Sustainable use of fisheries resources in Welsh waters

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Science User Advisory Group (SUAG)

- Ensure science is fit for purpose and meet industries needs
- Ensure that results meet objectives stated.
- Discuss potential changes to project objectives if appropriate.
- Ensure coherence among EFF projects.

Project Management (Dr H.Hinz)

- Communication on progress.
- Managing research personal.
- Coordination of work packages and time keeping.
- Quality control of research output
- Progress reports and final report writing.

Project Science Board (Prof MJ Kaiser, Dr L. LeVay, Dr Jan Hiddink, Dr Ian McCarthy)

- Science advisory role to project management.
- Communication with Science User Advisory Group (SUAG)

•Work Packages 1 – 5 (Lead by responsible scientist)

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Work-package 1— Fishers knowledge (questionnaire survey)

Work-package 2 — Habitat surveys

Work-package 3 — Stock status of target species

Work-package 4 — Connectivity of welsh stocks

Work-package 5 — Assessment and management advice

Additionally to these work packages the project is also able to response to specific burning issues to assist the fishing industry with the sustainable management of marine resources.

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Work-package 1— Fishers knowledge

Work-package lead: Dr. H. Hinz

Questionnaire survey across Wales with active and retired fishermen.

Aim:

- To map past and present fishing grounds and their importance to the industry.
- Map conflict zones with other users.
- Map ecological data of the target species (i.e. nursery grounds, migration routes etc.)

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Work-package 2 — Habitat surveys

Work-package lead: Dr. H. Hinz

Work to be conducted:

Habitat mapping of priority sites for industry.

Aim:

- Provide precise data on the location of specific species and habitat features for spatial management.

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Work-package 3 — Stock status of target species

Work-package lead: Dr. Hilmar Hinz and Dr. Gwladys Lambert

Scallops – Dr. Gwladys Lambert
Crustaceans and whelks - Dr. Jodie Haig, Dr. Natalie Hold
Bass and other fish species – Giulia Cambie

Work to be conducted:

Devise appropriate sampling program on the basis of fishermen and habitat information collected in WP1 and 2. Conduct stock assessments from research and fishing vessels. Implement sampling program that will continue after EFF.

Aim:

Capture the status of welsh stock to aid management decisions.

Work-package 4 — Connectivity of welsh stocks

Work-package lead: Dr N. Hold

Larvae modelling - Dr P. Robinson and Dr S. Neill
Population genetics - Dr N. Hold

Work to be conducted:

•Modelling of larvae source and sinks on the basis of data obtained form WP2 and 3 to determine connectivity of welsh stocks.
•Genetics to verify stock concepts and connectivity.

Aim:

Increase our knowledge of connectivity of populations for to inform spatial management.

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Work-package 5 — Assessment and management advice

Work-package lead: Prof M.J. Kaiser and Dr L. LeVay.

Personal involved: Modeller at CEFAS

Work to be conducted:

Modelling to set catch limits and minimum landing size.
Modelling of fleet behaviour.
Modelling of management scenarios.
Summary of model predictions into a report that will be communicated to stakeholders and SUAG.

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Work-package 1— Fishers knowledge

A questionnaire has been constructed and will be trialed in due course after confidentiality issues have been clarified.

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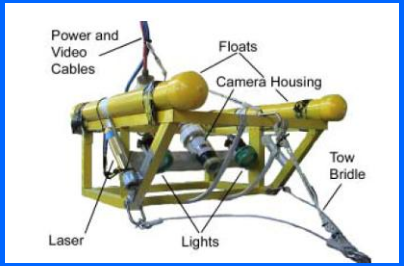
Work-package 2 — Habitat surveys

Surveys conducted thus far:

- Cardigan Bay habitat surveys 2009-2012 (Prince Madog)
- Fishers habitat mapping



Planned surveys:

Inshore potting grounds – flying array surveys

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Work-package 3 - Stock status of target species

The Aim

Gather information on the status of the stock(s) of target species in Welsh waters and their environment that will be relevant for the management of the fishery at the ecosystem level aiming at long term sustainability

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The challenge

- Limited data on the stock status
- Limited data on spatial distributions
- Limited information on fishing effort

Conventional stock assessment and fishing quotas are data dependant and this project should provide the basis for this long term goal.

