

SHELLFISH farmers in Iceland have announced that they are considering farming blue mussels for export. According to reports in the Icelandic media, the plan was announced by members of Iceland's Association of Shellfish Cultivators.

The association has experimented with blue mussel cultivation in Iceland in recent years with good results, and members now feel it is time to start producing blue mussels in large quantities for export.

Jon Baldvinsson, head of the Association of Shellfish Cultivators, is reported to have said that he hopes shellfish farmers will produce 20 thousand tons of shellfish off the coast of Iceland in the next few years, which would deliver about ISK three billion (EUR 32 million, USD 41 million) in profits.

Fish Update, February 2007

Langoustine focus for Clyde Fisheries Development Project

THE Clyde Fisheries Development Project (CFDP) is an industry led initiative that aims to introduce sustainable management into the Clyde Fishery and to improve current working practice.

Led by project officer Dr Jason Combes, the CFDP has brought fishermen, processors, scientists and environmental organisations together to investigate the fishery, with a view to ensuring its long-term social and economic future. The langoustine fishery is important in the Clyde, where vessels support 400 full time jobs at sea and a similar number in onshore processing.

Two outreach officers, Frank Armstrong and Michael O'Malley are currently working on a sustainable supply chain initiative, which in-

volves a year's sampling and recording regime onboard fishing vessels. "Frank and Michael are looking at working, handling, and storage practices on prawn trawlers and creel boats, and we are pleased that this project has support from the Clyde Fishermen's Association, Northern Ireland Fishermen's Federation, Scottish Creelers and Divers, and non-association boats," explains Jason.

Monitoring

The pair are spending a day onboard every vessel in the fleet, recording the size, grade and sex ratio of the catch, plus rate of discard, and type and proportion of bycatch. They are also monitoring hold and ambient deck temperatures, water surface and bottom temperatures, and using temperature loggers to assess the

catch in the supply chain.

"Various studies have shown that the temperature at which langoustine are stored has an impact on their quality, longevity, pack-out yield and ultimately on price, and part of our work is to help fishermen and hauliers to get this right," says Jason. "Ideally, langoustine should be quickly chilled to 4°C onboard vessels and kept at that temperature until they reach the processor or wholesaler," he adds.

Feedback is offered to people taking part in the project on an ongoing basis, and a series of seminars are planned for the end of the project to enable everyone to see the results of the year's sampling and to discuss the cost/benefits of effective temperature control.

"We aim to highlight the best regimes for onboard handling, holding, quality and minimisation of waste, in a set of quality and environmental standards that will help to improve the sustainability of the fishery. Once that is complete, we can look at how sustainability targets can be improved upon year on year," states Jason.

Further information is available from Jason on 07966 585740, Michael on 07976 840833 or Frank on 07976 769081.



Michael O'Malley, Jason Combes, Frank Armstrong

Fish Update, February 2007

Future of the native oyster discussed

THE 'native' European oyster (*Ostrea edulis*) has become a rare sight in Scottish waters over the last century, largely as a result of over-fishing and pollution. However, efforts are well underway to try to reverse these generations of decline, both under the biodiversity programme, the UK 'Native Oyster Species Action Plan' and the current SNH 'Species Framework'.

Unfortunately, the oyster disease bonamia was discovered for the first recorded instance in a Scottish sea loch last year, which was bad news for the prospects of the future revival of this species.

As a result of these developments, and other relevant issues such as successful prosecution of illegal 'poaching'



Native oysters - a rare sight in Scottish waters

activities in Argyll, the Association of Scottish Shellfish Growers (ASSG) held a meeting of interested parties at the Dunstaffnage Marine Laboratory, near Oban, on January 24, to discuss the concerns. Native oysters could prove to be a significant species for Scottish cultivation, but only if the disease-free status is preserved and then followed-up

with a coherent development strategy.

As part of the input to this debate, the meeting enjoyed a contribution from Bord Iascaigh Mhara (Irish Sea Fisheries Board), on the experience in Ireland of the appearance and spread of Bonamia and the national efforts to control the disease and develop the species.

Fish Update, February 2007

Are lobster fishermen boosting crustaceans?

A DEFRA-funded study is to try to find out if lobsters and crabs are using the pots used to capture them as a source of food and shelter. Following suggestions by some fishermen that lobsters and crabs are showing this behaviour, the University of Hull's Centre for Coastal Studies in Scarborough, with Bridlington fisherman Gary Hodgson, has secured £9600 from DEFRA to conduct research into interactions between commercial crustacean species and fishing gear. Undersized lobsters and crabs that are captured are returned to the sea immediately after capture. Because of the gentle way in which trapped crabs and lobsters are treated, the vast majority of the animals returned survive to forage another day. This is very different to the situation in the trawling industry where most of the undersized fish returned die or are already dead.

