The Channel Program : An ambitious challenge for a sustainable exploitation of the marine ecosystem

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1- The English Channel, an eco-region to preserve

The English Channel and the south of the North Sea (zones CIEM IVc and VIId, E) are marine ecosystems that has been, for a long time, strongly exploited by different human activities (fishings, tourism and leisure activities, marine aggregate extraction, shipping, port and embarcation areas, degraded estuarine areas, coastal wind mills, etc.), and thus has poses considerable economic issues as they are subjected to a multiplicity of users and stakeholders frequently having antagonistic interests.

In spite these pressures, the natural resources (fisheries, bivalve aquacultures and minerals) found in these zones are desired by different sectors, at the national and European levels. The government, several institutions (EU, state and territorial collectivities) but also the society (fishermen, industrialists, ONG…), concerning the analysis of ecosystem responses to these various constraints, including global climate change, that do not cease to grow. The questions raised are more and more related to complexities involving species interactions, fishing strategies and captured species exploitation, ecosystem degradation and other conflicting use linked to human activities. The expected responses should integrate the overall complexities of all these situations. It should be noted that the Regional Advisory Council (RAC) constitution at the European level, and more specifically the Channel sub-RAC body, envisages a larger association where stockholders, scientists and institutions work together in analysing different management scenarios for a sustainable exploitation of these marine resources.

In this ecoregion, system integrations and convergence of knowledge on these ecosystems as well as promoting the development of new research are essential for the implementation of an ecosystem-based approach towards marine stock management and quality improvement of policy advices and planning with the board of trustees to the public authority.

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2- The Channel Program kick-off meeting : a double objective

To face economic and ecological issues, it is essential that the countries adjacent to the English Channel and the North Sea share a common vision about the state and the quality of the marine ecosystem. A better integration of this knowledge in public policies will reinforce a common reflection towards a sustainable exploitation of the resources and a responsible management of human activites in this eco-region.

2.1- Federating the Channel specialists' work

The Channel Program is a framework that aims at merging scientific work and unifying developed research projects focused on the Channel marine living resources under a common label.

This unifying ambition implies the rapid creation of a scientific committee that will support the Franco-British interregional political structure "Channel Arc Manche".

This committee intends to gather together specialists in marine science implicated in existing or future research projects and will facilitate the transfer of scientific breakthroughs towards local and European decisional structures.

This program is structured along four major research actions:

Action 1 – Descriptive approach: Identifying the ecological factors that shape the distribution of living marine resources and define their habitats (environment, biotopes; faunal assemblages, communities, biocenosis; species' life- cycle and habitats associated)

Action 2 – Functional approach: Understanding the trophic network functioning (trophic links from primary production, including toxic phytoplankton, to top predators; mechanics of predator-prey relationships; spatio-temporal dynamics of food web; sensibility ot perturbations and resilience of food web dynamics and consequences for exploited marine living resources)

Action 3 – Impact assessment : Identifying and quantifying the impact of human activities on habitats and the trophic network (fishing, extraction of marine aggregates, offshore windmills, contaminants…);

Action 4 – Integrated applied approach: Defining new management strategies for the sustainable exploitation of natural resources while preserving marine environment and biodiversity.

2.2- Transferring scientific breakthroughs towards decisional structures

The objective of the Channel Program is to contribute to knowledge required for the management of marine living resources by developing an integrated and multi-partners systemic approach on this marine ecosystem. Another ambition is to make the scientific information collected transparent and available so that it can be effectively integrated in public policies, which can only be achieved by an increased effort in communication, knowledge transfer and exchanges of information between involved partners.

The interests of adapting a sustainable manner of managing a common marine ecosystem are necessary towards a multipartner approach at European level. Through the Channel Program, it provides to transfer easily the scientific knowledge to the decisional structures (local to European level) and the stakeholders.

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3- CAMIS-EMDI + project (www.emdi.certic.unicaen.fr)

This project is coordinated by the Region Haute-Normandie within Arc Manche project and is financed within the scope of the INTERREG IV A France (Channel) – England cross-border European cooperation programme, co-financed by the ERDF.

Channel Arc Manche Integrated Strategy

Aim of the project: to develop and implement an integrated maritime policy in the Channel area whilst fostering concrete co-operation between stakeholders.
Internet site: www.emdi.certic.unicaen.fr

Context and Drivers:

The EMDI (Espace Manche Development Initiative) project – INTERREG IIIB North West Europe, strongly contributed to the development of the Channel Arc Manche co-operation between 2004 and 2008: working-out a strategic vision, testing new co-operation avenues, developing greater knowledge of the Channel area and the issues at stake, in particular through the creation of a cross-Channel atlas. This first project brought some convincing arguments for the recognition of the Channel Arc Manche as a coherent co-operation area in Europe. It has also highlighted the opportunity for the Channel area to positioning itself as a demonstration maritime basin of the integrated maritime policy championed by the European Commission.