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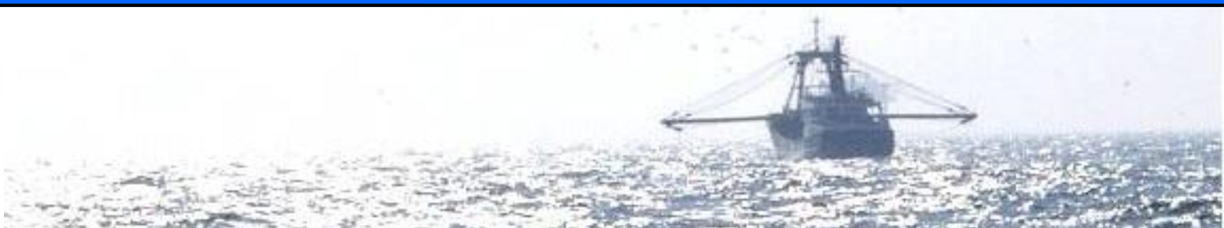
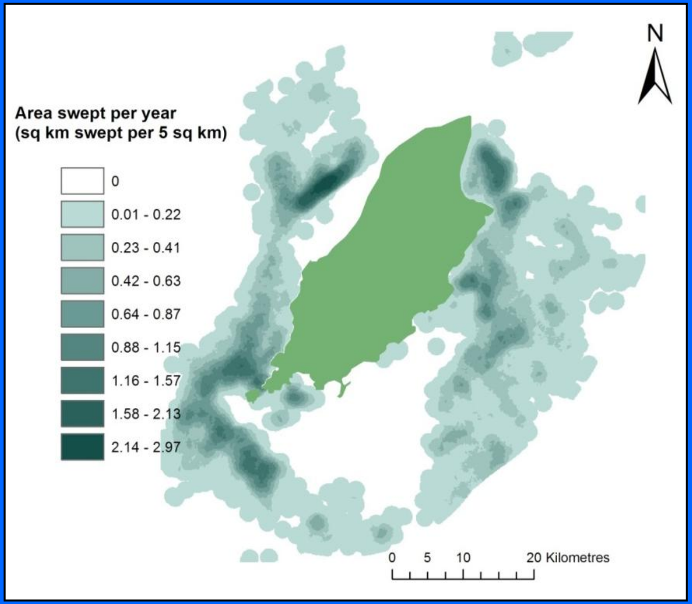


What information is needed

- Stock status
- Distribution of the stock
- Fishing effort and catches
- Habitat status
- Fishing impact



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Work-package 3 - Stock status of target species

Short term outputs: develop key indicators of risk of overexploitation

- Abundance of new recruits
- Sex ratio of population
- Size frequency data
- Catch and effort data

Long term outputs: long term data for accurate stock assessments

- Recruitment index
- Population structure
- Catch / effort
- Size at maturity
- Catch-ability index

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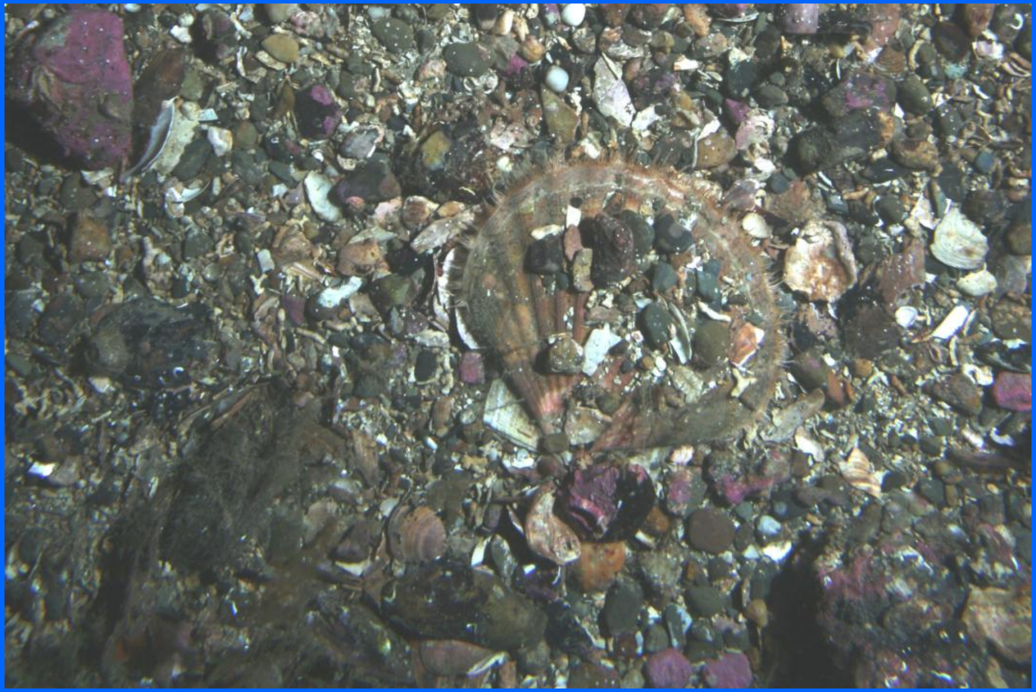
Work-package 3 – Scallop stocks