Working in partnership, the researchers and fishermen plan to try to discover the interactions between lobsters, crabs and pots. It is possible that high pot densities off the Yorkshire coast enhance crustacean populations. In Maine, USA, it has been found that up to 20% of lobster diet comes from the bait supplied by fishermen. The study aims to find out how much of the local lobster and crab diet comes from bait and to what extent juvenile, and possibly adult, crustaceans use lobster pots for shelter.

Dr Magnus Johnson, head of the Centre for Coastal Studies, said: "It is essential, if the enormously successful crustacean fishery off the Yorkshire coast is to continue to thrive, that we have a solid understanding of the interactions between the fishermen and their target species. "What is particularly pleasing with regard to this study is the close involvement of fishermen who understand that sustained research activity is essential to continued success and sustainability of the fishery."

Fishing News, 16 February 2007

Sustainable aquaculture critical to feed the world

NEW research has revealed the economic and health benefits of growing more seafood.

Research unveiled at the American Association for the Advancement of Science Annual Meeting demonstrated the enormous potential for sustainable growth of healthy farmed seafood production,

notably through advancements in feed efficiency and the ability to expand production in marine environments.

"At a time when heart disease kills one American every 35 seconds and the overall health benefits of consuming seafood are evident, it is essential to educate the public about

"It is essential to educate the public about increasing their consumption of a lean protein such as fish"

increasing their consumption of a lean protein such as fish," said Dr Steven Otwell, a University of Florida professor and member of National Academy of Sciences' Seafood Safety Committee.

"To meet the growing demand for healthy seafood, we absolutely must embrace and expand aquaculture."

As presented in the panel, scientific breakthroughs and new technology will be critical to continuing efforts to build a sustainable aquaculture community. From new methods of rearing farmed fish with smaller environmental footprints, to identifying new feeds, the

scientific study of aquaculture is essential to providing affordable and healthy seafood for U.S. and international consumers.

"Whether from fresh or marine waters, be it catfish or cod, farmed seafood allows greater numbers of Americans to enjoy the health benefits of fish in an environmentally-friendly way," said Dr Randy MacMillan, president of the National Aquaculture Association and AAAS panel organiser.

"Aquaculture is a 'relief valve' that takes the pressure off wild capture fisheries and helps promote sustainability of the natural ecosystem."

Cefas appoints Chief Executive



A NEW Chief Executive has been appointed to lead the Centre for Environment, Fisheries & Aquaculture Science (Cefas). Dr Richard Judge was formerly a Group Director with AEA Environment, responsible for a division that delivered a diverse portfolio of environmental consultancy, high-value technical services and IT products to the public sector and industry. He brings wide-ranging leadership and

business transformation experience, gained in market-leading science and engineering businesses in the UK and internationally.

Richard is a Chartered Engineer and a Fellow of the Institution of Mechanical Engineers. He says: "I am looking forward to leading and developing Cefas, particularly at this stage of its transformation. The commitment from Defra for our transformational programme and for the development of new fit-for-purpose laboratory facilities means that there is a bright future ahead for the agency. The organisation has grown significantly in recent years and its strong international scien-

Fish Farmer, March/April 2007

Fish Farmer, March/April 2007

Baby lobsters are two months early

LOBSTERS around Cornwall are defying science and releasing their larvae two months earlier than normal, reports Phil Lockley.

Staff at the National Lobster Hatchery in Padstow say experiencing such an abundance of juvenile crustaceans so early in the year is unprecedented.

Most of the pregnant lobsters – those with ripe eggs held under their tail – arriving at the hatchery are donated by Cornish fishermen. Hatchery staff member Rory Pryor told *FN* that close inspection showed that a large number of larvae have already started to hatch.

He said: "Caring for thousands of larvae is something the lobster hatchery is used to, although the season usually

starts between April and May.

"For a number of pregnant lobsters to release their larvae this early in the year is well before season and a very happy surprise for all of us."

Scientists are now scratching their heads as to why the lobster 'calendar' is so out of step.

Female lobsters carry about 5000 eggs attached to small appendages under their tails (called pleopods) and when the eggs are near hatching they turn from black to red. Fishermen can be a vital link in the future success of the hatchery by 'loaning' the animal until the eggs are released.

Landing of berried lobsters caught within six miles of the Cornish shore is illegal and permission must be obtained to land them. Most of the

lobsters are caught far offshore.