The new CAMIS (Channel Arc Manche Integrated Strategy) project seeks to confirm this position whilst taking into account :

- « An Integrated Maritime Policy for the European Union", communication of the European Commission and action plan
- Lisbon and Gothenburg Agenda
- Marine Strategy Directive
- Manche Programme Vision: "A common space" (INTERREG IVA)
- Member States' Marine and ICZM strategies and legislation
- Regional and local strategies

This project will consider the whole Channel area as well as its interaction with the Atlantic area and the North Sea area whenever it is relevant.

Project objectives:

1°) To develop a framework for maritime governance
2°) To provide expertise for Channel Arc Manche and decision makers in the Channel area
3°) To encourage co-operation that addresses strategic issues at stake

To meet these objectives the project will take account of the contribution of other projects which develop scientific knowledge, in particular the CHARM project, or sector-based strategies for the Channel area e.g. ports and transport, maritime safety, etc. An inventory of past and current projects in the different fields covered by CAMIS will be undertaken from the beginning of the project.

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4- CRESH project (www.unicaen.fr/cresh)

The CRESH project (Cephalopod Recruitment from English Channel Habitats) addresses the Priority 4 of the Interreg IV A programme which concerns the sustainable environmental development of the common space. Cephalopods are short living species, their abundance depends on the annual recruitment (juveniles entering the exploited stage) and they are directly concerned by this theme. The project gathers eight Franco-British partners from universities, research institutes and fishermen's organisations. This brief introduction underlines complementary skills gathered to better understand these animals and the part that they play in the English Channel ecosystem.

Some themes presented in the meeting :

- Recruitment success and resource abundance
- Habitat preferences in cuttlefish spawning and juveniles
- Comparison of pre-recruit stages from different coastal areas

5- CHARM project

5.1 – CHARM 1 & 2

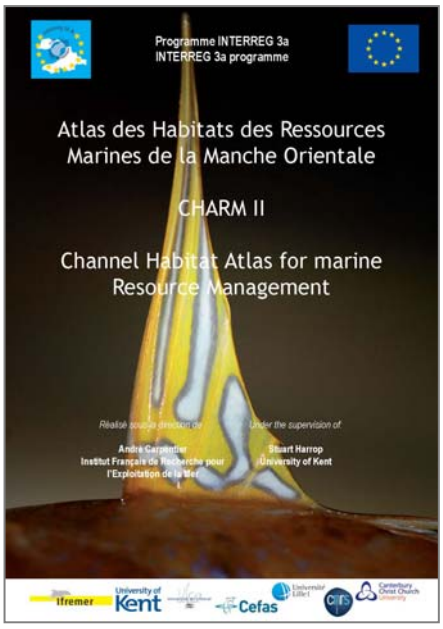
CHARM 1 and 2 have been a 4-year French-British cooperation project, funded under the UE Interreg programme, through the Haute-Normandie Region and the Government Office for the South-East.
The CHARM project aims to develop an atlas as a “toolbox” for decision-making and planning that can provide aid for sound governance and sustainable management of the English Channel marine resources

The first phase (2003-2005) covered the Dover Strait and the second one (2006-2008) covered the whole eastern English Channel.

For both side, the interest consists in gathering and harmonising environmental data. The English Channel is considered as an important economic site for various human activities (fisheries, aggregate extraction, harbours, shipping...).
Research institutes which were partners in this project are:

- Canterbury Christ Church University (CCCU) at Canterbury,
- Centre for Environment, Fisheries & Aquaculture Science (Cefas) at Lowestoft,
- University of Kent (KENT) at Canterbury,
- Institut Français de Recherche pour l’Exploitation de la Mer (Ifremer) at Boulogne-sur-mer and at Port-en-Bessin (and so Dinard),
- Université des Sciences et Technologies de Lille (USTL) at Wimereux,
- Université du Littoral-Côte d’Opale (ULCO) at Boulogne-sur-mer.

The Channel Habitat Atlas for marine Resource Management (1 & 2) can be downloaded on this website :
www.ifremer.fr/charm.



CHARM 2 atlas cover

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5.2 – CHARM 3 project

Project financed within the scope of the INTERREG IV A France (Channel) – England cross-border European cooperation programme, co-financed by the ERDF.