Lead scientist: Dr Gwladys Lambert



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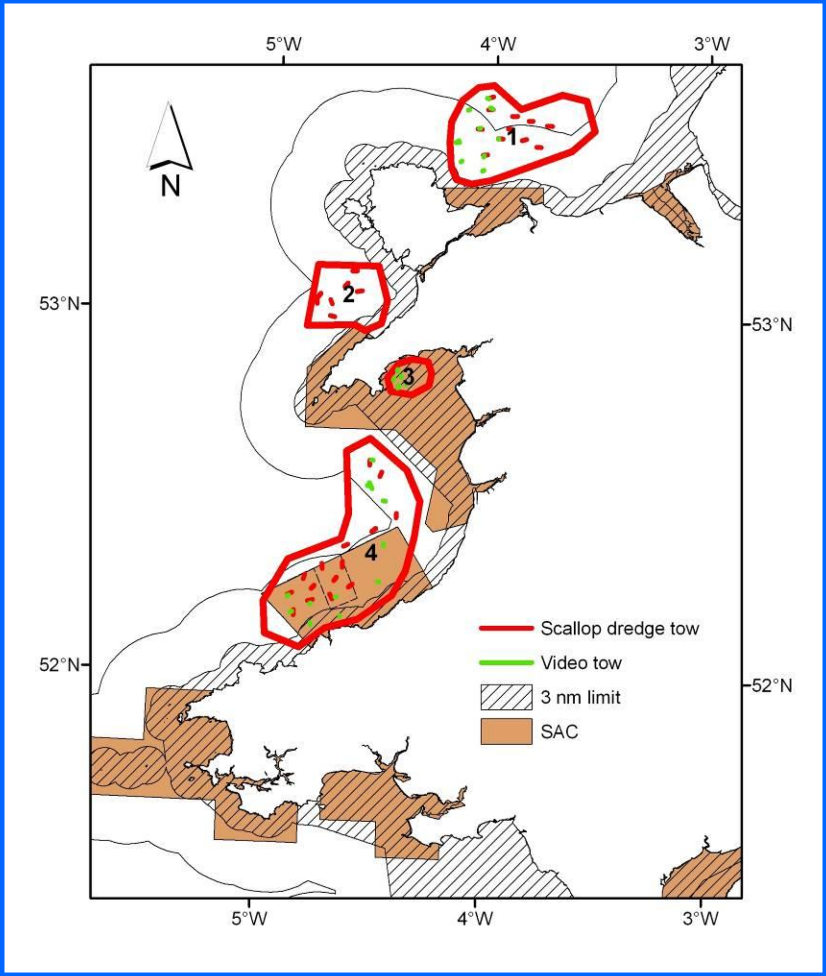
June 2012 survey

- The **Liverpool Bay** King scallop population showed low abundances and was dominated by old individuals (+6)
- Llyn Peninsula and Tremadog Bay similarly showed low abundances.
- Cardigan Bay showed the highest densities (mean abundances were 7 - 14 times higher) and was dominated by 3-4 year old scallops (105-125 mm).
- By-catch levels were high in Liverpool Bay but low in all other areas, particular Cardigan Bay.



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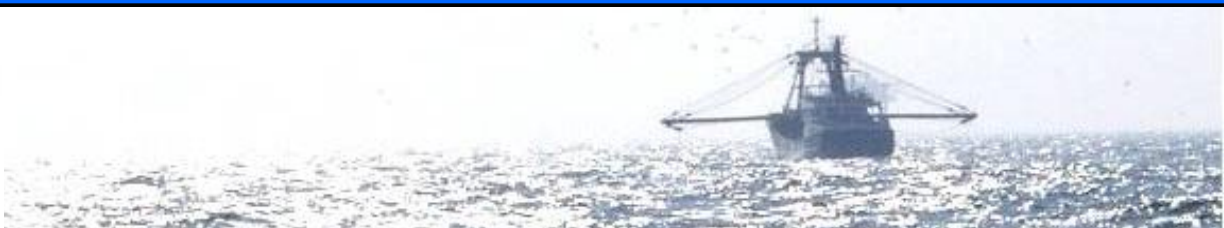
Gear improvements to limit dredge impacts

Modification reduces contact area of belly:

Potentially:

- Better sorting (i.e. lower bycatch)
- Lower fuel consumption
- Lower impact on benthos



Sampling of the fisheries catches (red bag scheme)

- Scallop fishers fill the red bag with a random sample of marketable scallops

- At the same time the number of discarded undersize scallops is recorded and added to the bag

- The bag of scallops gets process and the shells are returned into the bag and send onto the fisheries scientists for analysis.