"At the time of release the 'mother-to-be' will in effect do a headstand, sticking her tail up high and waving her pleopods as the ripe eggs hatch and larval lobsters appear, then swim away in the currents," said Rory Pryor.

"This is where our work starts, and these juveniles will be protected and cared for until such time as they are about two inches long and ready for release into the sea.

"Some people may suggest that the early lobster 'baby boom' is an indication of climate change, but whether this is the case or not, we are pleased to be caring for baby lobsters at this time of year."

The baby lobsters can be seen in the hatchery's visitor centre.

Fishing News, 16 February 2007

WHERE TO GET HELP & ADVICE

Policy Matters

Department for Environment, Food and Rural Affairs, Nobel House, 17 Smith Square, London SW1P 3JR
(Switchboard tel. (0207 238 3000)
General fax. (0207 238 6591)

Several and Regulating Orders, Shellfish Farming;
Fish Industry Management Division
Area 7E, 3-8 Whitehall Place, London SW1A 2HH
(Tel. 0207 270 8210) (Fax. 0207 270 8097)

Shellfish Health;
Aquaculture, Salmon, Freshwater Fisheries and Whaling Division
Area 5E, 3-8 Whitehall Place, London SW1A 2HH
(Tel. 0207 270 8826) (Fax. 0207 270 8827)

Public Shellfisheries, excluding Regulating Orders;
Sea Fisheries Conservation Division
Area 6A, 3-8 Whitehall Place, London SW1A 2HH
(Tel. 0207 270 8256) (Fax. 0207 270 8310)

Shellfish Licensing Scheme;
Fish Industry Management Division
Area 7E, 3-8 Whitehall Place, London SW1A 2HH
(Tel. 0207 270 8128) (Fax. 0207 270 8146)

Grant Aid;
Marine and Fisheries Agency
Area 6E, 3-8 Whitehall Place, London SW1A 2HH
(Tel. 0207 270 8041) (Fax. 0207 270 8019)

Policy on Marine Environmental Protection;
Marine Environment Protection,
Marine Environment Division,
Area 2C, 3-8 Whitehall Place, London SW1A 2HH
(Tel. 0207 270 1963) (Fax. 0207 270 8710)

You can also visit the Defra website at <http://www.defra.gov.uk>

Issue of Marine Consents for Disposal, Construction and Aggregate Extraction;
Marine Pollution Response.
Marine Environment Team,
Marine and Fisheries Agency,
Area 6B, 3-8 Whitehall Place, London SW1A 2HH
(Tel 0207 270 8644) (Fax 0207 270 8709)

Monitoring of Fishing Activities, Licensing;
Marine and Fisheries Agency
Area 6D, 3-8 Whitehall Place, London SW1A 2HH
(Tel. 0207 270 8778/8657)
(Fax. 0207 270 8146)

Research and Development Programmes;
Either contact Science Directorate at research.competitions@defra.gsi.gov.uk or the relevant Defra science unit from the contact page at <http://www.defra.gov.uk/science/contact.htm>

Welsh Assembly Government, Agricultural and Rural Affairs Department, New Crown Buildings, Cathays Park, Cardiff CF1 3NQ (Tel. 029 2082 3567) (Fax. 029 2082 3562) (<http://www.wales.gov.uk>)

Scottish Executive Environment and Rural Affairs Department, Pentland House, 47 Robbs Loan, Edinburgh EH9 1TW
(Tel. 0131 244 6224) (Fax. 0131 244 6313)
(http://www.scotland.gov.uk/who/dept_rural.asp)

Department of Agriculture and Rural Development for Northern Ireland, Fisheries Division, 4th Floor, Dundonald House, Upper Newtownards Road, Belfast, BT4 3SB
(Tel. 02890 524366) (Fax. 02890 378320)
(<http://www.dardni.gov.uk>)

Shellfish Hygiene

England - Food Standards Agency Aviation House, 125 Kingsway, London, WC2B 6NH
(Tel. 020 7276 8000) (<http://www.food.gov.uk>)

Food Standards Agency (Scotland), St Magnus House, 25 Guild Street, Aberdeen AB11 6NJ
(Tel 01224 285100);

Food Standards Agency (Wales), Southgate House, Wood Street, Cardiff CF10 1EW (Tel 029 20 678918);

Food Standards Agency (Northern Ireland), 10C Clarendon Road, Belfast BT1 3BG (Tel 02890 417711)

Scientific and technical advice

Cefas Weymouth Laboratory, Barrack Road, The Nothe, Weymouth, Dorset DT4 8UB (Tel 01305 206600) (Fax 01305 206601)

- Cultivation techniques; health regulations; disease control; shellfish hygiene classifications and purification plant approvals; shellfish water quality and effluent discharges (microbiology) (England & Wales)