The CHARM 3 project is the logical follow-up to phases 1 (2003-2005, 1.1 M€, 5 partners) and 2 (2006-2008, 2.1 M€, 6 partners) of the CHARM project (www.ifremer.fr/charm).
Firmly grounded on results obtained in the previous phases, CHARM's phase 3 objective is to emphasize the multidisciplinary nature of the studies conducted through an ecosystem-based approach. This means an "integrated" approach to management of marine resources, whether living, mineral or human.
The study area will be extended to the entire English Channel and the southern part of the North Sea (see map above) and new forms of expertise (economics, climate change) have been introduced.
The types of expertise involved range from marine sciences (oceanography, marine biology, fisheries, etc.) to economics, legislation, geography (cartography, spatial analysis, Geographical Information Systems, etc.), statistics (habitat and trophic network models, etc.), planning (marine conservation planning, etc.) and information technologies (web technologies, programming, etc.). Many of these skills are interdisciplinary by nature, an essential aspect for any integrated approach.

In all, seventeen French and British partners are involved in the project. All the actions are jointly implemented on both sides of the English Channel to ensure the truly cross-border character of the project. All partners have a speciality and acknowledged expertise (locally, nationally and internationally) in the various fields addressed, and their contributions complement those of other partners in each one of the actions.

A total of seventeen actions are envisaged. They can be grouped according to 3 orientations:

- collection and standardisation of information
- information integration
- tools and information dispersal

Some themes presented in the meeting :

- Seabed Habitat Mapping in the Channel
- Sea surveys IBTS/CGFS
- Overview (1992-2007) of the coastal hydrological conditions and associated phytoplankton communities
- Role of “engineer” species in benthic fluxes at the water-sediment interface
- Fluctuations of spawning locations of fish eggs in the North sea between 2006-2009
- Exploring the Western Channel for whales, dolphins and seabirds
- Scenarios of changes in the distribution of some benthic species in the context of global climate change
- Modelling of benthic food web in the Eastern Channel and the southern bight of the North Sea
- Consequences of human disturbances on sole *Solea* solea population
- Estimating fishing effort from Vessel Monitoring System (VMS) data
- Sense of place and marine fisheries: exploring social and cultural dimensions in the English Channel
- Marine conservation planning
- CHARM III Web Portal and Tools

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6- Other previous projects

FP7 VECTORS project

The project VECTORS (**Vectors of Change in Oceans and Seas Marine Life, Impact on Ecomic Sectors)** aims mainly to acquire knowledge about the present and future pressures, about the vectors of change on the marine environment. The formers could be direct: e.g. maritime freight as invasive species vector (via ballast tank waters), climate change and ocean acidification, intensive resources exploitation) or indirect : e.g. energetic needs change, gaz emission reduction, demographic pressure on the coasts, tourism, recreativ activities; food security, legislation). The research lead into VECTORS project should try to explain how pressures, vectors of change and their interactions will result in some changes in three specific domains: appearing of non endemic and non indigeneous species, spreading of endemic species and changes of commercial species distribution and productivity. The project answered to UE-7 PCRD call.

CHANGEMAN ANR project

The principal objective of the project CHANges in ecosystem and Channel Management ("**CHAN**gements dans l'écosystème et **GE**stion de la **MAN**che, CHANGEMAN) is to acquire a better knowledge on the current and potential pressures (e.g., fisheries, shipping, marine gravel extractions) occurring at different levels (e.g., trophic levels, commercial species distribution and métiers utilized) as well as the socio-economic consequences on the fisheries sector.

Different studies centered on six research actions are proposed following the DPSIR context:

1. Analysis of pressure drivers
2. Change mecanisms in the distribution of key commercial species
3. Change mecanisms in the food web
4. Change mecanisms in the fishing activities dynamics
5. Change mecanisms in socio-economy
6. Modeling the integrating processes (1)-(5).

This project will be submitted this year to the French National Research Agency (Agence Nationale de Recherche, ANR) Systerra.

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COMANCHE ANR project

The king scallop *Pecten maximus* is an important species in the English Channel, notably as it constitutes the first species in landings (15 to 20 000 tons per year) for the French fishing fleet (700 fishing vessels) based in this maritime area. Due to its economical importance, several scientific studies have been conducted on this species, but mainly at local scales. Moreover, despite the basic knowledge acquired through these studies, several points of the scallop dynamics remain poorly understood. Additionally, episodic perturbations (e.g., introduction of competitor, development of toxic algal blooms) have affected the king scallop populations in unpredictable ways, making it even more difficult to apprehend the dynamics of the populations and their interactions with the rest of the ecosystem.