- Size structure indicator of stock health

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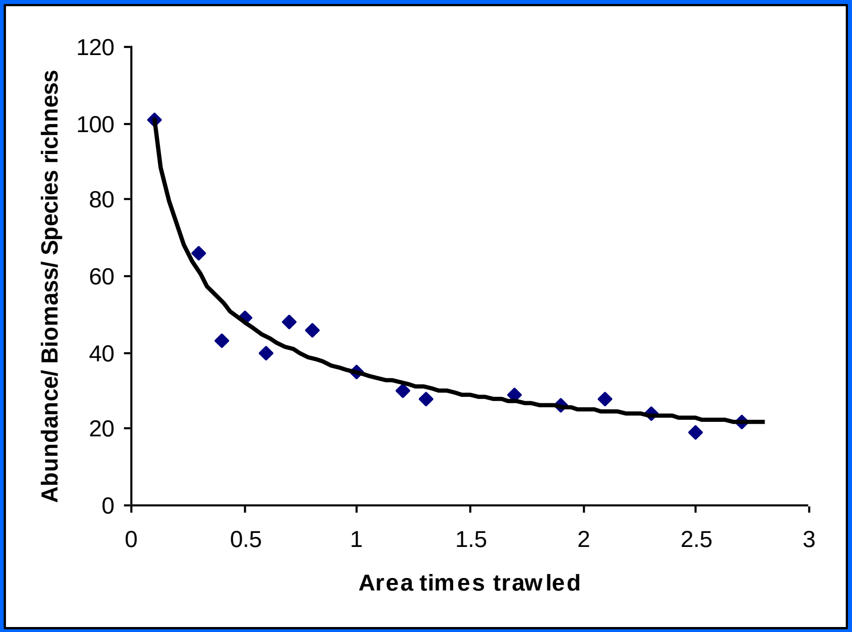
Fishing intensity trials to determine sustainable levels of fishing effort



Experimental fishing to determine threshold levels for Cardigan Bay

A) Stock
B) Environments

Threshold levels should be able to inform management of fishing effort (i.e. quota for stocks and the environment).

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Crustaceans & whelks
Dr Jodie Haig

Potting fishery in Welsh waters

- Lobsters (*Homarus gammarus*)
- Brown crab (*Cancer pagurus*)
- Spider crab (*Maja squinado*)
- Shrimp (*Palaemon serratus*)
- Whelk (*Buccinum undatum*)

Image source: Google images

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Project Goals

Adult population

- Abundance
- Distribution
- Population and age structure
- Size at maturity
- Sex ratio
- Growth rate
- Environmental factors that effect fitness

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Project Goals

Life History

- Larval behaviour & duration
- Juvenile habitat requirements
- Recruitment

Migrations and Movements

- What are temporal & spatial patterns in movements
- What initiates movement
- What movements are influenced by reproductive strategy

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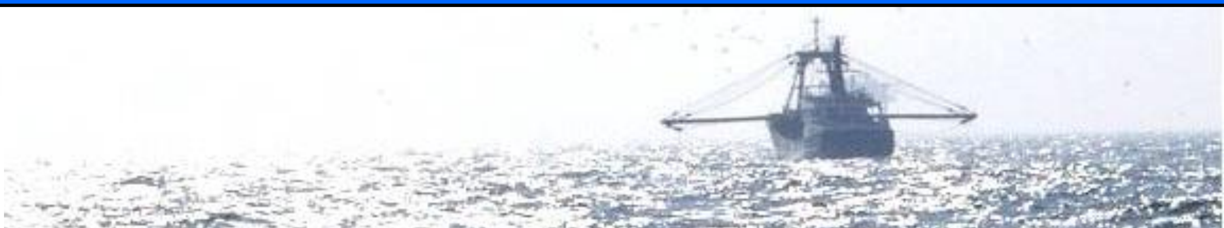
Project Goals

Fishery & Management

- Fishing effort
- Catch and Landings data
- Determine effects of sex biased fishing
- Catch-ability estimates



Big Picture Goals for Crustaceans and Whelks

Provide an understanding of ecosystem processes in Welsh waters

Build a foundation of knowledge to enable future monitoring and stock assessments of Welsh invertebrate fisheries species