Cefas Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk, NR33 0HT (Tel 01502 562244) (Fax 01502 513865)
- Shellfish stocks (England & Wales)

Cefas Burnham Laboratory, Cefas Laboratory, Remembrance Avenue, Burnham-On-Crouch, Essex, CMO 8HA (Tel. 01621-787200) (Fax 01621 784989)
- Pollutants (contaminants) and their effects

You can also visit the Cefas website at <http://www.cefas.co.uk>

Fisheries Research Services, Marine Laboratory, PO Box 101, Victoria Road, Aberdeen AB11 9DB (Tel. 01224 876544) (Fax. 01224 295511) (<http://www.marlab.ac.uk>)- Shellfish stocks, cultivation, hygiene, and disease control (Scotland)

SEAFISH. Individuals and organisations are encouraged to visit the main Seafish website (<http://www.seafish.org>) as a main port of call. To make contact with your Regional Account Manager please contact Dawn Sneddon (0131 524 8672 e-mail d_sneddon@seafish.co.uk) with details of your location, contact details and nature of the enquiry; she will ensure that somebody gets back to you immediately.

Advice on commercial activities

The Shellfish Association of Great Britain, Fishmonger's Hall, London Bridge, London, EC4R 9EL (Tel. 020 7283 8305) (Fax. 020 7929 1389) (<http://www.shellfish.org.uk>)

The Association of Scottish Shellfish Growers, Mountview, Ardvassar, Isle of Skye, IV45 8RU (Tel/Fax: 01471 844324)

Wildlife conservation and status of on-growing sites

Joint Nature Conservation Committee, Monkstone House, City Road, Peterborough PE1 1JY (Tel. 01733 562626) (Fax. 01733 555948) (<http://www.jncc.gov.uk>)

Natural England, 1 East Parade, Sheffield, S1 2ET (Tel: 0114 241 8920) (Fax: 0114 241 8921) (<http://www.naturalengland.org.uk>)

Countryside Council for Wales, Ffordd Penrhos, Bangor, LL57 2LQ (Tel. 01248 385500) (Fax. 01248 355782) (<http://www.ccw.gov.uk>)

Scottish Natural Heritage, 12 Hope Terrace, Edinburgh, Scotland, EH9 2AS (Tel. 0131 447 4784) (Fax. 0131 446 2277) (<http://www.snh.org.uk>)

Other Useful Numbers

Crown Estate Commissioners, Crown Estate Office, Marine Estates Division, 16 Carlton House Terrace, London SW1Y 5AH (Tel. 020 7210 4322, Dr Tony Murray) (Fax. 020 7839 7847) (<http://www.crownestates.co.uk>)

Central contact for local Sea Fisheries Committees - The Association of Sea Fisheries Committees of England and Wales, 6, Ashmeadow Road, Arnside, Via Carnforth, Lancashire, LA5 0AE (Telephone and Fax: 01524 761616; email: asfc.office@btopenworld.com).

Co-ordinator for Defra - CARD R&D –
Dr. Mark James, Fisheries Resource Management
Ltd., Rowanbank, 7 Atholl Gardens, Dunkeld,
Perthshire, PH8 0AY Scotland.
(Tel:/Fax: 01350 727484) (<http://www.frmltd.com>).

USEFUL PUBLICATIONS

Readers of Shellfish News may be interested in the publications listed below. These are available by contacting the relevant Department/Agency or via the websites (see contact details in Where to get Help and Advice). Full lists of publications are available on the respective websites.

Defra

- A Guide to Shellfish Health Controls
- Several and Regulating Orders: Notes for Guidance
- Several and Regulating Order Management Plan

Cefas

- The Fish Health Inspectorate and You - Service Standards and Code of Practice for Enforcement
- Bivalve cultivation: criteria for selecting a site
- Scallop cultivation in the UK: a guide to site selection
- Storage and care of live lobsters
- Research on Shellfish Cultivation (1990-2003)

SEERAD Fisheries Research Services

- Fish Health Inspectorate Service Charter
- Scottish shellfish farm production survey
- The classification of shellfish production areas using E. coli
- Marine biotoxins
- Ensuring the quality of fish and shellfish
- Supporting new aquaculture species in Scotland
- Bonamiasis
- Marteiliasis
- Aquaculture and Aquatic Animal Health Programme

Seafish

- The oyster hyperbook
- The suspended mussel hyperbook
- The seabed cultivated mussel hyperbook
- The scallop hyperbook
- The clam hyperbook
- Introduction to HACCP for Bivalve Purification and Dispatch Centres



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