In such context, COMANCHE (**CO**quilles Saint-Jacques de la **MANCHE**) project aims at improving our knowledge on the king scallop within its ecosystem, in an integrated approach and over the whole English Channel. We propose to identify the characteristics and the structure of the exploited populations of king scallop, to determine the position of this species within the English Channel ecosystem and to quantify the impacts associated to its exploitation. These objectives will be addressed using a multi-disciplinary approach, through the collaboration of physicists, biologists, economists, but also regional institutions such as the fisheries regional committee.

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7- The partnership

	Project partners	Financial partners
CHARM 3	Leader : Ifremer, Boulogne-sur-mer 1. Ifremer – Brest, Dinard, Port-en-Bessin 2. Université des Sciences et Technologies de Lille Lab. D'Océanologie et Géosciences Wimereux 3. Université de Caen Basse-Normandie Lab. Biologie et Biotechnologies Marine – Caen 4. Agrocampus Rennes Pôle halieutique - Rennes 5. Université de Haute Bretagne (Rennes 2) Lab. Rennes – Espaces et Sociétés – Rennes 6. SAS Alkante - Rennes 7. Université de Bretagne Occidentale UMR AMURE - Centre de Droit et d'Economie de la Mer – Brest 8. University of Greenwich - Medway 9. University of Kent DICE – Canterbury 10. CEFAS - Lowestoft 11. Plymouth Marine Lab - Plymouth 12. SAHFOS CPR team - Plymouth 13. Marine Biological Association - Plymouth 14. University of Plymouth Marine Institute - Plymouth 15. Marinelife Ltd - Bridport 16. University of Exeter Centre for Ecology & Conservation - Cornwall campus 17.University of Portsmouth CEMARE – Portsmouth	**Interreg IVa**
CRESH	Leader : Université de Caen Basse-Normandie 1. The Marine Biological Association of the UK 2. Devon Sea Fisheries Committee 3. Royal Holloway University of London 4. Centre for Environment, Fisheries & Aquaculture Science 5. Ifremer Boulogne/mer – Centre Manche Mer du Nord 6. Comité Régional des Pêches Maritimes de Basse Normandie 7. University of Plymouth	
CAMIS-EMDI +	Leader : Région Haute-Normandie 1. Régions Bretagne 2. Région Nord Pas-de-Calais 3. Région Picardie 4. Région Basse Normandie 5. West Sussex County Council 6. Cornwall County Council 7. Kent County Council 8. Southampton City County Council 9. Devon County Council 10. Conseil Général Côtes d'Armor, 11. Hampshire 12. Université de Caen 13. Marine South East 14. SEEDA	

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8- Abstracts of the meeting presentations

CRESH project

Recruitment success and resource abundance

Dr. Michael GRAS, Université de Caen Basse-Normandie, responsable du projet CRESH

The Cephalopod populations in the English Channel are the most significant stocks of cuttlefish and squid in the European Atlantic Ocean. They are shared stocks mainly exploited by French and UK fleets. These resources are becoming an increasingly important source of income for the fishermen. Because these animals are not finfish, stock assessment tools had to be adapted and the English Channel populations are the first European populations which have been punctually assessed.
The CRESH project aims to improve the knowledge concerning favourable conditions for the success of egg and juvenile stages and stock renewal. Pre-recruit results must be compared with abundance estimations provided by population models and scientific surveys.
Moreover, project partners also share their work expertise and their databases regarding fisheries statistics, discards assessment, biological data collection and surveys.
Amongst the specific tools which have already been developed for the Cephalopods, the project should allow us testing abundance indices which will be used to adjust the exploitation as early as possible. Contribution of inshore spawning areas to the recruitment in the central area will be assessed with mixing models. Opportunities to develop a spatial approach of juvenile sources will be explored in order to determine which seabed areas are the most useful for a sustainable exploitation of these resources.
The involvement of organizations like the Comité Régional des Pêches or the DSFC in this project underlines the need to discuss management options and scenarios together with all English Channel stakeholders.