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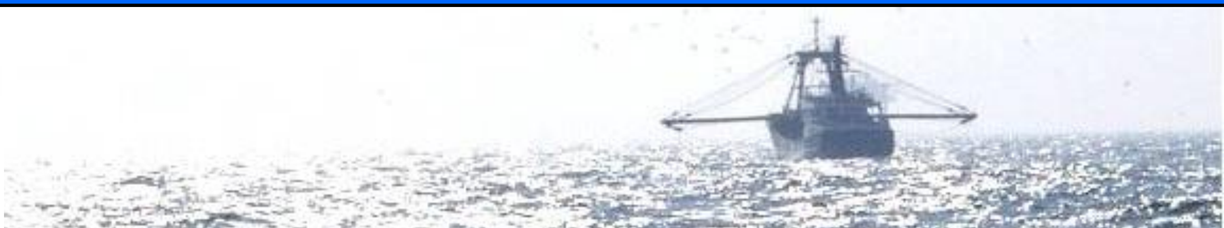

Genetic pilot study

Lobster Paternity: *Homarus gammarus*

Why: Bias in the sex ratio may decrease genetic diversity

GENETIC DIVERSITY PROVIDES RESILIANCE TO CHANGE

Aims

- Are larger males are more reproductively successful than smaller ones?
- What proportion of males contribute to the next generation?
- Does population density affect the observed pairing patterns?
- Does sex ratio affect genetic diversity?
- Does multiple paternity exist for this species?

Genetic pilot study

Methods

- Sample berried females, eggs and males from fishers’ catches;
  - Small pleopod sample: does not decrease market value of the specimen
  - Approximately 200 eggs

- Microsatellite genetic analysis
- Max. likelihood analysis (program Colony2) to construct paternity

Temperature loggers

Aim: To obtain long term temperature data from fished areas.

Details: Attached to fishers' pots, the logger records max/min temperature every 10 minutes for 100 days.

Multiple sites along the Welsh coast to build up a picture of small scale variation.

Flying array

Target crab and lobster habitats

- Compare abundance in different habitats
- Use of habitats by different life history stages
  - E.g. Juveniles, gravid females

Currently gear trials are underway

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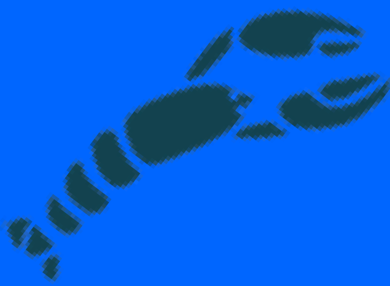
On-board camera



Collaborate with fishermen to video their on board processing of lobsters and crabs.

Requirements: mounted video and measuring grid

On-board video camera records

- Catch (landed & discarded)
- Size
- Sex

Use this data to estimate abundance, size frequency and sex ratio of catch for lobsters and crabs

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Other future studies

- Mark recapture
- Genetic connectivity & population structure
- CW_{50} studies (size at maturity)
- Determine age in large adult cohorts (viability neurolipofuscin-based aging, whelk growth rings, etc…)

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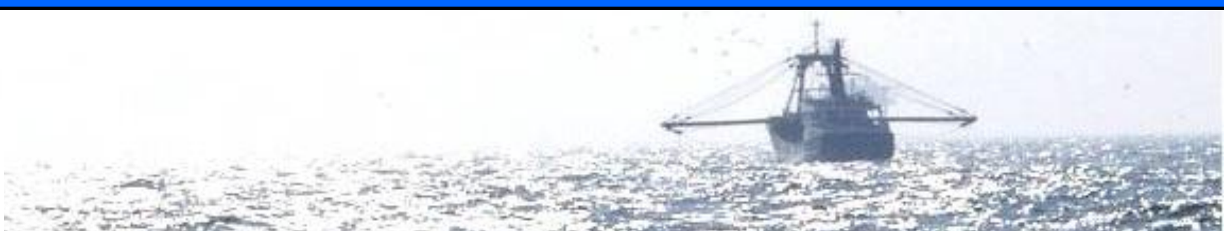
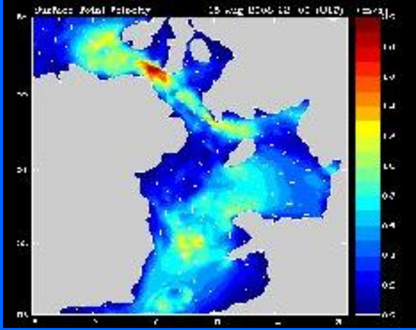


Work Package 4: Connectivity
Dr. Natalie Hold



- Combining oceanographic modeling with biology, ecology and genetics.

- Traditional Particle tracking models (PTMs):
  → Not biologically realistic
  → Poor confidence in outputs

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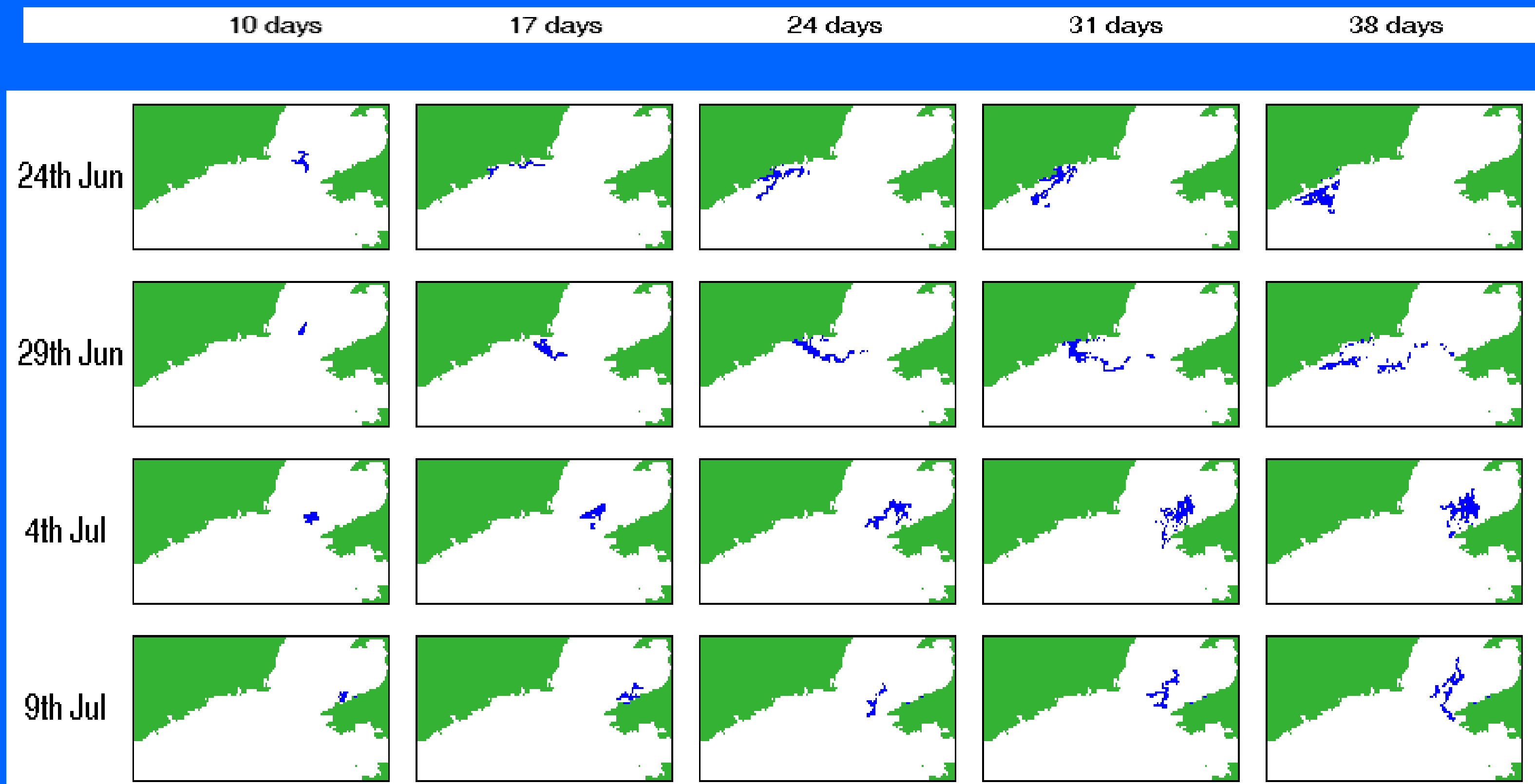
Example of differences in probability of end location with different larval release dates for the King scallop.