Habitat preferences in cuttlefish spawning and juveniles

By Emma JACKSON, Marine Biological Association of the UK

Cephalopod fisheries research has repeatedly demonstrated the existence of high annual variability in recruitment, abundance and growth rates. Annual recruitment requires the survival of that year's eggs and juveniles to an age at which they are able to recruit to the fishery. During these early life stages mortality rates are presumed to be at their highest and individuals are considered to be more sensitive to the environmental conditions surrounding them. In this presentation we discuss the effect that environmental conditions and habitat choice may have during cuttlefish spawning and pre recruit life stages. Often referred to as "nursery grounds", some habitats are thought to offer more optimal conditions (biotic and abiotic) for growth (e.g. due to the abundance of food resources) and survival (e.g. protection from predators) than others and may be contributing significantly more individuals to the overall recruitment success of the population. If key nursery grounds or habitats are identified for juvenile cuttlefish in the English Channel then this may help direct future conservation and management strategies for this species.

Comparison of pre-recruit stages from different coastal areas

Noussithé KOUETA, Université de Caen Basse-Normandie

In order to estimate the part played by inshore spawning sites which occur as well along both French and English coasts, a series of comparative analyses are planned. The aim is to look for a "site-effect" on the biology, the physiology and the ecology of pre-recruit stages. This will be sought by collecting eggs developed in the wild to compare hatchling rates and juvenile quality. Juvenile sampling from each pilot site will enable to confirm physiological differences and to study differences in food sources (via stable isotope analysis) and bioaccumulation of trace elements (like heavy metals). Such measurements will be compared to that of recruits fished by the commercial fishery in the central part of the Channel.
In 2009, hundreds of eggs sampled from two sites on the French coast and one site on the UK coast were brought to the CREC marine station rearing facilities. Preliminary observations indicate that hatchling rate and survival rate were identical whatever the site. Nevertheless, hatchling size is bigger and growth rate faster in specimen from Seine Bay and Tor Bay than from the West Cotentin site (Agon). Biochemical analyses show a faster maturation of the digestive cells and a faster implementation of the alkaline digestion in juveniles from both Bays.
Such observations have to be confirmed by monitoring other spawning seasons and another site along the UK coast. Juveniles sampling will make use of scientific surveys but will also require experimental fishing operations in studied sites.

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CHARM 3 project

Seabed Habitat Mapping in the Channel

Dr. Roger COGGAN, Cefas, Pakefield Road, Lowestoft, Suffolk NR33 0HT, United Kingdom

Previous CHARM projects have produced maps that show where important species might be found, which helps in their management and conservation. In CHARM 3 we are extending this work to map where important benthic communities occur. These communities provide food and shelter for many different animals and they can be recognised as distinct habitats (“biotopes” or “biocenoses”), such as rocky reefs, sand banks and sea-grass beds. Many distinct communities are described in the European Nature Information Service (EUNIS) Habitat Classification, but we know little about their distribution because we can not easily see the seabed. Instead, we have to take samples using grabs, dredges and video techniques, and use the information to try and build up a map. This work was started in the 1960’s and 1970’s by Louis Cabioch based in Roscoff and Norman Holme based in Plymouth. Since then technology has advanced, and modern acoustic survey techniques (e.g. multibeam sonar) allow us to build up a detailed topographic image of the seabed, showing distinct physical features like rock outcrops, sand waves and gravel patches. By sampling the benthic communities for representative examples of these features, we can quickly build up a map of the EUNIS habitat classes in the Channel. These maps help to identify areas that may be particularly sensitive to some activities like aggregate dredging or trawling, and so help to manage human activities and maintain the health of the marine environment.

Sea surveys IBTS/CGFS

Dr. Sandrine VAZ, Ifremer, Boulogne-sur-Mer

Marine scientific surveys often aim to collect specific data on the state of a given characteristic of the marine world. However, their objectives have considerably widened in recent years and multidisciplinary observations are now being undertaken to answer the need for integrated ecosystem based management. Here we will present two fishery surveys' methodologies and outputs and their potential uses in the context of the CHARM3 project.

Overview (1992-2007) of the coastal hydrological conditions and associated phytoplankton communities

Dr. Alain LEFEBVRE, Ifremer, Boulogne-sur-Mer

Monitoring the quality of marine waters is essential to better understand and therefore to better manage the coastal environment, in order to enable a sustainable development of its resources. The coastal zone plays a key role in the biogeochemical cycles, by supporting an important biological productivity, as well as the human activities that are carried out in its vicinity. Eutrophication is probably one of the best known consequences of the human activities that threaten the health of many coastal areas.
The spatial and main temporal variations of physico-chemical and biological parameters (including phytoplankton composition) have been investigated from a 16 years time series (1992-2007) in the Eastern English Channel and the Southern Bight of the North Sea, zones of steady *Phaeocystis globosa* outbursts.
The seasonal cycles of the parameters studied are well defined in the three locations considered. Silicate and Phosphate are the main nutrients which potentially limit phytoplankton growth but the dynamics of the limitation may be different between the sites. Nitrate was rarely or never a limiting factor, particularly in the bay of Somme. The phosphate concentration shows a clear monotonic decreasing trend whereas the patterns for the concentration of dissolved inorganic nitrogen or silicate are more complex.
We try to establish a link between its variations and those of the environment in terms of variability, shifts and trends. We also discuss the large-scale effects of the controlling factors.