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Connectivity continued

- **Addition of larval biology:**

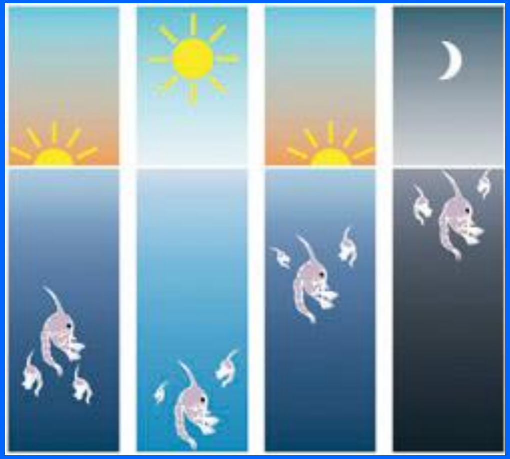
→ Improves realism and confidence in outputs

→ Can dramatically change the modelled connectivity patterns

DIFFICULTIES:

- Lack of published information on larval behaviour;
- Difficulty in studying larvae in the wild;

→ Need to improve baseline data for all species



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Connectivity continued

- **Addition of larval settlement ecology:**

  Model describes where a larvae might be carried

  → Is this suitable habitat for settlement?

Need improved knowledge of larval settlement habitat and nursery grounds

Need to increase the coverage of habitat mapping → Work Package 2.

Connectivity continued

- **Addition of genetic data:**

Levels of genetic differentiation depend on the magnitude of connectivity between sites

Genetics will be used to validate the model:

→ Areas identified as hydrographically isolated should have increased genetic differentiation than highly connected areas.

New type of genetic marker (RAD) will provide much better information than older marker types (e.g. microsatellites).

Aiming to collaborate with Aberyswyth University to develop genetic markers for a range of species.

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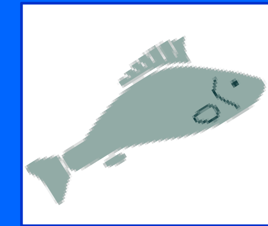
Work-package 3 – Fin fish

Lead scientist: Dr Giulia Cambiè



- **SPECIFIC AIMS (Sea bass fisheries)**

Fishing effort

Number of active boats for commercial fisheries

Number of people involved for angling and gill netting from beach

Spatial-temporal distribution of fishing effort by gear

Image source: Google images

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SPECIFIC AIMS (Sea bass fisheries)

Catch level

CPUE and total annual catch by gear

Mean body size of sea bass caught by gear

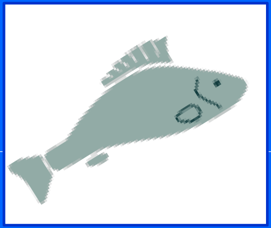
Economic dimension of the fisheries

Cost structure

Economic and financial performance

Image source: Google images

SPECIFIC AIMS (Sea bass fisheries)

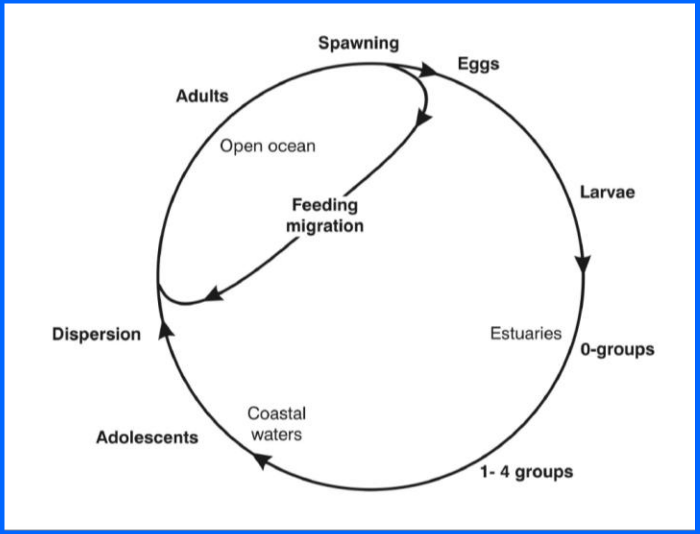


Biological and ecological aspects

Identify priority areas for one or more life cycle stages

Assessment of migration pathways

Assessment of inter-annual fidelity of adult bass to specific feeding grounds



Source: Pawson & Pickett, 2003

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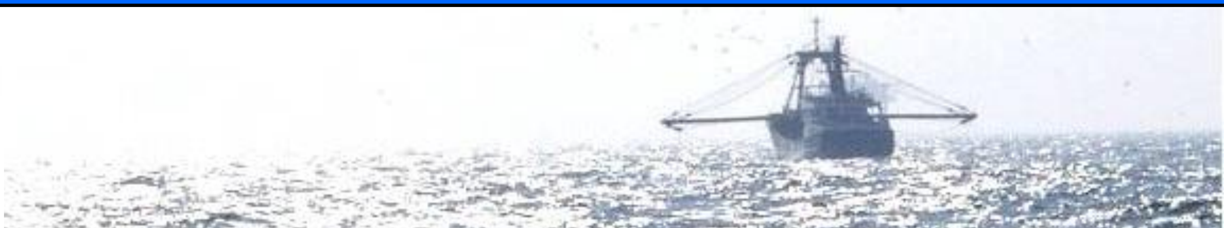
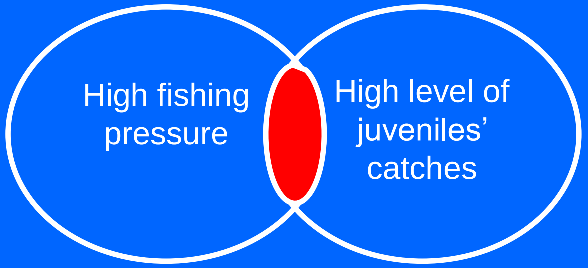


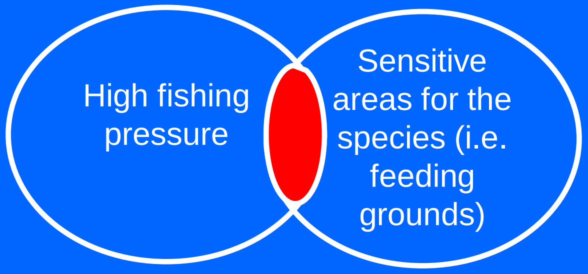
SPECIFIC AIMS (Sea bass fisheries)

Risk areas and precautionary approach

Identify risk areas (spatial matrix of the risk)

Identify indicators related to possible overfishing





1980/'90

2010 ?

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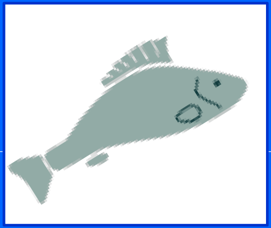
SPECIFIC AIMS (Sea bass fisheries)



Simulating management scenarios

Simulate potential economic consequence for a set of management options

Evaluate the management scenario more acceptable from a social and economic point of view

Precautionary approach

- **Option 1**
- **Option 2**
- **Option 3**

MANAGEMENT

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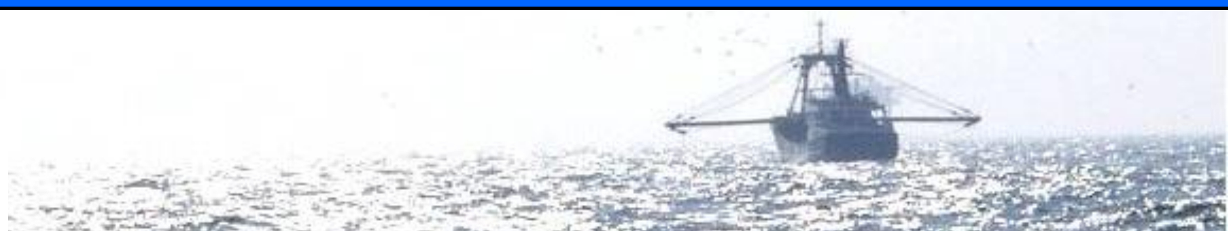

SPECIFIC AIMS (Sprat fisheries)

<u>**Scientific support to the sprat fishery (inshore)**</u>

Evaluating catch species composition

Evaluating discarding practices and bycatch

Identify possible catch and bycatch hotspots

Apply a precautionary approach to a fishery in expansion

Image source: Google images

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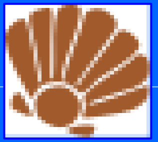
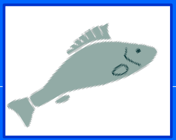
GENERAL OVERVIEW





Official data

- Fishing licences
- Catch/effort data
- Landings records
- VMS and log-books
- Other

Input

Data from Interviews

- Effort distribution
- Economic performance
- CPUE and body size
- Habitat

Input

On-board observations
Samplings from fishers

- Fishing strategy
- Discards and bycatch
- Biological data

Input

Analysis

- Data comparison
- Catch trend
- Indicators of possible overfishing
- Biological indicators
- Economic indicators

Output

- Identify lack of data
- Implement data collection protocols

Output

- Identify priority areas
- Identify risk areas (matrix of the risk)

- Potential management options
- Economic simulations

- Meetings with stakeholders
- Adaptive approach

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