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Role of "engineer" species in benthic fluxes at the water-sediment interface

Dr. Armonie TOUS RIUS, PhD student, UMR LOG, Université de Lille

The water-sediment interface plays a key role in marine ecosystems. Marine sediments are the ultimate trap for particles that originate from the water column and the sediment compartment is the receptacle of thousands of tons of naturally suspended matter in the water: SPM.
Because of the complex relationship between benthic species and physical and sedimentary processes, we decided to investigate two major habitats: a gravel community and a muddy fine sand with *Abra alba* community. These benthic communities are characterized by the presence of engineers species (*Ophiothrix fragilis* for the first community and *Lanice conchilega* and *Ensis* sp. for the second). In the eastern basin of the Channel, these benthic communities are present both in the North / Pas-de-Calais and the Bay of Seine. These two sites have contrasting characteristics, especially in terms of hydrodynamics and organic matter inputs. Measurements on both sites will be carried out in order to estimate the seasonal variability in the quality of organic matter and its incorporation into the food web–using both lipid biomarkers and stable isotopes. The seasonal variability of metabolic fluxes (respiration, excretion) will be investigated during the year 2010. In addition, in 2011, experiments in the racetrack laboratory flume of Dinard will help to understand (i) the role of some engineers species in the process of deposition / resuspension and (ii) the attractiveness of sediment for the juveniles of these species.

Fluctuations of spawning locations of fish eggs in the North sea between 2006-2009

Stéphanie LELIEVRE, PhD student, Ifremer, Boulogne-sur-Mer

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Due to the current fragility of some fish stocks, the marine spawning grounds are considered as "essential habitats", and their study has become important. The spatial extent of fish spawning habitat may be influenced by habitat preferences and the demographic state of the adult population. In return, the configuration of spawning habitat affects recruitment and therefore the future structure of the adult population. Interannual changes in spatial patterns of spawning reflect variations in adult population structures and their environment. The aim of this study was to determine the location of winter spawning grounds of fishes in the Southern North Sea and the Eastern Channel and to describe the changes in their spatial distribution and extent for several winter spawning species in the North Sea, between 2006-2008. Using data from IBTS (International Bottom Trawl Survey) conducted in winter, the spatial distribution of eggs are modelled and mapped by means of geostatistical analyses. For each species a yearly map of fish eggs distribution is constructed, and then compared over the available period to define (1) recurrent spawning areas corresponding to locations where individuals from a particular population are regularly found, (2) occasional spawning areas, which are visited but can be empty at given time whist, (3) unfavourable spawning areas or avoided areas, are usually deprived of eggs. This study permits to locate the core spawning areas of the studied species which may reveal itself useful in order to better understand fish population spatial dynamics and to implement spatially explicit protection scheme.

Exploring the Western Channel for whales, dolphins and seabirds

Dr. Tom BRERETON, Marinelife, 12, St Andrews Road, Bridport, Dorset. DT6 3BG, UK

There are many threats to marine animals in the Channel including depletion of food sources through fishing, climate change, pollution, offshore developments such as wind farms, noise pollution and disturbance from boat traffic. We need to know where animals live in order to be able to conserve them, and to reconcile conflicts with economic activity. To address this knowledge need, the charity Marinelife has been carrying out whale, dolphin and seabird survey and research work in the Channel since 1995. Through the Charm III project, Marinelife is now conducting the most wider-ranging program of offshore marine animal surveys ever conducted in the Channel. The public are being encouraged to submit sightings via a postcard survey and a website http://www.biscay-dolphin.org.uk/submit_SWsightings/, whilst data are also being gathered from recording organisations located in both France and England.
Results from past surveys, public sightings and from over 46,000 km of survey effort in 2009, highlight the remarkable marine animal life to be found on our 'doorstep' in the Channel. In 2009, four species of whale, six species of dolphin and over 30 species of seabird were recorded confirming the European importance of the Channel for marine animals. Special species living in the Channel in internationally important numbers include Bottlenose Dolphin, Harbour Porpoise, and Europe's rarest seabird the globally and critically Balearic Shearwater. A number of extremely rare species were recorded in 2009, including Little Shearwater (from

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the Canary Islands), Great Shearwater (from Tristan de Cunha), Wilson's Petrel (from Islands in the South Atlantic) and Fea's Petrel (from Madeira). A further highlights of surveys has been the discovery of the world's most southerly population of White-beaked Dolphins, living in a restricted area within Lyme Bay.

Scenarios of changes in the distribution of some benthic species in the context of global climate change

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Coastal waters around Europe became warmer over the last century and a further warming trend of as much as 2.5°C is expected by the 2050's. As a result of global warming, changes in the distribution and abundance of terrestrial and marine species have already been observed. Consequently, it is timely to understand the key factors that define the distribution of marine life in order to anticipate its future responses to global warming. The spatial distribution of a benthic organism largely reflects the occurrence of its preferred physical environment (defined by e.g. temperature, salinity, bathymetry, substrate, etc.) which allows it to settle, grow and reproduce. Hence, each species can be defined by its "environmental envelope" or niche (*sensu* Hutchinson) and this information can be used in ecological niche models to predict the potential distribution of the organism in areas where sampling is lacking. Furthermore, by applying climate scenarios proposed by the Intergovernmental Panel on Climate Change, it is possible to anticipate future changes in species distribution with global climate change.

Modelling of benthic food web in the Eastern Channel and the southern bight of the North Sea

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Benthic organisms appear to be accurate proxies for assessing environmental coastal ecosystem structures and changes due to climatic and anthropogenic stresses, for example. Functional studies of benthic systems are relatively recent, mainly because of the difficulties in obtaining the basic parameters for each benthic compartment (i.e., detritus, bacteria, meiofauna and macrofauna). Our study focuses on the eastern basin of the English Channel and the southern bight of the North Sea. Trophic web modelling was used to try to assess the functioning of the three main benthic community assemblages. In order to test and assess relative importance of factors assumed to influence trophic structure, the study area was subdivided into divisions defined *a priori* according to the two main structural factors of community distribution: geographic distribution (i.e., Bay of Seine, Dover Strait and North Sea) and sedimentary patterns (i.e., Gravel & Pebbles, Coarse sand and Fine sand). Then, an inverse trophic model was applied to each of these units to estimate the flux within and between the units of the benthic system and to assess the amount of trophic energy stored in these units, available to higher predators higher (benthic or pelagic fishes). Our results showed that suspension-feeders control most of the matter transfer through the macrobenthic food web, except in the fine sand community where deposit-feeders control most of the transfer. The results also showed that, whatever the geographic area, the trophic structure is strongly linked to the sedimentary conditions. Since benthic communities are connected through hydrodynamics the main sediment types have to be taken into account when modelling the relationships between the functional units.

Consequences of human disturbances on sole *Solea* solea population

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Estuaries and coastal waters are essential nursery habitats for many marine species, and especially for flatfishes. Thus, investigating how anthropogenic disturbances affect the quality of these habitats is of major importance to understand their consequences on the population renewal of marine species. The aim of the present study is to analyse the effects of anthropogenic disturbances on the population of the common sole in the Eastern Channel, a key species in fish community and fisheries in this area.
In a first approach, we focused on the drastic drop in the surface area and on the low water quality of the Seine estuary, the main river of the Eastern Channel. A geographic Information System (GIS) was used to develop maps of sole nursery habitats in the Eastern Channel by using a habitat suitability model based on bathymetry and sediment structure. Then, thanks to historical maps of the Seine estuary, habitat maps were built for key dates in the modifications of this estuary since 1850. This backward predictive approach showed that habitat loss in the Seine estuary has led to a 42 % decrease of its nursery capacity. As the density of juvenile sole in the Seine estuary is low in comparison to other sectors, this represents only a 4% loss at the sole population scale, in the Eastern Channel. However, while considering that the juvenile density in the Seine estuary has been, before anthropogenic disturbances, equivalent to the actual density of adjacent

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sectors with higher quality, the loss in abundance could be evaluated to be nearly 17%. Results suggest that loss in habitat surface combined with habitat degradation had led to an important loss in the contribution of the Seine estuary nursery to the whole sole population in the Eastern Channel.
These results are now taken into account to develop a population model for the common sole (*Solea solea*) at the scale of the Eastern English Channel. The demographic model will be coupled with an hydrodynamical model of the Eastern Channel that provides prior information about the dispersion of sole larvae, from spawning grounds overseas to the coastal nurseries. Previous work to map nurseries habitats will be used to account for the habitat capacity in coastal nurseries. Thus, the whole life cycle will be taken into account in this end to end model to estimate the respective influence of different anthropogenic pressure (degradation of coastal and estuarine nursery habitat and fishing mortality) on a marine population, especially important for fisheries.

Estimating fishing effort from Vessel Monitoring System (VMS) data

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Vessel Monitoring Systems (VMS) are used primarily for fisheries enforcement purposes but also provide information on the spatial and temporal distribution of fishing activity useful for fisheries and environmental assessment and management. We develop, test and apply a reliable, repeatable and accessible method using readily available software for estimating fishing effort from unprocessed VMS data. We identify caveats associated with the method and quantify the biases introduced by our assumptions. Application of the method provides a high-resolution description of gear-specific fishing activity by UK vessels. We develop and apply an index to describe variation in the spatial pattern of fishing effort generated by different gears. The proposed method for VMS analysis involves removing duplicate VMS records and records close to ports, calculating the time interval between successive records to identify periods of activity, linking each record to a vessel and gear type, differentiating fishing and non-fishing activity and summing fishing records in time and space to estimate fishing effort. The approach is a step towards the development of standardised methods to facilitate wider exchange and use of European VMS data. We encourage further documentation and development of a clear audit trail for methods of VMS analysis that are already being used to inform management. In Charm 3, by working together with both UK and French fishing vessel data, we aim to provide a cohesive set of data for the Channel region.

Sense of place and marine fisheries : exploring social and cultural dimensions in the English Channel

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Policy development and research for marine fisheries has tended to focus on biological and economic objectives. However, there is a lack of understanding of the socio-cultural impacts of fisheries. There is increasing recognition that policies incorporating explicit social objectives are more likely to help restore fish stocks and succeed in creating a sustainable fishing sector. Evidence suggests that active fishing communities contribute to the local social fabric and culture of an area, and can provide a motif or icon for marketing tourism activities. The aim of this study is to explore the contribution that fisheries make to a sense of place in coastal communities. This will involve a qualitative GIS methodology that combines spatial analysis with qualitative research strategies to explore place identity, cultural heritage and social networks throughout the study area. Case studies will be selected on both the English and French coasts along the Channel. Initial scoping visits suggest that sense of place for fisheries is characterised by a combination of *physical attributes* (for example, buildings, ruins, boats, nets, place names) and *activities* (fishing, festivals, tourism), intertwined with the subjective *meanings* that people associate with fishing. Such meanings can be understood as ‘situated experiences’ and provide a rich and diverse picture depending on people’s individual backgrounds and perspectives. It is hoped the outcomes from this research will contribute to the inclusion of real and explicit social goals in future fisheries policy.

Marine conservation planning

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Responsible and integrated management aided by information systems and tools capable of assisting decision-making is essential for the construction of policies to ensure the sustainable exploitation of Eastern English Channel marine resources. MARXAN is a computer program that deliver decision support for reserve system design. It finds reasonably efficient solutions to the problem of selecting a system of spatially cohesive sites that meet a suite of biodiversity targets. The aim of this study is to develop a tentative conservation plan for the eastern English Channel to identify important sites for conserving biodiversity, whilst using anthropological, economic and legal data to minimise potential opportunity costs.

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CHARM III Web Portal and Tools

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Emerging web technologies and innovative content visualisation techniques have made it possible for scientific data to be targeted to a wider audience. The aim of CHARM III web portal is to provide an integrated modular website that can appeal to a wide range of audience such as policy makers, scientists, environmentalists, educators and public. Successful identification of target audience is key to the success of web deployed information. A questionnaire has been specifically designed to identify different categories of interested audience. In addition to common interactive media contents and scientific reports, the web portal will include three innovative tools to deploy spatial and non-spatial results of CHARM III. The '*WebGIS*' tool provides users a comprehensive and integrated overview of the fisheries activity within the English Channel. It enables users to build their own maps using layers of information directly extracted from the data within the HARMONIE database of the Ifremer Fisheries Information System. The '*WebGIS*' allows relating fisheries data with other environmental, political and physical data. A second tool called '*Web Atlas of the Fisheries*' aims to interactively provide valuable information on the indicators of fisheries related activities within the Channel. The Atlas uses data from fisheries monitoring systems (such as Logbooks, auctions) and scientific publications associated with both French and English fishermen. A third tool '*the Gazetteer'* will employ novel crowd sourcing techniques to build ontology of place names for spatial information retrieval. CHARM III Web Portal aims to disseminate CHARM III results effectively and innovatively to its appropriate audience.

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